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Intersectoral Management of River Basins

Proceedings of an International Workshop on "Integrated Water Management in Water-Stressed River Basins in Developing Countries: Strategies for Poverty Alleviation and Agricultural Growth," Loskop Dam, South Africa, 16-21 October 2000

Editor: Charles L. Abernethy

International Water Management Institute

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Cover photograph by Barbara van Koppen: Public consultation meeting to establish the Catchment Management Agency of the Olifants River Basin, South Africa

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The international workshop on "Integrated Water Management in Water-Stressed River Basins in Developing Countries: Strategies for Poverty Alleviation and Agricultural Growth" dealt with an issue that is fundamental to the implementation of South Africa's new water policy. I regret I was unable to attend and not only address the participants, but also listen and learn from such a distinguished set of participants. I am pleased that the Department of Water Affairs and Forestry was able to assist in organising the workshop, and I know participating members of the Department learned a great deal.

I would also like to say that I welcome the establishment of IWMI's new African regional office in South Africa. The office was officially launched shortly after this workshop, and is now well-established. Its establishment is propitious. We face many challenges as we proceed to implement South Africa's national water policy and will be seeking help and counsel from those who have faced similar challenges. My Ministry looks forward to a long-term collaborative relationship with IWMI, which will benefit South Africa, and will also contribute to improving water management throughout Africa.

H.E. Ronnie Kasrils

Minister of Water Affairs and Forestry

Republic of South Africa

March, 2001

Foreword

Managing Water in River Basins

This book contains the proceedings of an international workshop conducted in South Africa, at Loskop Dam, in October 2000. The book gives the full texts of 20 papers that were prepared in advance of the meeting, and 12 reports that were outputs of working groups, developed during the meeting.

The subject of the workshop was "Integrated water management in water-stressed river basins in developing countries: strategies for poverty alleviation and agricultural growth."

The title is rather complex, and it reflects a number of current concerns in the evolution of policies towards the management of water resources. Historically, in many countries, the management of water services has been put in the control of several agencies of government whose tasks were to deliver specific services to the people: domestic water supply, irrigation, power generation, navigation, and so forth. In recent times, as economic activities increase and diversify, as population numbers increase, and as the balance between rural and urban people and activities changes, many countries are now perceiving a need to integrate these water services.

Countries are also facing problems of water stresses, which usually arise from two causes: insufficient *quantity* of water, in relation to the numbers of people and the uses that they want to make of water; and reduced *quality* of water, due most often to pollution that is brought to it by return flows of used water.

These problems do not arrive uniformly or simultaneously everywhere. Some countries are much nearer to the limits of their available water resource quantities than others. Within countries, some river basins are under much more stress than others. This means that the socio-political pressures to bring about change in our water management arrangements are also not uniform. In some places, people perceive a great need for early and rapid changes, while in other places people feel content to continue traditional styles of management.

The International Water Management Institute (IWMI) has adopted the useful term "closure" to mean the condition in which all the accessible water resources in a river basin (or even in a country) are already in use or have been allocated to users. In a "closed" or "closing" basin (which means one at or approaching this state) the pressures are different; the vested interests of those with use rights, and the likely anger of those without, make this a divisive condition, in which negotiations are likely to be difficult. It is desirable, therefore, that countries should try to formulate their management systems well in advance of that situation, when the attitudes of water users are still somewhat relaxed and agreements on sharing and co-operation are easier to achieve.

In recent times the phenomenon of sectoral change has become highly significant. This refers to the emergence or growth of new water-using sectors of the economy, especially industry and hydropower, and the rapid expansion of others, such as

the domestic sector through urbanisation. These trends in the latter twentieth century were particularly noticeable in the developing countries. They were accompanied by declines in some traditional sectors such as navigation, and they put new pressure on other traditional sectors, especially irrigation, to improve efficiency. All of these broad socio-economic changes have put in doubt the appropriateness of many traditional processes of allocating water among users, but often this has left an unfilled void in the institutional process, where traditional customs, although found inadequate, have not yet been replaced.

Water is not a very "transportable" substance, in comparison to that other economically important liquid, oil. Water flows in rivers according to the natural slope of the ground, which forms river basins; and people put it into canals or pipes to send it in other directions, sometimes into neighbouring basins. But we do not often move it between countries in large ships, like oil, whose price is in the order of a thousand times greater, and for which we therefore feel (rightly or wrongly) that we can afford more expensive facilities. This relative lack of transportability means that many countries have addressed their water problems separately, rather than collaboratively, and this contributes to the wide variety of policies, economic frameworks, and rules in general, for water management in different countries.

Countries also have other reasons for different perceptions and attitudes about co-operation over water. Island countries, and countries that consist of complete river basins, have a different perspective from those that must share rivers with neighbours. Those who share have varied locations: upstream, downstream, or on either side of the shared waterway. These differences of situation are apt to influence their people's views.

For all these reasons and many others, countries' experiences of managing water and of managing river basins are very varied. Some of the papers in this book, therefore, describe specific experiences of individual countries or basins. These are taken from countries whose economic and geographical situations are diverse: Mexico, France, Indonesia, Australia, South Africa, United States of America, and Turkey. Other papers describe experiences on internationally shared river basins: the Danube, Rhine, Limpopo, and the Southern African Development Community.

There are four papers focusing on the special recent experience of South Africa, as it replaces former inequitable water laws with a new one to reflect its major political reorientation, and at the same time takes this opportunity of change to bring in several other principles of modern thinking about water, with a focus on participation by stakeholders, on the river-basin as management unit, on financial principles such as "users pay" and "polluters pay," and on the potential role of access to water in addressing social issues such as poverty and gender discrimination.

The existence of these issues, and the South African government's use of transparent and participatory means in devising the new framework for management, were major reasons why South Africa was the location for these discussions. The venue of the workshop lay in the basin of the Olifants River, one of the 19 water management areas into which the new law divides the country. The Olifants basin is already under water stress, and there is competition for water

access among many groups and for many kinds of use. One of the South African papers describes the processes used to develop a new catchment management structure to face such circumstances.

Because of the diversity of national situations, just discussed, it is not easy to find generic principles of management for river basins. Five of the papers here attempt to do that, addressing different fields: water accounting, stakeholder identification and participation, financing of management, methods of institutional assessment, and the extent to which ideas and experiences may be transferable between different countries.

The workshop was attended by about 80 people, coming from 26 countries. This amount of expertise was used in three rounds of working group discussions on a range of widely-felt issues. The reports made by these working groups are assembled in the latter part of the book.

Charles L. Abernethy

Acknowledgements

Four organisations joined together to promote this workshop. They were the Food and Agriculture Centre (ZEL) of the German Foundation for International Development (DSE: Deutsche Stiftung für Internationale Entwicklung), based at Feldafing near Munich; the International Water Management Institute (IWMI), whose headquarters is in Sri Lanka; the Department of Water Affairs (DWAF) of South Africa; and the Water Research Commission (WRC), also of South Africa.

Each of these organisations has developed significant expertise in the area of water management analysis and institutional reform in recent years. IWMI has recently opened its new African regional office in South Africa.

The DSE promoted a workshop on "Strategies for intersectoral water management in developing countries: Challenges and consequences for agriculture" at Berlin in 1996, which provided some of the impetus and some indications of the necessary agenda for the Loskop Dam workshop.

IWMI has undertaken a number of multi-country studies of these issues. Several of the papers presented here were generated under two such projects. The "Institutional support systems project for sustainable local management of irrigation in water-short basins," funded by the German Ministry for Economic Co-operation and Development (BMZ) and supervised through the German Agency for Technical Co-operation (GTZ), facilitated studies in Turkey, Mexico and South Africa. BMZ also provided the support that made the workshop possible. A "Regional study on development of effective water management institutions" was funded by the Asian Development Bank, and has involved studies in the People's Republic of China, Indonesia, the Philippines, Nepal, Sri Lanka, Australia and Japan.

The experience and contributions of the South African sponsors of the meeting are different. South Africa has accumulated in the past decade a special degree of hands-on, direct experience of reform, and its difficulties, as well as the optimising of procedures for achieving people-centred changes of policy. The consultative processes used in the middle 1990s for framing the republic's new water law were widely noticed and admired. The DWAF has been the major implementing agency of water reform, and the WRC the main organisation for reviewing and analysing the lessons learned.

Special thanks are due to the 29 authors of papers, and the 80 participants, who gave their ideas in the framework of the workshop.

The organising group is also especially grateful to the DWAF, whose staff took responsibility for logistical arrangements of the workshop.

Much more now remains to be done, in many countries, and the urgency for water reforms is great and is probably increasing. It may be hoped that the contents of this book, derived from this wide set of national and international experiences as well as from generic theorising, will be found useful to other countries involved in these processes.

Section A

Key-note address

At the start of the Workshop on
16 October 2000,
the key-note address was given by

Mr A M Muller
Director General of the Department of
Water Affairs and Forestry
Republic of South Africa

The address shows how reforms of water
policy are an integral part of social and
political transformation

How National Water Policy is Helping to Achieve South Africa's Development Vision

Mike Muller
Director General
Department of Water Affairs and Forestry
South Africa

1. Introduction: a product of political transition

The simple goal of South Africa's new democracy was captured in the slogan "a better life for all." Since the first democratic elections in 1994, the challenge for all sectors, including water, has been to translate that goal into social reality.

Policy reform since 1994 has, for obvious reasons of history, been focussed upon the promotion of basic human rights and the democratic values of human dignity, equality and freedom throughout the society. In the water sector, these values have had to be given effect within a demanding physical environment as well as at a time of dramatic social and political change. As a consequence, it has been possible to introduce radical approaches in an environment normally characterised by a relatively slow pace of change.

The objective of presenting this paper is to offer South Africa as a case study, illustrating the context within which South Africa's new water policy has been developed and, in particular, to describe the innovative approaches and instruments which have been developed to reflect the values and principles upon which the new society is based. It is hoped that both the process and the specific instruments may be of value in the discussions that follow.

2. Historical perspective: the development context

To understand the approaches taken, it is perhaps helpful to begin with the recent past and the vision for the future. South Africa entered a new phase in its history with the election of its first non-racial democratic government in 1994. The new government was elected on the promise of "a better life for all". It had a vision for South African society encapsulated in its Reconstruction and Development Programme (RDP) which was described as "an integrated programme based on the people, that provides peace and security for all and builds the nation, links reconstruction and development and deepens democracy."

The RDP thus emphasised that growth and development are not two opposing goals but essential components of a common strategy; that without an improvement in the quality of life of the majority of South Africans, the political conditions for growth would not exist and that without growth, the economic conditions needed for an improved quality of life and to sustain the political system could not be created.

The RDP was thus not primarily about houses, services and education but first and foremost about opportunities. It was intended to tackle the development crisis

in South Africa that found more than 30 percent of the working population without jobs and many without the basic skills they need to be gainfully employed. It addressed the fact that the most needy people live in rural areas or informal peri-urban settlements, often artificially created in areas that offer the least opportunities.

In the final analysis, it was about achieving a vision of a South Africa in which people have opportunities to develop their skills and opportunities to use them productively to work and earn an income with which they can meet their basic needs. It was about a vision of a country in which, because there are these opportunities, people could live at peace with one another, in dignity and security; where, because of our wise management, the environment in which we live, work and relax is healthy and pleasant and can be kept so.

The ambitions of the RDP were underpinned by the adoption of a new constitution. In the two years following 1994, the whole nation engaged in the process of drafting a Constitution, which entrenched a Bill of Rights, including extensive social, economic and environmental rights. It also allocated responsibility for the governance of water to government at a national level and the function of providing water services to local government. While providing very clear direction to government, the Constitution also recognised that social rights cannot be realised overnight. The state is required "to take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights."

3. Water management reaches the political crossroads...

The ambitions of the RDP and the requirements of the Constitution would present a formidable challenge for any country, the more so for one which has so recently emerged from a history of oppression and division, exploitation and deprivation which has left South Africa with huge inequalities between extremes of poverty and substantial wealth.

To address this challenging agenda, all sectors of society have had to review their policies and programmes and, for the water sector as in many, the implications have been dramatic. At this juncture, it is helpful to look further back, to get some broader historical context through which to understand the specific reforms in the water sector.

The political transition of 1994 was the culmination of a long process which included the colonisation of South Africa in the 17th century and subsequent subjugation of the indigenous peoples, its transformation through the South African war 100 years ago into an independent-settler state; the transfer of power to the nationalist majority of the white minority in 1948, the state's continued aggressive and painful exclusion of the majority of the population from political (and economic) life and the inevitable, but no less stressful, transition to democratic government.

As in all countries, the governance of the water sector over that period reflected the political changes in the society. Water management moved from the pre-colonialist collective realm to become a publicly regulated resource in terms of Roman-Dutch law, and then, under Anglo-Saxon jurisprudence and the pressures

for settler expansion and economic development, was captured as a private resource for the minority.

In support of these processes, institutions were developed which increasingly intervened in the development of water resources in favour of the white agricultural community. Meanwhile, the development of water services, the supply of pure water and the provision of sanitation, were devolved to local level. This allowed white communities to serve their needs using the financial base of industry and commerce in the white cities while black communities depended on budgetary handouts. It ensured an inheritance, in 1994 of profound inequalities whether in access to water as a resource or to the domestic services it provides.

... as water managers seek new legal instruments to cross the physical watershed

In parallel with the political developments, another equally important drama was being played out in the physical realm. South Africa is a relatively arid country. As in many parts of the developing world, its rainfall is also extremely variable and erratic in time as is reflected even in its largest rivers whose total flow can vary ten-fold from one year to the next and a further ten-fold from one month to the next. (There was a dramatic demonstration of this during the February 2000 floods when two years of average flow passed down the Limpopo at Beit Bridge in just eight days.)

The social and economic development of South African society was inevitably accompanied by a continued increase in the demands placed on the nation's capricious water resources. By 1994, almost 50 percent of the rainfall that reaches the country's rivers was being captured and used. This is a very high proportion and can only be achieved and reliably sustained by means of extensive storage reservoirs and transfer systems.

There is a limit, however, to how far storage and transfer can be taken. While water resources are relatively plentiful, the water manager's task is to harness them. We build dams to store the flood for the drought, canals, aqueducts and pumping stations to move it to where we need it. As the resources are developed (and the floodwater becomes too costly or too unreliable to be worth storing) the task is to manage with the resources available and within the constraints that are given. That is the stage which South Africa has now reached. In physical terms, water resource development has reached its own watershed.

The policy framework and management approaches needed in the two phases, that of plenty and that of scarcity, are necessarily different. There is a very real danger that if the transition from resource development to resource management is not provided for, the instruments used in the first phase may become obstacles to the application of instruments appropriate for management in the second phase.

South Africa's historic approach to water allocation provides a classic case that is reflected, to a greater or lesser extent, elsewhere. The riparian principle, which underlay water allocation, made some sense while the country needed to encourage landowners to use water to develop their land and thus the broader economy. It provided landowners with security and guarantees of access to water for use on their land.

Such a riparian system makes less sense when there is growing competition from consumers who are far more productive in their use of water but do not have riparian access. Industry generates far more jobs per kilolitre, the value added by each kilolitre they use is orders of magnitude greater than in agriculture. Yet a riparian system gave historic agricultural users (from whose activity society derived relatively less benefit) entrenched rights to use the most reliable proportion of the nation's water. Further, under the old law, riparian users were not usually allowed to transact water so that it could be applied for more productive purposes, away from the land to which it is attached. Other users were compelled to invest in storage and transfer schemes.

Further, as the pressure on the resource grows, it becomes increasingly important to focus on activities which indirectly impact upon the availability of water. So, in South Africa, controls were placed on pollution (which impacts on "usability"), which were in many cases stricter than similar controls in developed countries. Measures were introduced for the regulation of commercial afforestation since its impact on the water resource had been demonstrated as early as the 1970s.

This highlights the fact that the post-94 development of South Africa's water policy has been driven not just by the demands of equity and social transformation. Even without the political change, the basic reality would still have to be addressed; the same amount of water has to be shared between a larger number of users and the growing needs of our developing society.

4. Approaches taken in South Africa's water policy review

The review of the water policy was guided by a set of basic principles developed through an intensive process of consultation. One was that the use of water, in all its dimensions, should be for the optimal benefit of society as a whole. The right of all citizens to have access to basic water services was emphasised and it was stated that the water required for basic human needs as well as for the environment should enjoy priority of use by right, while use of water for all other purposes would be subject to authorisation.

The basic physical realities were addressed by recognising that all water, wherever it occurs in the water cycle, is a resource common to all. The principles emphasised that resource development and management should, where possible, be done at a catchment or regional level. They also further clarified the role and objectives of the state in the management of the nation's water and recognised the importance of ensuring that the interests of those whose livelihoods depended on water use and who had invested to achieve this were protected. They indicated that institutions for water management should as far as possible be self-driven with minimum need for state intervention.

Driven by the constitutional distinctions, the management of water as a natural resource— crudely, natural water in rivers, lakes and underground—was treated differently to the management of water services, the activity of providing a pure water supply and using water for sanitation purposes—water in pipes—although the link between the two was noted.

The specific nature of water services and the fact that responsibility for their management was dealt with in a different manner to water resources in the Constitution, led to further considerations. Thus it was recognised that water services must be regulated in a manner consistent with and supportive of the aims and approaches of the broader local government framework and that, where water services are provided in a monopoly situation, the interests of the individual consumer and the wider public must be protected and the broad goals of public policy promoted.

Finally, it was stated that international water resources, specifically shared river systems, would be managed in a manner that optimises the benefits for all parties in a spirit of mutual co-operation. Allocations agreed for downstream countries would be respected.

5. Key instruments

A number of key instruments and concepts were introduced to give effect to these principles in policy and legislation:

- the concept of the Reserve, through which water requirements to meet basic human needs and sustain the environment are given priority;
- a system to classify water resources in terms of desired environmental protection levels which will guide the technical determination of the environmental reserve;
- a flexible allocation system that allows changes of use to achieve equity and meet changing social and economic priorities by regulation rather than administration or expropriation, but limits the duration of use rights to a maximum of 40 years;
- institutional arrangements to manage water at a catchment level within a national framework articulated in a National Water Strategy;
- a pricing strategy to ensure that payment for water use covers development, operational costs and resource management costs and reflects the value of water while still achieving equity objectives;
- separate legislation for water resources and water services, distinguishing between the regulation and management of water in rivers and water in pipes.

6. From principle to policy, legislation and implementation

These principles were translated, first into a statement of policy (White Paper on a National Water Policy, 1997) and thence to legislation (Water Services Act (1997) and National Water Act (1998)). The resource management framework is currently being implemented.

Considerable effort is currently being expended to develop the detailed instruments required. These include regulations governing the process of registration of existing water uses as a precursor to allocation; the development of regulations for classification of rivers and other resources to enable the determination of the Reserve. New institutional arrangements and the pricing framework have also to be established and regulated.

The basic approach is for water resource management to occur at the catchment level, and an institutional framework is being established for this purpose. But the policy recognises the need for such management to fall within a national strategy. Based on experience in other countries, provision has been made for a national water strategy to provide the overall framework within which catchment management can be carried out and this is currently in preparation.

In the field of services, the National Water Policy specifically provided for a distinction to be made between the role of local government (as the authority for ensuring access to water services) and that of direct service provision. Legislation has also been passed which provides for the application of best practice instruments such as water services development planning (or facilities planning as it would be known in other countries) in a manner which is integrated with broader local government development planning. Technical norms and standards as well as approaches to tariff setting are also now regulated. Finally, since the services legislation formally enables the participation of private-sector providers, provision is made for these contracts to be regulated, a delicate task in view of the contentious nature of water supply privatisation.

Given the fact that democratic local government is a new, still fragile institution, the focus of the National Department is at this stage on support—through capital and technical assistance rather than the enforcement of regulation.

7. The outcome so far

The measure of any policy must be the extent to which it successfully achieves its objectives. To what extent has desirable economic activity been promoted—or hindered? Has the state of the environment improved—or deteriorated? Have objectives of equity such as access to water and water services been realised—or has inequity been reinforced?

A definitive evaluation of such impacts in a field as complex and diverse as water can necessarily only be made over a long period. The preliminary indicators of the response to South Africa's new water policy are however encouraging.

There is always the danger that far-reaching policy of this nature will have unintended consequences. In particular, it was suggested that the approach taken could discourage investment in critical areas of agriculture and industry, that it could foment conflict rather than promote co-operation.

Happily the reverse has so far proved to be true.

Since 1994, over nine million people, 20 percent of the nation's population, have had their access to basic water supply services significantly improved, albeit often still to a relatively low standard. Despite the acute resource shortages in many areas and the residual conflicts, access to water resources to provide basic services has hardly ever been an issue.

Within the framework of the policy, new partnerships are being developed to ensure the expansion of water services. Two private concessions have been awarded and others are under study including one for Johannesburg, South Africa's premier city. In the (publicly managed) city of Durban, application of new approaches made possible under the Water Services Act has seen free basic-needs water supplied without undermining the financial viability of the service provider.

Meanwhile, in the area of water resources, the careful distinction made between unacceptable expropriation of water use rights and the gradual regulatory deprivation of less productive uses seems to have been accepted. There has been extensive investment in private sector water-related projects. Hundreds of millions of rand has been spent by private farmers in dams and other infrastructure for the expansion of high value irrigation, in vineyards, sub-tropical fruit and sugar helped by post-1994 opening of export markets. The switch from low value field crops to high value perennials is invariably associated with substantial gains in employment, contributing directly to government's broader development strategies.

In addition, investors have often included a substantial component of social investment, giving access to newly irrigated land or other opportunities to formerly disadvantaged communities as well as using water more efficiently. This investment has been explicitly encouraged by the recognition that investment in water infrastructure is an important criterion to be taken into account when water allocations are reviewed.

Innovative approaches are being used to address water quality problems. The multi-million rand Amanzi project, being promoted to treat gold mining wastewater to potable quality, has attracted extensive international investor interest. A scheme to provide an important Northern Province town with water, and use the treated domestic wastewater for other mining process purposes, is also under consideration. In Durban, a substantial investment has been made in water reclamation, delaying the need for expansions in river abstractions.

The continued expansion of the scope of water management to include land use activities, which impact on the water cycle, is also proceeding successfully. The plantation forestry industry co-operates actively in restricting their activity so as not to impact negatively on other water users, although it still contests the fairness of being the only dry-land water user to be charged for its water use.

The picture is thus an encouraging one.

8. Conclusions

For South Africa, political transition has provided a window of opportunity for the radical transformation of the country's water policy. In a broader context, it would be unwise to propose that the reforms necessary to achieve the goals of water security and sustainability should wait for such momentous periods of national history. The nature of the policy process is likely to be different in each national context.

What the South African case does serve to highlight are certain specific principles and instruments that may usefully be applied to the management and use of water resources in other countries with resource constraints similar to ours.

These include recognition of the role of the state as custodian of the resource, as well as of the need to manage water as a unitary resource, while distinguishing between service provision and resource management. The systematic recognition of the right of access to basic services and of environmental requirements is also critical. In a country where the resource is close to full utilisation, the provision of a framework that allows for flexibility in allocation between uses must be put in place if the needs of a changing society are to be met.

While some of these issues might not be seen as critical to resource management in their own right, there is no doubt that the detailed attention to the provision of basic water services contributed substantially to the sector's political mandate and the legitimacy of its resource management proposals.

Success in achieving water security will depend on effective co-operation through new institutions, as well as the establishment of practical systems to allow both environmental protection and the justifiable economic development provided for in our Constitution.

Perhaps the key message for this presentation is that the success or failure of South Africa's water policy will depend on our ability to address the practical challenges imposed on us by our physical realities in a manner which enables us to meet the social imperative of a better life for all. So far, we can report that we have used the window of opportunity provided by our political transition to lay the foundation we need.

Section B

South Africa's recent experiences

The three papers in this section present aspects of changes in water policy and water law, which have been occurring in South Africa in the past decade and are under active development and testing

The papers describe:

the overall legal and policy innovations;
the consultation processes being developed for establishing participatory river-basin management;
and the inter-relation of water management with equity issues including poverty and gender

South Africa's New Water Policy and Law

H. Karodia and D. R. Weston
Department of Water Affairs and Forestry
Private Bag X313, Pretoria, 0001
South Africa

Abstract

South Africa's water policy is going through a period of rapid changes, following the country's radical political changes of the early 1990s. The paper describes the principal aspects of these changes, which are based on the new National Water Law of 1998. The law divides the country into 19 Water Management Areas, and prescribes processes by which strategies and management institutions will evolve for these Water Management Areas, using the principle of stakeholder participation to ensure that each such area can develop its institutional and management systems to satisfy its own specific situation. The institutional roles of Catchment Management Agencies, Catchment Management Strategies, and Water Users' Associations are explained in this context.

1. Introduction

Change is not always so exciting. Often change is a scary concept that brings with it uncertainty and fear of the unknown. However, change has become part and parcel of South Africa and, in many ways, its people see a bright future amidst all the changes that have swept across this beautiful land. Certainly, these changes will provide improvements to the lives of present and future generations of South Africans.

The National Water Policy, the National Water Act (Act 36 of 1998) and the Water Services Act (Act 108 of 1997) are transformational masterpieces that will not only redress the problems of the past, but will also help to build a better future. This is very much embodied in the purpose of the National Water Act, which is to ensure that the nation's water resources are protected, used, developed, conserved, managed, and controlled in ways that take into consideration such factors as, inter alia, meeting the basic human needs of present and future generations, promoting equitable access to water, redressing past discrimination, facilitating social and economic development, and protecting aquatic and associated ecosystems.

The slogan of the Department of Water Affairs and Forestry (DWAF) is "Viva water pure and clean, Viva forests rich and green". The statement "Viva water pure and clean" celebrates the meaning of water to life and the importance of water to South Africa; however, whilst celebrating, we have to consider carefully how we use this precious resource, how we ensure that everyone has access to this and how we ensure that future generations can also shout "Viva water pure and clean."

This paper looks at aspects of the National Water Policy and National Water Act and how the goals of efficiency, equity and sustainability can be achieved.

2. Policy and legal context

The far-reaching political and social changes that swept across South Africa during the early 1990s only added to the tension caused by the chasm between outdated policy and the realities of resource management. With time it had become very clear that the approaches of the 1956 Water Act, that of water resource development and riparian rights, were not sufficient to meet the rapidly changing political, social, and economic environments. Furthermore, our understanding of the importance of ecological integrity and the role this plays in maintaining resource quality demanded new approaches. It was therefore, high time for policy and legislation that was integrative, flexible and more dynamic.

The White Paper on National Water Policy (DWAF, 1997) set out new integrated policy positions for protection, use, development, conservation, management and control of South Africa's water resources. It did this in plain English and explained how this would be implemented. This remains a remarkable document.

The National Water Act is often described as an "enabling" piece of legislation. It provides little in the way of regulatory procedures, standards and tools which will be used for the integrated approaches that were emphasised in the National Water Policy. The strength of this approach is that it enables the flexibility that is required in regulating a dynamic world.

The framework for the integrated management of water resources is provided in the National Water Act via water resources strategies.

3. Water resource strategies

The National Water Act provides a two-tier approach to the development of strategies to facilitate the management of water resources.

At the national level, the Act provides for the Minister to progressively develop a National Water Resource Strategy (NWRS). This strategy must set out the objectives, plans, guidelines and procedures of the Minister and institutional arrangements relating to the protection, use, development, conservation, management and control of water resources. The NWRS provides the framework within which water will be managed at regional or catchment levels, in 19 defined Water Management Areas (WMA) that were established in October 1999. It provides this framework as follows:

The ecological component, via:

- the Reserve (the water required to maintain ecological sustainability);
- setting out of water conservation and water demand management principles; and
- stating objectives for water quality to be achieved.

The social and economic component, via:

- the Reserve (the water required for basic human needs);
- international rights and obligations;
- estimates of present and future water requirements;
- stating WMA surpluses and deficits;
- stating the quantity of water available in each WMA; and
- providing for inter-catchment transfers.

Integrated management, via:

- objectives for the establishment of institutions;
- determination of the inter-relationships between institutions involved in water resource management; and
- promoting the management of catchments in a holistic and integrated manner.

At a regional level, the NWA provides for the progressive development of Catchment Management Strategies. The Catchment Management Strategy (CMS) must be in harmony with the NWRS and in developing the CMS, the co-operation and agreement of stakeholders and interested persons must be sought with regard to water related matters.

The CMS must set out the strategies, objectives, plans, guidelines and procedures for the protection, use, development, conservation, management and control of water resources in the WMA. As with the NWRS, the CMS also addresses the ecological, social and economic imperatives as well as making provision for integrated approaches, as follows.

The ecological imperatives, via:

- the class of the water resources, the resource quality objectives and the requirements of the Reserve; and
- taking into account the geology, climate and vegetation.

The social and economic imperatives, via:

- considering international obligations;
- taking into account demography, land use and waterworks;
- water allocation plans; and

- taking into consideration the needs and expectations of existing and potential water users.

Integrated management, via:

- taking into account any relevant national or regional plans prepared in terms of any other law;
- enabling the public to participate in managing water resources; and
- setting out the institutions to be established.

Often, when these strategies are discussed, it is said that they can be summarised as working towards equity, efficiency and sustainability. In a complex way the various components do. But, to try and make the picture simpler, these strategies are about finding a balance between socio-ecological needs for resource protection and socio-economic needs for resource development and utilisation, by involving stakeholders via various institutional arrangements.

4. Water management institutions

The National Water Act provides for the establishment of a variety of water management institutions. The aim of establishing these institutions is to delegate water resources management to more regional and localised levels, to involve stakeholders in water resources management and thereby give effect to integrated water resources management.

4.1 Catchment Management Agencies

These agencies will be established progressively throughout the country, within the Water Management Areas defined by the National Water Resource Strategy. Whilst certain water resource management functions may be assigned or delegated to these agencies, there are initial functions that all Catchment Management Agencies must perform upon establishment. These include, amongst others:

- Playing a co-ordinating role regarding water-related activities and water management institutions;
- Developing and implementing a Catchment Management Strategy;
- Encouraging public participation.

A range of organisational models for these agencies will be required to suit the differing needs of the various Water Management Areas. Furthermore, the organisational structure will depend largely on the functions that are assigned or delegated to it. Certainly, the structure will need to be sustainable in terms of both human and financial resources. The aim is for Catchment Management Agencies is to be focussed and responsive and not to be bureaucratic hurdles.

The Governing Board of the Catchment Management Agency will be accountable to the Minister for the Agency's performance, and will be primarily responsible for setting the vision, mission and strategic direction. This Board will reflect the relevant sectoral, demographic and gender profiles, as well as possess the appropriate expertise and experience.

The Governing Board will ultimately be responsible for implementing the Catchment Management Strategy. Therefore, this Board will be responsible for ensuring that the balance between socio-ecological protection and socio-economic development is maintained in the Water Management Area. This will mean that the Governing Board will have to ensure, via the staff of the Catchment Management Agency, that stakeholders have their say with regard to resource protection and resource development and that the strategy reflects their needs and requirements.

4.2 Catchment Management Committees

The National Water Act provides specifically for the establishment of committees by the Catchment Management Agency "to perform any of its functions within a particular area or to advise it." It also provides for powers to be delegated to Committees. Catchment Management Committees provide an important means by which Catchment Management Agencies can broaden their management and technical capacity. They also provide a mechanism through which a broader range of stakeholders can be included in water resource management.

4.3 Water User Associations

A Water User Association (WUA) is a statutory body established by the Minister in terms of the National Water Act. WUAs are, in effect, co-operative associations of individual water users who wish to undertake water-related activities for their mutual benefit.

The broad role of a WUA is to enable people within a community to pool their resources (money, person-power and expertise) to carry out water-related activities more effectively. The establishment of a WUA must also assist in achieving the purposes of the Act. WUAs, firstly, enable members to benefit from addressing local needs in terms of local priorities and resources. Secondly, they provide a mechanism through which a CMA (or the Minister) can devolve the implementation of aspects of the Catchment Management Strategy to the local level.

WUAs will normally operate at a localised level. However there will be exceptions, such as when the length of a river managed by a WUA is so long that it relates more to a regional than a local interest. A WUA may be concerned with a single purpose, such as controlling recreational activities on a river or providing water for emerging farmers. Alternatively, a WUA may be multi-sectoral, dealing with a variety of water uses within its area of operation. WUAs may derive their functions through a process of delegation from the Minister or the CMA. The WUA is accountable, for exercising a delegated function, to whoever gave the specific delegation.

The DWAF has for some time been busy with a process of transforming Irrigation Boards which, constituted under the auspices of the 1956 Water Act, were essentially exclusive in their nature. Typically, these Boards did not include the participation of previously disadvantaged groups in the management of the water resources, and also had limited human and financial support. The transformation and establishment of these WUAs with regard to the participation of previously disadvantaged groups have certain constraints and difficulties that need to be overcome. One of many issues that need to addressed is ensuring that the historically disadvantaged become empowered sufficiently to have their say and not be overpowered by those who are economically stronger. Much is to be done, also, in bringing people together so as to learn and understand each other's needs and requirements. It is strongly believed that institutions such as WUAs can play an important role in ensuring that water resource management becomes more integrated.

4.4 Institutional linkages

Naturally one of the questions that arises when looking at these various Water Management Institutions is, how do they relate to each other and who is responsible for what? For sound, and maybe obvious, reasons the relationship between a CMA and DWAF is likely to be a very close one. DWAF is responsible for the development and implementation of the National Water Resources Strategy, whereas the CMA will be responsible for the development and implementation of the CMS within its Water Management Area. The Minister is ultimately accountable for the management of the nation's water resource. He or she must therefore ensure that CMAs carry out their functions effectively.

A WUA, together with other water management institutions and water services institutions, will be responsible for executing the Catchment Management Strategy at a local level.

Therefore, the establishment of these water management institutions will provide a more effective conduit for stakeholders to voice their needs and requirements for socio-ecological protection and socio-economic development.

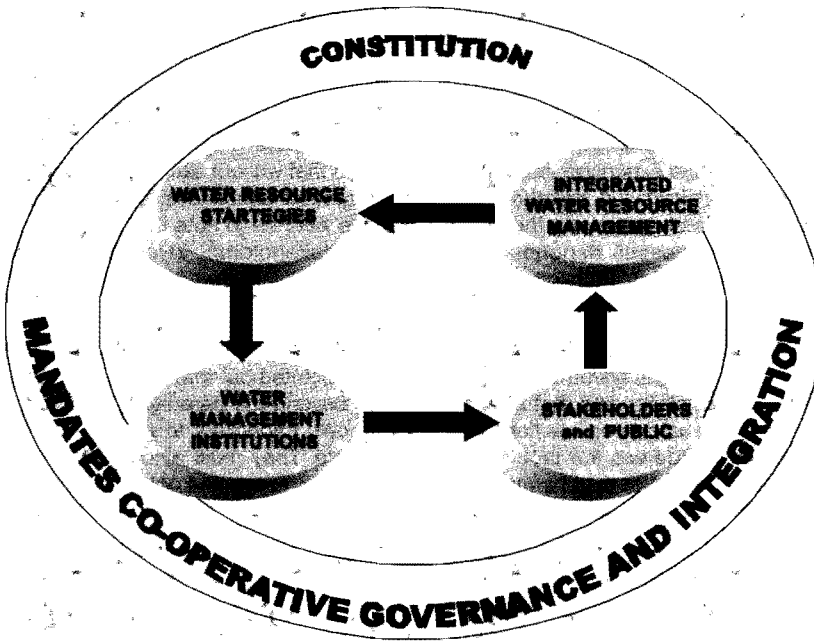
5. Co-operative governance and public participation—a road to sustainability

CMAs will manage activities impacting on the water resources of their WMA. In doing so they will have to actively work with these various water management institutions as well as other national departments, provincial and local government, non-governmental organisations and so on. Co-operative governance will have to be the order of the day to enable successful integrated water resource management.

The various dimensions of integration present an exciting challenge to water management institutions as South Africa's environmental, water and land-use legislation and administration is typically characterised by fragmentation (Görgens et al, 1998). However, the Constitution provides that all spheres of government and all organs of the state must co-operate with each other in mutual trust and good faith by co-ordinating their actions and legislation with each other (DWAF, 1997).

Therefore, co-operative governance is not only a policy matter, it is in fact constitutionally mandated (see Figure 1).

Figure 1: The constitution mandates co-operative governance and integration, and this is carried through into the National Water Act



Dent (2000) made the pertinent observation that successful integrated water resource management will require interaction between individuals, organisations and disciplines, thereby enabling the collective, timeous, wise and cost-effective assessment of proposed, present and past actions. Therefore, integration is also about interaction and therefore, the need for co-operative governance and public participation is carried through to the NWA via the water resource strategies.

The NWA provides a number of legal requirements for public participation in a number of sections throughout the Act. Words often used include: *co-operation and agreement; public to participate; consult with any persons or organisation; co-operation and consensus;* and *community participation.* However, despite the legislative requirement, integrated water resource management will not be achieved without public participation and, therefore, it should not be seen as regulatory "add-ons". This is supported by Jendroska (1998) who contends that

> *"public control, enhanced by transparency, is not only considered important; it is, in relative terms, the least expensive of all instruments for implementing environmental policies and enforcing environmental legislation."*

Water resource issues are complex and large amounts of technical information are often required to assist the process. Further, due to the complexity of issues many stakeholders are typically involved. Some of these stakeholders are lay people, some are experts. Often these people see things very differently. Certainly the public participation and stakeholder involvement processes have to take into account these dynamics (DWAF, 2000). The processes may be awkward, time-consuming and expensive, but Behr (1999) noted that without exception all models indicate that involving stakeholders achieves greater consensus about methods for appropriately managing the environment. He went on to note that the success of these processes depends on identifying stakeholders, involving them in informational and decision-making processes, and ultimately implementing programmes in co-operation with community groups.

However, the responsibility for the success of this approach does not just lie at the door of central government. Zazueta (1995) pointed out that civil society also has a responsibility and that it needs to move beyond the paradigm of criticising government action, or inaction, and build its own capacities to propose viable options that address the problems they articulate. They must also learn how to work together better to generate a broader range of choices and options for people to assess as participatory democracies evolve.

It is, therefore, the policy of the Department of Water Affairs and Forestry to strive for integrated water resource management arm-in-arm with its stakeholders; both aware of each other's importance. For without each other we will not be able to ensure that our water resources are managed in a manner that is sustainable, both in terms of the environment and of process. If we ensure that the sustainability of the resource is ensured by means of Resource Quality Objectives, and if we ensure that the approaches of involving stakeholders in water resource management are also sustainable, then as a "team" we can work towards ensuring that the allocatable water resources of South Africa are used equitably and efficiently.

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Olifants Water Management Area: Catchment Management Agency Establishment

Magda Ligthelm
Department of Water Affairs and Forestry
Mpumalanga Regional Office, Nelspruit, South Africa

Abstract

South Africa's Department of Water Affairs and Forestry (DWAF) started the process of establishing a Catchment Management Agency (CMA) in the Olifants Water Management Area (WMA) in March 1998. The emphasis during the early stages was on getting representatives from water users in the catchment, and sharing information on the new water legislation (specifically related to the proposed catchment management agencies) and existing DWAF projects in the catchment. At that stage DWAF already identified that a special effort would have to be made to involve emerging farmers and potential water users through water related and water unrelated community structures. Such an effort was taken forward in 1999/ 2000 with the appointment of consultants to identify and brief these users and potential users before meetings, and to assist them in attending the relevant meetings. The consultants would also assist DWAF in establishing suitable structures for drafting the proposal to the Minister of DWAF for establishing a CMA in the Olifants, assist in building capacity of participants, prepare the proposal to the Minister and manage the project up to the formal establishment of the Olifants CMA.

During the process frustrations regarding lack of water (domestic supply, irrigation supply) were prevalent. Those were noted but DWAF was of the opinion that they could not be addressed through the project but would get high priority when the strategy would be developed as part of the next phase of the management of the Olifants water resource where all could then participate. Concerns were also referred to relevant sections in DWAF where appropriate.

A smaller team of consultants started the establishment of a small-scale irrigation farmers forum. They started the process by having nine workshops throughout the catchment where emphasis was put on getting the expectations of the participants and then briefly looking at existing structures and how those could be used as vehicles for participation of the people in the CMA process, and in the longer term, as formalised structures where small-scale farmers could be represented to get their needs addressed. The expectations mentioned centred around getting water (access to drinking water and water for domestic use, water for agricultural purposes) and then using it efficiently and effectively (assistance from government in providing water and sanitation, and agriculture-related finances, equipment, land, training, market information, etc.). This now has to go forward.

The approach used during the process was to get the public involved through two rounds of public meetings held in the five sub-catchments in the WMA. Consultants familiar with the area assisted in identifying relevant stakeholders and assisted them in attending. During the meetings one of the aims was to ask people to nominate

representatives who could bring the perspective of the users during the drafting of the proposal. The idea was to work with a single smaller group of people (the Olifants Reference Group) who would participate in the drafting of the proposal and then give feedback, to the people they represent and to the team drafting the proposal. Other components of the process included discussions with a DWAF Reference Group (established because the process is so new), a review by IWMI, and the establishment of an advisory committee to advise the Minster on the composition of the proposed CMA governing Board.

A proposal is being drafted, containing the proposed name and water management area; description of the significant water resources in the WMA and information about the existing protection, use, development, conservation, management and control of those resources; proposed functions; funding; feasibility of proposed CMA in respect of technical, financial and administrative matters; and details on the consultation already undertaken and the result of the consultation.

As a consequence of the deliberations on the functions that a CMA would do, but also when discussing "where" and "how" (through which structures) water users and interested parties would participate, the proposed structures to be established for future water resource management were discussed. These would include a Governing Board; Regional Catchment Management Committees; Task Committees and an Operational, Technical and Social Support structure. Where funding is concerned, the idea is that the costs associated with the functioning of the CMA would be paid by the water users according to the policy explained in the National Pricing Strategy. Provision is made in the strategy for subsidising poor water users. Details on financial support from government is still being discussed.

A new institution is thus being developed for management of the water resources in the Olifants WMA. Water users and other interested parties in the WMA would be part of this institution to which the responsibility for WRM could be delegated where possible and appropriate.

Acronyms used:

CBOs:	Community Based Organisations
CMA:	Catchment Management Agency
DWAF:	Department of Water Affairs and Forestry
GB:	Governing Board of the CMA
NGOs:	Non-Governmental Organisations
NWA:	National Water Act, 1998 (Act 36 of 1998)
WMA:	Water Management Area
WRM:	Water Resource Management
WUA:	Water User Association

1. Introduction

South Africa went through major political changes in 1994 with the first democratic elections being held. Since then radical changes have been made in promulgation of new or amended legislation to give effect to the political changes. The new water legislation reflected the changes that have to take place to equal the imbalances created previously and to lay the foundation for a society based on democratic values, social justice and fundamental human rights. Significant additional changes were also made in how water resource management (WRM) would be done. All new requirements were reflected in the purpose of the National Water Act (NWA), promulgated in 1998 (Box 1).

Box 1: Purpose of the National Water Act, 1998 (section 2)

The purpose of the Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors the following:

(a) Meeting the basic human needs of present and future generations;

(b) Promote equitable access to water;

(c) Redressing the results of past racial and gender discrimination;

(d) Promoting the efficient, sustainable and beneficial use of water in the public interest;

(e) Facilitating social and economic development;

(f) Providing for growing demand for water use;

(g) Protecting aquatic and associated ecosystems and their biological diversity;

(h) Reducing and preventing pollution and degradation of water resources;

(i) Meeting international obligations;

(j) Promoting dam safety;

(k) Managing floods and droughts;

and for achieving this purpose, to establish suitable institutions and to ensure that they have appropriate community, racial and gender representation.

Slogans used by the Department of Water Affairs and Forestry (DWAF) when administering and implementing the act are "Ensuring some for all forever" and "Viva water pure and clean." The words "efficiency", "equity", "sustainability" and "representativity" give the essence of the purpose of the act.

An important new concept contained in the NWA, 1998, is the establishment of catchment management agencies (CMAs) within delineated water management areas (WMAs). One of the main objectives for the establishment of the CMAs would be to provide institutions where stakeholders can participate in the management of the water resource.

Some of the principles and objectives of relevance to new envisaged institutions as decided early on in the process when the new water law was drafted are shown in Box 2.

Box 2: Fundamental principles and objectives for a new water law in South Africa: water institutions (DWAF, 1997)

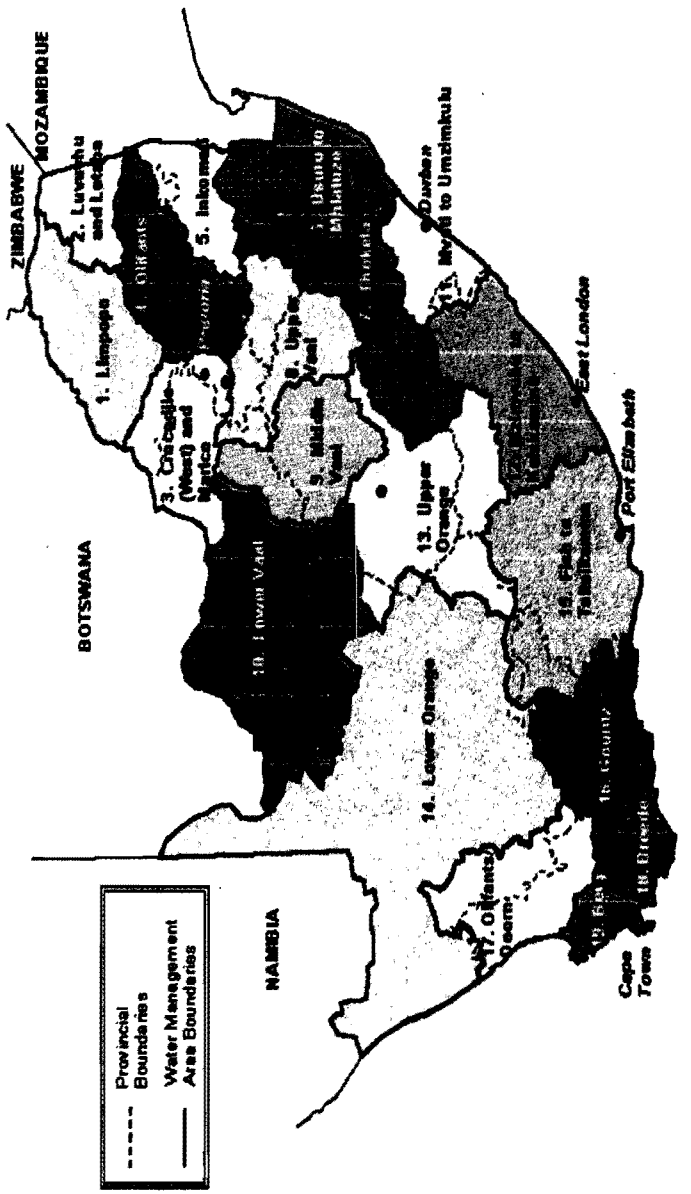
Principle 22: The institutional framework for water management shall as far as possible be simple, pragmatic and understandable. It shall be self-driven and minimise the necessity for state intervention. Administrative decisions shall be subject to appeal.

Principle 23: Responsibility for the development, apportionment and management of available water resources shall, where possible and appropriate, be delegated to a catchment or regional level in such a manner as to enable interested parties to participate.

Principle 24: Beneficiaries of the water management system shall contribute to the cost of its establishment and maintenance on an equitable basis.

The boundaries of the WMAs were established through legislation in October 1999 and are indicated in Figure 1. The Olifants is one of these 19 areas (WMA 4 on Figure 1, and Figure 2).

Figure 1: Map of South Africa, showing boundaries of water management areas



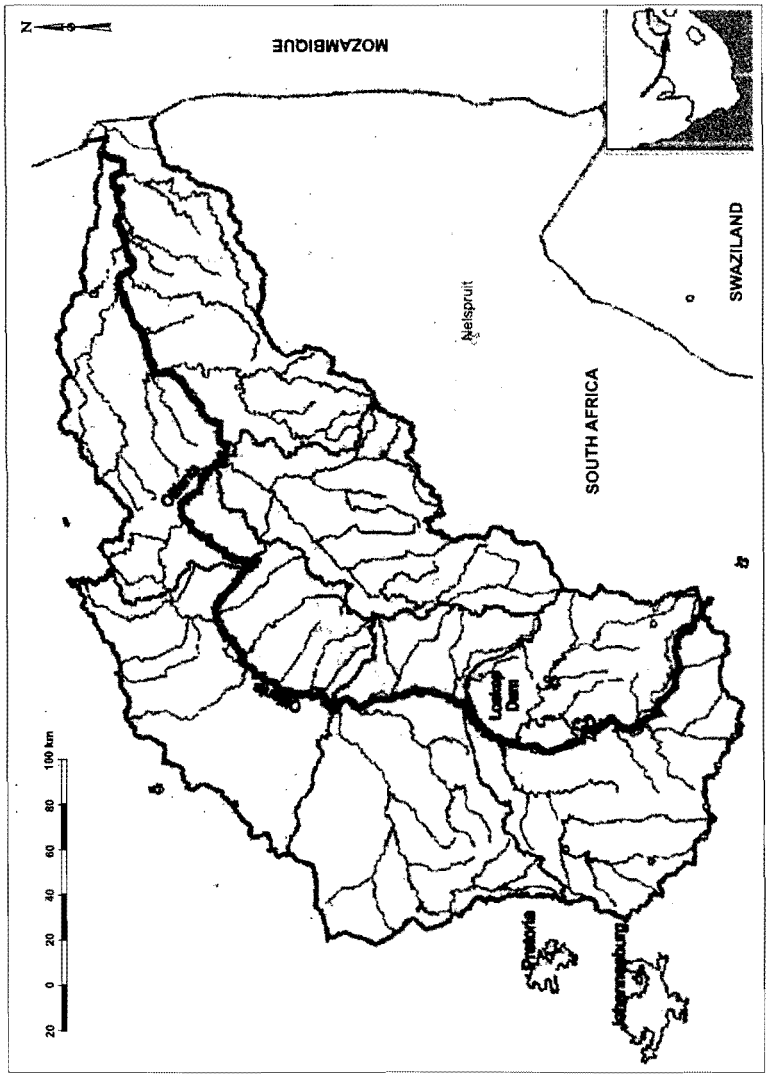


Figure 2: Map of the Olifants River Basin

The definition of a WMA as contained in the NWA, 1998, is given in Box 3.

Box 3: Definition of a Water Management Area (section 1[xxv])

"water management area" is an area established as a management unit in the national water resource strategy within which a catchment management agency will conduct protection, use, development, conservation, management and control of water resources.

2. The process

2.1 Initial and later process

The process to establish the CMA started in March 1998 when the idea was deliberated at a joint meeting of committees established previously in 1994. These committees were co-ordinating and technical advisory committees for the Middelburg and Witbank dams and the Klipspruit River and consisted of the following stakeholders: DWAF, mining houses, individual mines, power generation (Eskom), industry, city councils and government departments. An interim task team was formed to take the process of water resources management (including the establishment of the CMA) forward in the catchment and the first meeting was to be convened by the Olifants River Forum. This was an existing body creating awareness on river management with the mines and nature conservation (Kruger National Parks) as the main participants.

The task team focussed on getting a representative group of people together with the main aim of setting up the CMA. Various meetings were held with different stakeholders where information was shared on the main aim and to get input from them.

During the process it became apparent that a special effort had to be made to involve civil society at large and emerging farmers or potential new farmers. This transpired as large areas of the WMA were part of the former homelands where very little services were provided and limited agricultural development took place. Newly elected transitional local councils struggled to provide these services immediately and conflict was also created between them and the traditional authorities in the areas, on this and other matters. All newly elected parties and existing old structures thus had to become part of the process for the establishment of the CMA.

The DWAF decided to fund the process for the establishment of the CMA and to appoint consultants to assist with getting representative committees in place that could draft the proposal. The latter is a requirement of the NWA when establishing CMAs.

In May 1999 a team of consultants were appointed to assist DWAF with the above and the establishment of the governing board—the first body to be appointed by the Minister when establishing the CMA. The team consisted of managers of the project, experts on the water use and impacts associated with mining and irrigation, people with experience in agricultural use of water by emerging farmers, facilitation of public meetings and social aspects. Two newly developed consultants, Bavumile Community Development Initiative and KMI Communication, consisting of people who are very familiar with the catchment, were part of the team.

Important elements of the later process are:

- establishing a representative stakeholder reference group;
- drafting of the proposal for the establishment of the CMA;
- discussing the process with a DWAF reference group—in view of the implementing the new act where all the supporting policies and legislation are not yet developed;
- reviewing of the CMA process—reviewed in terms of international and the new national developments.

To get a representative stakeholder group, an existing group of stakeholders (established as part of the consultative process to determine the Olifants river ecological reserve) was expanded. For the latter, public meetings were held in five areas in the WMA (the boundaries of sub-catchment areas were used to determine the five areas).

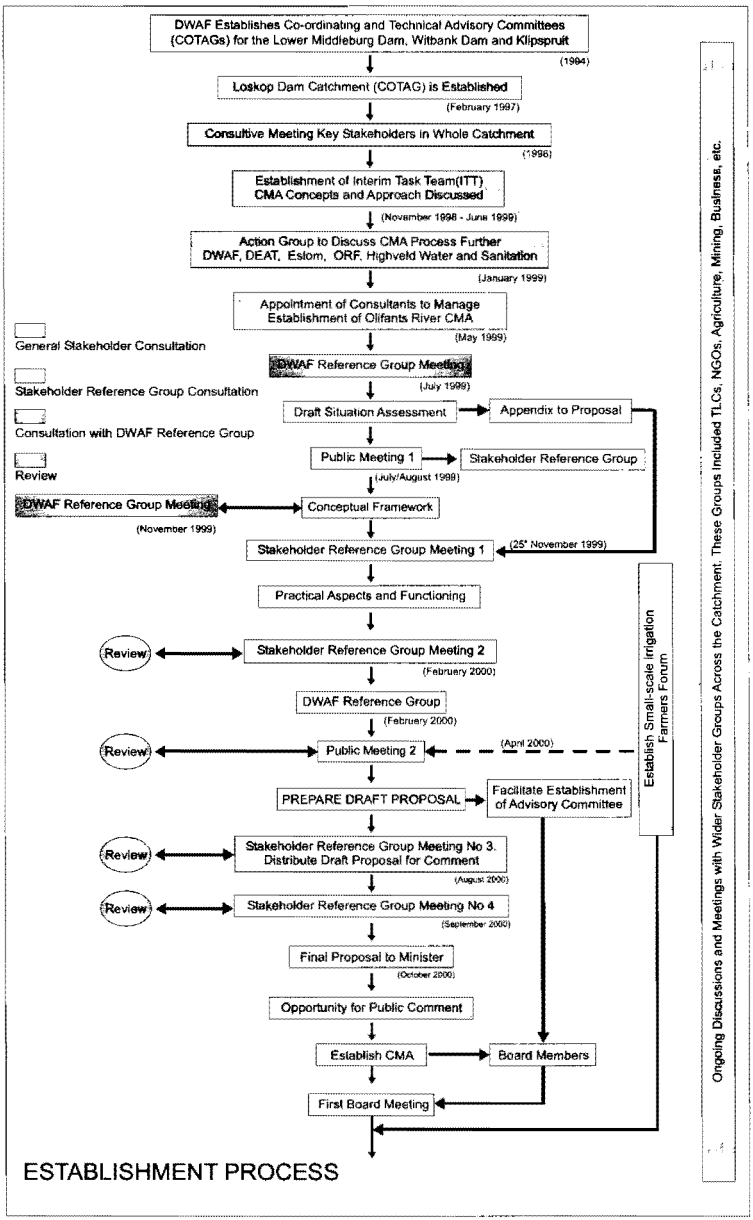
The whole process is shown in Figure 3.

2.2 Stakeholder identification and participation

As mentioned, existing structures were involved in the process and included the DWAF advisory committees in the Upper Olifants catchment and the Olifants River Forum. Other existing structures that were11 contacted to nominate representatives for the process included the irrigation boards, water boards, transitional local councils, district councils, traditional authorities, NGOs and the South African National Civic Association. Other civil society structures contacted included Community Based Organisation (CBOs) and the youth.

Meetings were also held with different sectors and information was shared in an informal and formal manner when people were contacted for meetings. People who were not familiar with the new process were briefed beforehand and in later instances pre-meetings were held if people felt that they could not participate meaningfully due to lack of understanding or inability to attend previous meetings. Material used in the process included workbooks (documents prepared for the workshops containing information and "exercises" that would be done during the workshops), newsletters, letters and press releases.

Figure 3: Process followed for the establishment of the Olifants CMA



Various methods were used during meetings to enable people to participate. These included discussions in smaller groups on identified topics and plenary sessions. Translations were provided in the public meetings.

2.3 Small-scale farmer forum

A special effort is being made to involve small-scale farmers in the process. The issues surrounding their involvement are touched on in the next section. These farmers often do not yet have access to irrigation water and are not organised into boards or water user associations. They thus have to be contacted almost on an individual basis. It was decided to try to assist them to form a forum that could then nominate people to act as spokespersons during the CMA establishment process. The questions stated in Box 4 were put as terms of reference to the consultants who assisted in the process.

This process has just started and only one round of workshops has been held throughout the catchment. During the workshops an initial effort has been made to obtain answers to the questions posed in the terms of reference (Box 4). This process will be taken forward during 2001.

BOX 4: Small-scale farmer forum

- Do they exist?
- Where are they?
- What are their current activities?
- How could they be defined?
- Are they interested in forming a forum?
- What functions could it perform?
- What would be the structure and functions of the forum?
- Would they require a budget?

Transport was organised and paid for, for people who could not afford or whose constituent could not afford to pay for it.

3. Issues

3.1 Representation

A major question asked during the process is how do you identify and involve potential water users in the process. The inequality in South Africa is so extensive that new water users will probably have to emerge with time. These potential users will probably come from the civil society and small-scale sectors and that was also why so much effort was put into involving them. The CMA would probably be one of the main vehicles through which the NWA would be implemented and its purpose fulfilled.

Another question raised was to what extent should people at grass roots level be involved in the process. Again the idea was to involve people if they expressed interest and to concentrate from the DWAF's side on existing structure such as local municipalities, civil organisations (SANCO), traditional leaders and CBOs for nominating representatives. A special effort was made in the specific case of small-scale farmers to go to grass roots to get representation and spread the message.

Another concern especially of DWAF is that by far the largest volume of water is still used by white-owned companies and farmers. These structures are also well organised around water usage and thus also well represented. They are also well positioned to participate in processes.

3.2 Problem to participate meaningfully: awareness, capacity-building and empowerment

The public generally has little knowledge on water resource management and legislation. They, however, now have the opportunity to participate in the management of this resource. Thus, there is a huge need for awareness, empowerment and capacity-building in general.

Many of the existing water users are well established and have the means to protect their interests well, while new users are still in a disadvantaged position.

One of the main challenges facing DWAF would be to ensure that especially the previously disadvantaged people could participate meaningfully—peoples' voices must be heard and their participation must be effective and influential.

3.3 General

There are still extensive conflicts, racism, lack of transformation and inequalities in South Africa in general. Examples of such conflicts are given in Box 5.

Box 5: Examples of conflicts

- people who have water (and the associated improved quality of life), those who are in the process of getting water and those that do not yet have it;
- conflicts between traditional or tribal authorities and newly elected local councils or municipalities;
- conflicts between communities and newly elected local councils or municipalities;
- conflicts between water service providers (or non-providers) and communities;
- conflicts between water users and government departments on non-delivery of services in general, etc

Not even people's basic needs regarding water and sanitation are fulfilled. Understandably, therefore a lot of tension is created when people are involved in water related projects.

Some water users want to get the best deal possible for themselves in the process (at the cost of other water users).

3.4 Other issues

Other issues identified during the process included:

- an urgent and serious need for water for especially irrigation purposes for previously disadvantaged farmers
- water users do not want to register and pay the water use management charge (see point 4.6)
- tourism as a sector is not contributing to the water use management charge as a water "user" at this point in time and the other sectors feel that they benefit financially by using the "goods and services" provided by the Olifants River

4. The proposal

4.1 Introduction

The proposal is now under drafting (DWAF, 2000). Section 77 of the NWA contains the requirements on what should be contained in a proposal for the establishment of a CMA. The information contained in the section is provided in Box 6.

Box 6: Proposal for the establishment of a CMA (NWA, section 77)

77(1) A proposal to establish a CMA must contain at least:

(a) a proposed name and a description of the proposed water management area of the agency;

(b) a description of the significant water resources in the proposed WMA, and information about the existing protection, use, development, conservation, management and control of those resources;

(c) the proposed functions of the CMA, including functions to be assigned and delegated to it;

(d) how the proposed CMA will be funded;

(e) the feasibility of the proposed CMA in respect of technical, financial and administrative matters; and

(f) an indication whether there has been consultation in developing the proposal and the results of the consultation.

(2) The Director-General may assist a person to develop such a proposal.

4.2 Description of Olifants WMA

Salient detail on the Olifants WMA is that –

- it covers an area of 54,388 km^2
- it has a population of about 3,400,000
- it had a water demand of –

- 1,135.2 million m^3 per annum in 1995 and
- 1, 375.2 million m^3 per annum have been predicted for 2010

- it is a highly water-stressed catchment and has to import high-quality water from the Usutu (a neighbouring catchment) for power generation
- the catchment is highly developed
- pollution and water quality problems arise from mining activities, industries, power generation and agriculture use of water
- another feature is that the lower part of the WMA forms part of a national park—the Kruger National Park—that is a major tourist attraction in South Africa
- it is an international river—the Olifants flows into Mozambique

4.3 Issues identified

The proposal identifies the following major issues that DWAF already faces and that the new CMA when established, will also have to address:

- The WMA's resources will be fully utilised by 2010. Strategies will have to be developed to address the growing demand and the imbalances evident throughout the WMA. These could include -
  - Re-allocation of water amongst users;
  - Rigorous management of demand;
  - Importation of water from other basins
- The greatest growth will be in urban demand, which is predicted to increase from 12 percent to 17 percent of total demand.
- New irrigation allocations for emerging farmers will have to be done.
- The WMA is already highly regulated with 30 large dams and 2,500 small dams. There is already a problem in maintaining flows in the lower region of the WMA during winter and droughts.
- Water quality issues include point and diffuse pollution from mining, industrial and agricultural activities. Pollution includes high salinity, high concentrations of metals, low pH. Poor land use practices are resulting in high silt loads in some areas in the catchment.
- Erosion and over-grazing occur in various parts of the catchment.

4.4 Functions: Water resources management

The initial functions of CMAs are described in section 80 of the NWA, 1998, and are provided in Box 7.

Box 7: Initial functions of CMAs (NWA, section 80)

80. Subject to Chapter 2 and section 79, upon establishment of a CMA, the initial functions of a CMA are:

(a) to investigate and advise interested persons on the protection, use, development, conservation, management and control of the water resources in its WMA;

(b) to develop a catchment management strategy;

(c) to co-ordinate the related activities of water users and of the water management institutions within its WMA;

(d) to promote the co-ordination of its implementation with the implementation of any applicable development plan established in terms of the Water Services Act, 1997 (Act 108 of 1997); and

(e) to promote community participation in the protection, use, development, conservation, management and control of the water resources in its water management area.

Schedule 3 of the NWA, 1998, gives the powers which may be exercised and duties to be performed by CMAs on assignment or delegation. These are briefly given in Box 8.

Box 8: Powers which may be exercised and duties to be performed by CMAs on assignment or delegation (NWA, Schedule 3)

- Power to manage, monitor, conserve and protect water resources and to implement catchment management strategies
- CMAs may make rules to regulate water
- CMAs may require establishment of management systems
- CMAs may require alteration to waterworks
- CMAs may temporarily control, limit or prohibit use of water during periods of water shortage

In practice this also includes that CMAs can issue licences for water use and control potential pollution sources through enforcement of development of Integrated Water Management Plans, implementation of best management practices, participating with other government departments in evaluating Environmental Management Programmes and Environmental Impact Assessments.

Another challenge will be for the CMA to actively assist DWAF in the protection of the resources as explained in Chapter 3 of the NWA. This entails determining and giving effect to the reserve, and determining and ensuring that the class of the water resource is maintained.

The definition of the reserve is provided in Box 9 and the description of the classification of water resources and resource quality objectives given in Box 10.

Box 9: Reserve means the quantity and quality of water required (NWA, section 1 [xviii])

(a) to satisfy basic human needs by securing basic water supply, as prescribed under the Water Services Act, 1997 (Act 108 of 1997), for people who are now or who will, in the reasonably near future, be:

  (i) relying upon;

  (ii) taking water from; or

  (iii) being supplied from the relevant water resource; and

(b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.

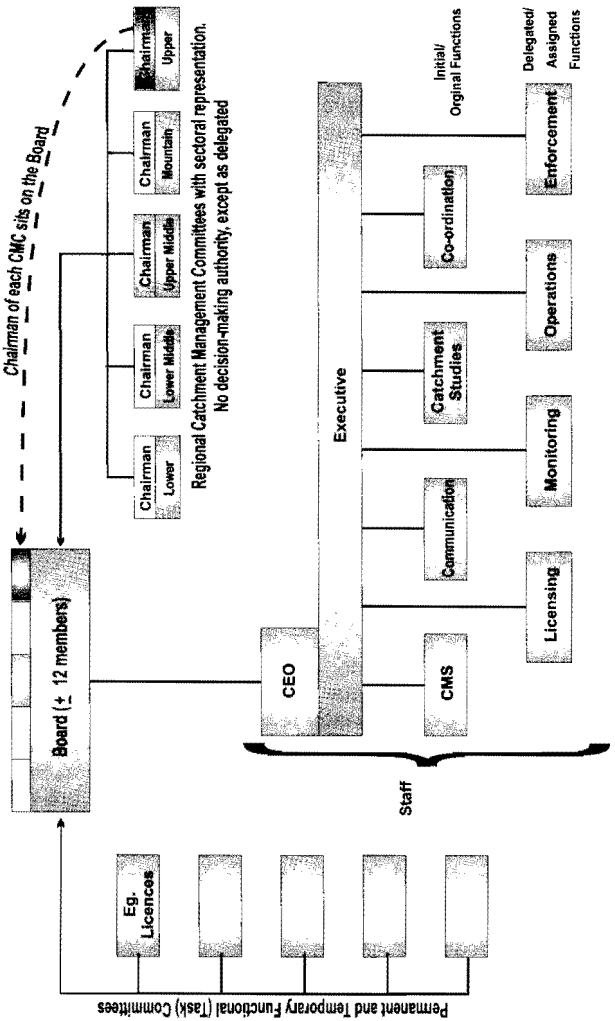
Box 10: Classification of water resources and resource quality objectives (NWA, Chapter 3 part 2)

...the Minister is required to use the classification system established in Part 1 to determine the class and resource quality objectives of all or part of water resources considered to be significant. The purpose of the resource quality objectives is to establish clear goals relating to the quality of the relevant water resources. In determining resource quality objectives a balance must be sought between the need to protect and sustain water resources on the one hand, and the need to develop and use them on the other. Provision is made for preliminary determination of the class and resource quality objectives of water resources before the formal classification system is established. Once the class of a water resource and the resource quality objectives have been determined they are binding on all authorities and institutions when exercising any power or performing any duty under this Act.

4.5 Structure

The structure as proposed for the CMA at this point in time is given in Figure 4.

Figure 4: Proposed structure of the Olifants River CMA



The structure proposed is in line with what is required in the new legislation and guidelines already developed, but has not been tested in practice. The CMA would consist of:

- A Governing Board (GB) consisting of about 12 members. The members of this board have to be appointed by the Minister who will do so with the object of "achieving a balance among the interests of water users, potential water users, local and provincial government and environmental interest groups" (section 81(1) of NWA, 1998).

- Regional Catchment Management Committees. The thinking at this point in time is that there should be five such committees, one in each of the five sub-catchments of the WMA. The different water use sectors of that sub-catchment would mainly be represented there. These committees have to be established by the GB and can then perform any of the board's functions within a particular WMA. It can also be established in an advisory capacity (section 82(5) of NWA, 1998).

- Task Committees. These committees should also be established by the GB to perform specific functions (see previous point). Should the GB decide to delegate a power to such a committee it must consist only of members of the GB or employees of the CMA. A power to authorise the use of water can only be delegated to a committee consisting of three or more members of its GB (sections 82(5) and 86 of NWA, 1998),

- Operational and technical support structure (staff). This part of the structure would constitute the employees of the CMA and would consist of the chief executive officer (CEO), executive and other staff required to do the initial and delegated or assigned functions as appropriate.

4.6 Funding

The NWA, 1998, provides for water use charges to be levied for the funding of the direct and related costs of water resources management, development and use (NWA, Chapter 5). Only the water resource management charge that could be used for the funding of water resource management is considered at this point in time when determining whether it would be feasible to establish the Olifants CMA. The functions that could be funded from this charge are described in "A Pricing Strategy for Raw Water Use Charges" (Government of South Africa, 1999) and can include functions performed by the DWAF and/or management institutions exercising delegated or assigned powers under the NWA.

Until such time as CMAs are established, the water use charge would have to fund water resource management services being provided by DWAF.

Box 11 explains the purpose of the levying of water use charges as explained in the NWA.

Box 11: Financial provisions
(NWA, Introduction to Chapter 3 and Part 1)

Chapter 3: This Chapter deals with the measures to finance the provision of water resource management services as well as financial and economic measures to support the implementation of strategies aimed at water resource protection, conservation of water and the beneficial use of water.

Part 1: In terms of Part 1 the Minister may from time to time, after public consultation, establish a pricing strategy which may differ among geographical areas, categories of water users or individual water users. The achievement of social equity is one of the considerations in setting differential charges. Water use charges are to be used to fund the direct and related costs of water resource management, development and use, and may also be used to achieve an equitable and efficient allocation of water. In addition, they may also be used to ensure compliance with prescribed standards and water management practices according to the user pays and polluter pays principles. Water use charges will be used as a means of encouraging reduction in waste, and provision is made for incentives for effective and efficient water use. Non-payment of water use will attract penalties, including the possible restriction or suspension of water supply from waterworks or of an authorisation to use water.

A CMA must be funded from the levies mentioned above, money appropriated by Parliament and money obtained from any lawful source for the purpose of exercising powers and carrying out its duties in terms of the NWA.

At the time of presenting this paper, the possible sectoral charges for the Olifants CMA have not been determined. The following information is compiled to assist in determining this charge:

- total existing water requirement for each sector and within the five sub-catchments;
- the assurance of supply associated with each sectoral use;
- the envisaged total budget needed to exercise original and delegated or assigned functions.

An example of annual sectoral charges set for a WMA in terms of the raw water pricing strategy is given in Table 1.

Table 1: Example of annual sectoral charges set for a WMA in terms of the raw water pricing strategy

	Sector			
	Municipal water use	Industrial water use	Irrigation water use	Forestry water use
Sectoral charge	0.83 c/m³	0.83 c/m³	0.54 c/m³	0.49 c/m³

Note: *1 South African cent = 0.13 US cents (October 2000)*

5. The way forward

The proposal being prepared will be submitted to the Department and the Minister of DWAF in early 2001. The evaluation process will take about a year, after which the governing board will be appointed by the Minister. A separate parallel process will also have to be followed as the Minister has to be advised by an advisory committee on whom he should appoint to the GB (section 81(3) of the NWA, 1998). This process will be initiated as soon as more clarity is received on what is required.

The Mpumalanga Regional Office will also start the process of drafting the catchment management strategy for the WMA during the second half of 2001.

The intention is to distinguish between the process of drafting the strategy and the content of the strategy itself. A lot of effort will go into a preparation phase during which stakeholders will be re-identified where necessary, roles and responsibilities of stakeholders will be determined, methods will be developed to ensure proper two-way communication between water users and their representatives on relevant structures drafting the strategy. During this stage key performance indicators will also be decided on for the drafting process.

Another key objective would be to chart the drafting process and determine what would be decided by whom and when.

The drafting of the strategy will probably occur within different phases –

- determine a vision for the catchment
- re-visit and re-identify water resource management issues
- determine strengths, weaknesses, opportunities and threats for WRM in the WMA
- determine broad prioritised WRM objectives for the WMA, catchments and sub-catchments regarding

- situation assessment (DWAF, 2001);
- foundation strategies;
- supporting strategies; and
- integration between the above.

determine detail of prioritised objectives in terms of

- action plans;
- responsibilities; and
- time schedules.

The CMS then has to be submitted to the Minister of DWAF for approval after which it can be implemented.

The CMA establishment process moves through different stages of participation of the public in water resource management, starting with fairly informal discussions, progressing into the establishment of the GB and other components of the CMA, through to ultimately having a high level of awareness and participation at all levels in WRM.

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From Bucket to Basin: Poverty, Gender, and Integrated Water Management in South Africa

Barbara Schreiner
Chief Director, Water Use and Conservation,
Department of Water Affairs and Forestry, South Africa
and
Barbara van Koppen
Co-ordinator, Gender, Poverty, and Water Project,
International Water Management Institute, Colombo, Sri Lanka

Abstract

Based on the South African experience of integrated water management under the new dispensation since 1994, this paper proposes a new paradigm for water management. Rather than as an end in itself, water management is seen as a means to eradicate poverty, foster gender equity, preserve the resource base and, thus, achieve social and environmental justice. This paradigm is rooted in the strong linkages between water, poverty, and gender. Satisfying poor women's and men's unmet water needs for domestic and productive uses, while enhancing the productivity of water used by poor men and women, is its primary aim. The far-reaching implications of the new paradigm are traced for mainstream policies and tools in the economic domain (water valuation and pricing), the legal domain (state's custody and legislation), and the governance domain (users' participation within basin boundaries). It is shown that policies proposed in international forums as blanket measures, 'equally' applicable in the North and South, for the poor and non-poor, and for men and women, are bound to aggravate poverty and widen race and gender gaps, especially under growing competition for water. Instead, the analysis of both failures and early positive experiences in South Africa and elsewhere indicate the directions for pro-poor and gender-inclusive economic, legal and governance policies and tools, and the need for strong synergy with efforts to eradicate poverty beyond the government and beyond the water sector.

1. Introduction

A new water management paradigm

Water management is not an end in itself, but a means to eradicate poverty, guarantee basic human rights to all, ensure gender equity, and preserve the natural resource base for future generations. The primary objective of water management is to contribute to the transformation of society towards social and environmental justice.

This statement reflects the policies of the government of South Africa and of an increasing number of governmental and non-governmental water and development institutions today. However, the implications of this policy statement, especially under

growing water scarcity, are hardly recognised as yet: it implies a paradigm shift in water management. This new paradigm is discussed in this paper, based on experiences in South Africa, a water-scarce country in which, in a sense, the North and South co-exist in one nation, and social inequities along race, class and gender lines are strong.

In the new paradigm, poor people's water needs for multiple purposes are the starting point. Conforming to the needs and aspirations of poor women and men themselves, action is taken from local to national and basin level to improve their access to water and their well-being. The interests of people who still have to carry buckets to supply water to their homes or tiny plots for sub-minimal welfare are at the centre stage of integrated water management at basin level. In the new water management paradigm, social divides along race, class and gender lines are key determinants, and more relevant than analysis according to 'sectors', or any other entity that insufficiently highlights poverty and heterogeneity within the entity. Sections two and three give a sketch of the role of water in poverty eradication under growing competition for water.

The later sections of the paper highlight the far-reaching implications of the new paradigm for a wide range of policies and intervention tools that are currently debated both in the international forums and in South Africa to address increasing competition over water. These measures encompass economic tools (water valuation and pricing), legal tools (the state as custodian and legislator) and governance issues (user participation and basin-level management institutions). Many professionals in the international community and donor agencies still assume that there would be best single blanket measures applicable in the North and South alike. Just some mitigating "extra subsidies" or "special consideration" or "postponed phasing in" for the disadvantaged would sufficiently address poverty and gender issues of the South. The analysis in this paper, however, shows the opposite.

The inescapable conclusion, for each of the mainstream economic, legal, and governance policies and intervention tools, is that the proposed measures are often entirely inadequate and may, in fact, aggravate poverty. In order to avoid negative impacts on poor women and men and achieve positive ones, such blanket policies are to be dismissed, thoroughly revised or nuanced. Moreover, if poverty eradication is the ultimate aim, synergy needs to be sought with other governmental and non-governmental endeavours within and outside the water sector, such as agricultural markets, that also aim to eradicate poverty, because water is often only one of the inputs in an income-generating activity like irrigated agriculture. Thus, this paper looks for a consistent and mutually reinforcing blend of multi-objective water management policies and other policies, in which meeting poor women's and men's water-related basic needs for consumption and production have absolute priority.

2. Linkages between water scarcity, poverty, and gender

2.1. Poverty

Water scarcity, poverty, and deprivation

A closer look at the linkages between water and poverty shows that the lack of access to water to meet multi-faceted basic needs is intrinsic to poverty. For poor people water is so scarce that even basic human needs, for which water is needed, such as health and incomes, are not met. Moreover, poor people's costs for water are often exorbitantly high either as drudgery of fetching water, especially for rural poor women, or as high purchase prices from vendors in areas where the subsidised piped systems do not reach. So, if water scarcity, or water deprivation, is defined as the extent to which human needs for water remain unmet, poor people suffer most from water scarcity. Water deprivation is an intrinsic dimension of the general state of deprivation that poverty is.

The primary cause of water scarcity for the poor is their lack of assets to access the available water resources, even when water resources are abundant. If, moreover, all available water resources are developed and committed and "water scarcity", as usually defined by technical people, exists, a second cause of poor people's water deprivation is added: non-poor competitors with stronger bargaining positions and more money to pay for water may directly deprive poor people of the water they already use. Any future access to water to meet their still unmet needs will be forfeited forever. Even under extreme "water scarcity" or competition the better-off still use large quantities of water for secure and comfortable living and incomes. Hence, under competition, poor people tend to suffer double, both from asset-related and competition-related water scarcity.

Multi-faceted needs

The human needs for which water is needed are multi-faceted, and so are poor people's needs that are still unmet. This is most straightforward for health, income, and lack of drudgery. All general definitions of poverty encompass lack of access to near and safe drinking water and sanitation, and its negative health impacts. In South Africa this form of poverty is extensive. Twelve million South Africans still lack adequate facilities for domestic water, especially in the rural areas of former homelands where the majority of South Africa's poor black people are concentrated.

Lack of income is the core component of poverty as it is commonly defined. What is often not acknowledged is that water is vital to increase incomes above one US dollar per day. This is especially the case for rural areas where water is indispensable for agriculture, livestock, forestry, fishery, and small industries. Rural employment is important in South Africa, where the majority of the poor are rural and where the rural population is expected to continue to increase (May 2000). One of the reasons is that people are reportedly returning to the rural areas because of growing off-farm unemployment.

Elsewhere, better access to irrigation infrastructure and water has proven to be a powerful means for income improvement among the poor in semi-arid or arid areas with high rainfall variability, by enhancing yields during a longer period of the year and at lesser risk. But in order to realise the potential of income generation, a range of other factors that hamper poor smallholders from using water productively, must be taken into account as well. Poor farmers in South Africa, the majority of whom are women, lack access to markets, inputs, training, and seasonal credits. Moreover, although irrigation-induced intensification of agriculture can have considerable income impacts on even the smallest plot, it is evident that access to more land helps better to escape poverty. The land distribution in South Africa is the second most skewed in the world, after Brazil. The slow implementation of land redistribution also hampers the adoption of irrigated agriculture and poverty eradication (Cousins 2000). Collaboration with other government departments, NGOs and private institutions beyond the water sector is clearly needed.

Competition

Under growing competition, when all available water resources in a (micro-)basin are developed and committed, water easily becomes even more scarce for poor people. Competition in several of South Africa's basins, such as the Olifants and Inkomati Basins, is growing rapidly. Poorer water users, such as the black emerging farmers in the Nkomati Basin, have limited negotiation power vis-à-vis the white large-scale farmers with whom they compete (Woodhouse and Hassan 1999). Poor people's bargaining position with mines and industries is weak as well. In the congested former homelands, the competition for scarce water resources is between smallholders and other water users, as in the Tongwane micro-basin in Mathabathaland, Northern Province (Van Koppen, Joubert and Grobbelaar forthcoming). Increasing competition not only affects current users, but also inhibits potential new entrants from even considering new investments in water infrastructure. If water management is to contribute to poverty eradication under direct competition for water, new rules and practices are needed in which former use, which is very unequal, ceases to be the main criterion for continuing use in the future.

2.2 Gender

Gender inequities in the domestic water sector

Water deprivation affects poor women more strongly than poor men. Widespread global gender inequities—men dominating the productive and political spheres, relegating low-paid jobs and unpaid domestic chores to women (UNDP 1995)—are reflected in water management policy and intervention[1].

[1]Gender-sensitive water management is neither "natural" expertise nor the sole responsibility of women professionals. Being female does not, in and of itself imply an understanding of or a commitment to gender transformation—indeed there are men who are more committed to this process than some of their female counterparts. The skewed gender composition in the staff of water institutions is another issue, but not further elaborated here. We focus on the interface between gender and poverty.

The invisibility of women's work in domestic water provision is part and parcel of the general invisibility of unpaid domestic labour, across all classes, even though it represents a market value of up to 70 percent of the total global output (UNDP 1995). Or, in daily life:

> *The men do not know how clothes are washed. They just see the clean clothes and that is good enough for them* (Sinah Thibedi, pers. communication 1999)

Poverty critically impinges on women's workload in drinking water supply. Water has never been a "free good" for poor women. Whereas the health aspects of improved drinking water supply and sanitation are well articulated at policy levels, the need to liberate poor women from this drudgery is still underestimated. Related to this, the status of the "female" domestic water supply sector as a whole is still lower than that of the "male" productive water sector.

The burdens of the responsibility to provide the family with water often fall disproportionately on women. This is illustrated in a study in South Africa, in which paying an apparently meagre US$ 1.60 per month for water has resulted in the women having that much less money to spend on food for themselves and their children, while their husbands maintain their drinking and smoking allowances of about US$ 8 per month—allowances which the women dare not ask to be reduced for fear, inter alia, of being beaten.

Emphasising poor women's heavy burden in domestic water supply is not to deny men's contributions to this essential component of family welfare. Across the developing world, several studies report a gender division in domestic water supply, in which men take the responsibility for most of the construction work of village wells, ponds, or tanks and also dominate their management, while women are responsible to ensure daily supply from the water source to the house[2].

Redressing gender inequities in the long-term would imply that water supply for household welfare becomes less drudgery and that both men and women contribute equally and share responsibilities for its provision. At community level, then, women and men would also contribute more equally to the management of water supply schemes. As women and men perform different tasks, they bring different

[2]Gender divisions may also diverge from this rather stereotypical picture, as is the case in slightly better-off households in cultures where women's mobility is restrained. For example, in Morocco's gravity irrigation schemes, men are the main ones responsible for fetching water from larger distances for family use; both girls and boys perform much work in fetching water as well. Another example is in the Punjab in Pakistan where men are responsible for bringing water from far during the annual period of canal closure for maintenance, when the wide range of canal water uses are stopped. Whatever the arrangements, these gender relations are not static or 'nature'-given but negotiated between the genders. In West Burkina Faso, for example, women refuse to marry into villages where the drinking water wells are inadequate. Elsewhere in Burkina Faso, among the Gourounsi, women are supposed to bring water for homesteads for free, but men pay when the women bring water to the fields where they are cultivating.

perspectives. For instance, women in a drought-prone part of Gujarat, India, insisted on a collective tap instead of connections in the homesteads, as the men had proposed. The reasoning was that a collective tap would enable them to keep a much better eye on the quantities that each of them used and, thus, on a fair distribution (Barot, personal communication). In this way, women's better inclusion in planning of drinking water schemes from the start onwards has proven to lead to better schemes (UNDP 1999).

Hence, domestic water supply policy and intervention entail two challenges for "social transformation" (Khumbane, personal communication): lessening or abolishing unpaid work loads, which are now mainly borne by women, and fostering gender equality in the provision of water for family welfare from household level to community and basin level.

Gender inequities in the productive water sector

The challenge of redressing gender inequities in the productive water sector is to improve incomes of both women and men, rather than continuing to ignore women's income needs. Outside the water sector, the need to improve especially poor women's incomes is now widely recognised and justified for the following reasons. Among the poor, the incomes of both men and women are required to meet basic family needs. If in male-headed households women and men are responsible for different household needs, both types of needs must be met. Women's incomes, however, benefit the family relatively more than men's because, reportedly, women spend a higher proportion of their incomes on family expenditures than men do (Agarwal 1994). In female-headed households, women's incomes are usually the major source of income. A last reason for making poor women's independent economic security a priority, is that women's own economic security is the crucial factor at the micro-level that explains a reduction in fertility rates at the macro-level (Safiliou 1986).

In the case of irrigation, the focus of this paper, women's needs as producers were systematically ignored. The allocation of newly developed irrigated land and water, accompanying agricultural inputs, training and marketing services has almost exclusively been to men, as criticised over a long period (Hanger and Morris 1973). Irrigation interventionists even seriously eroded women's existing land rights, productive capacities, and incomes by communicating and negotiating only with men, especially the male village elite (Dey 1980; Carney 1988; Van Koppen 1990, 1998). Men also continue to be the privileged members of Water Users' Associations and particularly dominate in decision-making committees (Chancellor 1996). Even if women are committee members, this does not necessarily guarantee that they have any say. Male committee members reportedly gave women's names as committee members, without the women themselves even knowing[3], to please an external agency, politician, or donor to get more money.

[3]Reported in Water Users Associations in Nepal (Van Etten et al. 1999) and Andhra Pradesh, India (1999).

Irrigation planners still rarely consider women as being independent farm decision-makers who manage the production process, and control the output, and who, therefore, are the ones primarily interested in improving the productivity of their enterprise through irrigation. This is based on the stereotypical assumption that a whole family is engaged in farming, with the male household head as the manager and representative. In reality, however, farm households often diversify incomes and encompass several production sub-units within a household, with specialisation along gender and age lines. Male- and female-managed cropping units co-exist, especially in many ethnic communities in Sub-Saharan Africa. In areas with remunerative off-farm employment opportunities for men, farming often becomes the full-time activity of women. Then, farming does not provide one family income, but the income for one of its specialising adults (Safiliou 1988).

The assumption that only landowners are farmers also contributes to women's invisibility as farmers. In the irrigation sector, this is reflected in the tendency to vest water rights in the one with the strongest land titles rather than in the farm decision-maker and factual irrigator. This excludes all women farmers who cultivate land of their husband's family and have life-long tenure security to that land, but without owning it. In this respect, the South African National Water Act is unique in providing scope to vest water rights and membership in the factual water user, irrespective of his or her type of land rights.

A study in South Africa that debunks the myth that women are just helping their husbands, rather than being farm decision-makers in their own right, was done in the Tongwane catchment in Northern Province. It was found that, out of 176 households with plots in state-supported and self-initiated irrigation schemes in this basin, women are the farm decision-makers on 62 percent of the irrigated plots, and in another 14 percent they decide jointly with their husbands. The proportion of women managers is highest in the government schemes, where women decide alone or jointly with their husbands in 88 percent of the households. The lower proportion of women in the informal schemes is due to the fact that these schemes were recently started under the leadership of some men who lost their jobs in a nearby mine. The study also found that among women decision-makers, land was registered in their husbands' names in 36 percent of the cases. Among male farm decision-makers, 10 percent cultivated land registered in the names of their female kin. Overall, if in these schemes formal membership criteria were to be based upon land titles, 28 percent of the farm managers would be excluded (Van Koppen, Joubert, and Grobbelaar forthcoming). Similar results are found in other studies in Southern and Eastern African countries (Makhura and Ngqaleni 1996; FAO 1998; Safiliou 1985, 1994). These findings corroborate the need to develop irrigation and other support systems not only for men but also directly for women farmers.

In cases in which both men and women farm on their own account, gender-sensitive measures, such as fostering full representation in meetings and committees, reportedly led to women's positive responses, men's general acceptance, and thus broader farmers' support for scheme affairs. The impact of the policy change by the Provincial Irrigation Unit in the Nyanza Province, Kenya, is a well-documented example (Hulsebosch and Ombarra 1995). Traditional chiefs and agricultural extension workers in Northern Province, South Africa also favour women farmers'

stronger land rights. Giving women their own land rights would better motivate them to increase productivity, as it would protect them against men's appropriation of the fruits of their labour (Van Koppen 1999).

Women's independent position as members and their representative inclusion in committees will also be crucial for the formal establishment of small-holder Water Users' Associations and women's participation in higher-level water management bodies like the Catchment Management Agencies in South Africa.

Conclusion

In sum, a pro-poor and gender-sensitive (or people-sensitive) integrated water sector gives absolute priority to meeting poor women's and men's water needs for domestic and productive uses. Further, it transcends the current boundaries between "male" and "female" domains by attaching equal importance to domestic and productive water uses, and by overcoming the artificial institutional separation and split in mindsets between water management for "men as producers" versus "women as housewives."

As for any other policy, the policy of managing water to eradicate water deprivation among men and women requires clear definition and quantification. Goal-setting would specify the numbers of poor men and women affected and the dimensions of well-being, such as incidence of water-related disease, hours spent on drudgery or absolute and relative amounts of money spent on water, and water-related incomes gained through, for example, irrigated agriculture. Unambiguous quantified goals also allow monitoring and evaluation of progress and the assessment and comparison of the impact of different public and private measures.

Eradicating water deprivation is the challenge for the water sector. The reality that competition for water is growing cannot become another fate against the poor. On the contrary, it brings the urgency to address poor people's water needs first even more strongly to the forefront. It implies that economic, legal and governance tools that are currently proposed in mainstream international forums need to be dismissed or fundamentally revised, as argued in the remaining sections.

3. Water allocation to poor women and men: economic tools

3.1 Valuing water as an economic good

Water as an economic good

The recognition that water is an increasingly scarce good has contributed to a widespread agreement that water should be treated as an economic good. Economic analysis is more and more seen as a "rational" and "objective" tool to orient water allocation under growing scarcity. However, this statement that "water is an economic good" has "the virtue of being sufficiently vague to allow agreement, while leaving the implied operational content—over which there may be strong disagreement—unstated" (Perry et al. 1997). Three aspects of the common interpretation of this

statement are especially contentious in the light of the new water management paradigm that aims to combat poverty. First, "value" is often interpreted in a very narrow sense and based on an assumption that all people are sufficiently able to pay for water. Second, only goods that are exchanged on the monetary market and the single main use of water tend to be considered. And third, the crucial question "benefits for whom" and the distribution of wealth within society are ignored. The implications for pricing policies will be discussed in section 3.2.

Which value reigns?

In the discussion on "water as an economic good", Perry et al. (1997) argue that the issue is not whether water is an economic good, as it is, but what kind of economic good water is, a private or public and social good, and hence which values govern analysis and decision-making. Proponents of water as a private good define its value as the maximum amount that the user would be willing to pay for the use of the resource. The distribution of water should be determined by the overriding value (and not more than a value) of the consumer's sovereignty on a free market. However, their opponents find this a misleading analysis: it does not take into account that willingness to pay depends largely on ability to pay and it ignores the unequal distribution of incomes (Perry et al. 1997). Thus, valuing consumer sovereignty is incompatible with another widely endorsed value of a society, in which all people's basic needs are met, including the basic consumptive and productive needs in which water plays a role.

Valuing consumer sovereignty as primary allocation principle may make sense in Northern countries, where the ability to pay is generally sufficient to meet basic needs, but not in the South where poverty and the lack of assets to access water are still rampant. If poverty eradication is the primary goal, all water used to that end has by definition an infinite value. In fact, both the public-good and private-good adherents tend to agree on the importance of the value of poverty eradication for society. Whether private markets or public interventions, or a mix, are most effective in bringing about such a society is the question to explore.

Only single-purpose market values?

In many valuation studies, the costs, values and benefits of water tend to be narrowed down to the (opportunity) costs and gains of the main product that is exchanged on (male-dominated) monetary markets, such as irrigated crops or mining products. However, a more encompassing concept of costs, values and benefits would also include the huge benefits that are not exchanged on a market, and are often difficult to express in monetary terms. The most obvious of such impacts are the "soft-sector" health impacts of safe drinking water or unpolluted water for agricultural use. Another example is the cost of labour that is not exchanged on a market but within a household, as (female-dominated) fetching of household water is.

Further, the focus of water valuation tends to be only on the main purpose of a water source. However, one water source is often used for multiple purposes, so all uses of the water source should be counted, giving equal importance to the

"male" affair of productive water use and the "female" affair of domestic water use. The value of irrigation water, for example, becomes considerably higher if the use for livestock, fishing, homestead gardening, domestic purposes of that same water are included as well (Bakker et al 1999).

Valuing the multiple purposes of water both within and outside monetary markets has many practical applications. One application would be that new Water Users' Associations, which are world-wide still largely single-purpose Farmers' Associations focussing on irrigation, would open up to the many simple and no-cost or low-cost opportunities to broaden the ultimate benefits of investments in irrigation infrastructure for men and women. Also, many poor people, especially women, could get a much better deal if the development of mines, for example, as in parts of South Africa, is accompanied by additional benefits. Here the potential exists to issue licences to mines by negotiating strong added value for local poor people in a "quid pro quo" arrangement—the provision of water services from the new pipelines to the surrounding communities, the mine's commitment to purchase agricultural products from small-holders, micro-credit provision, training, etc.

Values and benefits for whom?

Perhaps the most serious flaw in mainstream water valuation is the tendency to focus on the value of water as such, as an abstract contribution to Gross National Product, without even considering the distribution of the created wealth within society. Distributive aspects are a critical part of any valuation study and absolutely crucial if water managers intend to redress social inequities and aim to alleviate poverty. In employment creation, for example, the crucial issue is for whom employment is created. The same volume of water, if allocated to a mine, may give employment for a handful of highly qualified staff (some may be expatriates) and a limited number of male workers. However, if used in a smallholder scheme with a majority of women farmers, it may contribute to the alleviation of income poverty among a much larger group of beneficiaries, even if it created only half of the overall monetary value. So any overall value per unit of water remains rather meaningless without the analysis of distribution along race, class and gender lines, or "jobs per drop for poor women and men." This over-arching social divide is valid across all water sectors and uses.

3.2 Water Pricing

Capital and operational costs of infrastructure

While water valuation is still a rather theoretical endeavour, the statement that "water should be treated as an economic good" already tangibly reinforced the privatisation waves in which governmental and non-governmental agencies stop subsidising capital and operational costs of water infrastructure, often under the euphemistic heading of "participatory water management." Higher payment by users is further assumed (rather than proven) to be an effective way to promote water savings. The South African government faces this issue as well. The Department of Water Affairs and Forestry (DWAF) discusses the introduction of one overall strategy for full cost recovery from all water users for water development and use and also, which is quite unique, for water resources management. The latter is currently carried

out by DWAF but in the long run intended to be delegated to Catchment Management Agencies (CMAs).

It is true that the huge subsidies in the past mainly benefited the large, non-poor water users. If water charges are proportional to volumetric water use, the larger consumers would pay considerably more than poor people who tend to be small water users. So better cost-recovery would lead better-off consumers to pay directly for services that were formerly financed from their taxes. Such pricing policies would free up considerable funds for the government. But whether governments would use these newly available funds for poverty eradication is another question.

It is also true that some private initiatives and public-private partnerships can better reach the poor than governmental and even NGO interventions. In fact, it is inherent to poverty that public interventions tend to fail in reaching this group. Small water-vendors are major suppliers of domestic water to the urban poor. Poor people in rural areas typically arrange their drinking water from wells or water management devices on their own. Competitive groundwater irrigation markets in India and Bangladesh provide good water service at competitive prices to even the poorest farmers. Much can be learned from such initiatives, about quality service provision and poor people's willingness to pay for good service. But it may be that other types or levels of subsidy, such as subsidies for bulk water supply or for rural electricity supply, have influenced these private initiatives, and are still needed in current or future infrastructure uses by poor people.

Generally speaking, pricing policies for cost-recovery of infrastructure development and operation applied as a blanket measure runs the serious risk of aggravating water deprivation and poverty. Sudden payment of high operational costs may cause some poor people to give up current water use. The creation of future new demands by poor people through subsidised new infrastructure development would be forfeited as well. Pushing poor people out of the water-business would be an ironic form of water conservation and demand management. Therefore, the South African government is embarking on a differentiated pricing strategy.

Domestic water use

When the democratic government of South Africa was elected in 1994 it immediately recognised access to drinking water as a basic right and identified the lack of subsidised infrastructure development as the main reason for the fact that more than 12 million South Africans were still deprived of near and safe drinking water supply. The government adopted a Water Services Act in 1997 and the National Water Act in 1998. The former provides the framework for the provision of water services to all, while the latter guarantees, through the provision of a reserve, that sufficient water to provide a minimum of 25 litres per person per day is set aside before water is allocated for other purposes. The costs for the first-tier infrastructure to provide for these 25 litres are subsidised by the government or cross-subsidised by well-off water users. For larger quantities, sliding tariffs are adopted. The option of individual vouchers, as sometimes recommended in global debates, is discarded as of little use for poor women, who have no supply system near their houses, nor

the contacts and organisational power to make the suppliers come. Massive implementation of new infrastructure development and stepped tariffs is underway.

The need to provide minimum levels of water supply for free was illustrated in a village in South Africa that was recently supplied with potable water but still for a fee. The Minister of Water Affairs and Forestry found a woman with a baby tied on her back, digging for water near the bank of a river. When asked why she was not using the water from the communal standpipe, her reply was that she could not afford the R10 required by the water committee to pay for the water. This example also highlights that South African women would bear the larger burdens of pricing of costs for the drinking water services for their families.

An important challenge is to develop sustainable forms of cross-subsidisation. The Durban Metropolitan Council is pioneering this approach. The town is sub-divided into four neighbourhoods, encompassing both poor and non-poor water users. Everybody, whether rich or poor, receives the first 25 litres per person free of charge. This cost is paid for by cross-subsidisation from higher levels of water use and the sliding tariff scale. This approach, coupled with other customer service improvements has also raised levels of payment for water, enabling the local authority to provide and maintain better levels of service.

Productive water use in agriculture

Withdrawal of state support and imposing even partial cost-recovery in irrigated agriculture, whether farmers are poor or not, has proven to be very negative for poor small-holders in South Africa. While impacts for better-off farmers were minimal if not positive, this policy aggravated poverty.

The introduction of cost-recovery has been quite smooth for the white, large-scale farmers, who occupy 95 percent of the irrigated land. In the past, these large-scale white farmers benefited from substantive state subsidies for capital investments and agricultural services. Farmers also had a strong voice in the design and operation of the scheme. While for a long time scheme operation and maintenance was subsidised, this started to be phased out in the mid-1990s. This was a well-prepared and transparent five-year process, in which farmers accepted the increases in their input costs. Further, in South Africa it is feasible to leave new capital investments to large-scale farmers because the private equipment that is now available on the shelves, such as pumps or high-tech sprinkler and drip irrigation systems, fits the needs of large-scale farming. Moreover, banks continue to provide agricultural loans to large farmers as they did in the past.

In contrast, black small-holders, who occupy the other five percent of irrigated land, suffered seriously from the general agricultural liberalisation policies of the 1990s, which included only partial cost-recovery for irrigation. If on top of this full cost-recovery at a par with the large-scale farmers is imposed, the effects are bound to be even worse.

Most small-holder irrigation schemes in the former homelands, and many other African countries as well, were designed and constructed for centralised state-

management and uniform cropping patterns, typically maize and wheat. The state used to deliver highly subsidised services for ploughing, credit and input provision, irrigation, and marketing. Farmers, although bearing the risks, were often no more than labourers on their own one- to two-hectare plots. The withdrawal of most subsidies and services such as electricity payment, ploughing, inputs, and credit services, and mediation in marketing for the state-managed smallholder schemes in the late 1990s came very abruptly, without guidance and training for gradual take-over. The question was also not addressed as to whether farmers' management of these schemes designed for highly subsidised, centralised state management is feasible at all. The impact of this partial abandonment of schemes has been extremely negative. Farmers' own market linkages are still weak, the costs for water in these inefficient schemes are relatively high, and inputs and credits are still lacking, so net profits from irrigated farming dramatically declined. Many poor farmers gave up irrigated farming and returned to rainfed agriculture. Schemes are increasingly in a dilapidated state. This effect is not only reported for South Africa's small-holder schemes in the former homelands, but is also observed in other irrigation schemes in sub-Saharan Africa (Shah et al. 2000).

Under these conditions, further withdrawal of the limited remaining subsidies for water bailiffs and for maintenance costs, let alone imposing charges for water resources management for national and basin-level management, will further diminish net gains or push more poor people out of the business of irrigated agriculture. As long as the "value per drop" is sub-optimal because input provision and marketing channels are lacking, concerted efforts with other agencies are needed to enhance the profitability of smallholder irrigated farming (Shah et al 2000). This should be a precondition for any further implementation of recovery of even operational costs.

Besides the state-managed smallholder schemes, the South African government and civic society also financed and constructed an unknown number of smaller community gardens, and continue to do so. These smaller schemes, designed for self-management, are generally easier to operate and manage by farmers themselves, although they remain dependent on external support for major rehabilitation or replacement of infrastructure. But in these schemes as well, lack of markets is the most general complaint. Although the output per unit of land or per unit of water on, for example, intensively cultivated micro-plots of poor women is considerably higher than on large-scale cereal farms, the real profits that can be realised are still relatively low as a result of lack of access to markets. So for these schemes as well, stopping external support for major rehabilitation and replacement would mean the collapse of the scheme as long as the net profits are not sufficiently high for farmers to provide for such costs. Bringing poor farmers in upward ratchets of profitable farming is equally important for them.

In answer to these realities, the Department of Water Affairs and Forestry is now actively collaborating with other government and non-government agencies to address this key issue of the profitability of small-holder irrigated farming, and the issue of rural loan facilities. Moreover, subsidies for new scheme construction and for the upgrading of formerly state-supported schemes are made available, although the information about these subsidies is still not known widely enough. In the future, water charges may be minimised by introducing sliding tariff scales in irrigated

agriculture as well. In the absence of measuring devices for volumetric charging, the same purpose can be served by levying lower or no water charges for users of small-scale technologies, for example treadle pumps, and users of small plots of, say, less than five hectares.

Last but not least, pricing policies that leave all responsibility for future capital investment to the user would certainly further widen the existing gaps in adoption and ownership of equipment. As for domestic water supply, the lack of subsidised infrastructure development targeted at the poor in the past has caused highly skewed access to irrigation assets now. Moreover, technologies appropriate for smallholders are simply not available on the shelves. Therefore, DWAF and other agencies started to promote irrigation technologies that are appropriate and affordable for smallholders, such as treadle pumps and bucket drip irrigation systems, or water harvesting techniques. More attention is also paid to the credit facilities that are indispensable for financing these technologies. Although private markets are expected to be crucial for the manufacturing and dissemination of these technologies, external support to catalyse these developments is needed.

Conclusion

The most tangible but analytically flawed implication of the statement that "water is an economic good," pricing of the capital and operational costs of infrastructure, has been implemented as a blanket policy and proven to have considerable cost to society in that water deprivation is aggravated and inequities are amplified. The challenge is to ensure that at least part of the funds that the government gains by charging the non-poor and large water consumers, and introducing sliding tariffs and cross-subsidisation are used to combat water deprivation and redress inequities. This can be achieved, for example, by ensuring better access to new infrastructure by poor people and promoting the design, testing and dissemination of appropriate low-cost technologies and water service provision, and financing facilities. Last but not least, for the case of irrigation, more value per drop for the poor is to be recognised as the precondition for any recovery of a small, reasonable part of considerable profits. Co-ordination and synergy between government agencies and between the government, the private sector and NGOs are indispensable.

Pricing as a tool for water conservation and demand management is not about poor people having to give up the use of water, but saving water where it can be saved without major implications for the beneficial use. Demand measures are to address the larger farmers and the larger consumers—the "big fish" in terms of water use, wasting and polluting.

4. Water allocation to poor women and men: legal tools

Formal water law in South Africa

Whereas economic tools steer water allocation indirectly, legal tools do so in a direct way. Under growing competition for scarce water, legal tools for water allocation in the new water management paradigm ensure that poor people's current water use

is protected and that poor new entrants can still access water as new entrants and satisfy their unmet basic water needs. Pro-poor water legislation not only implies that there should be a formal legal framework in which poor people's water needs have priority, but also that the law is implemented and enforced. The state, as custodian of the nation's water resources and legislator, has an important role to play, but collaboration and integration across governmental and non-governmental agencies and local social, political, and legal arrangements are vital as well.

In South Africa, the Water Services Act (1997) and the National Water Act (1998) provide various legal tools that are potentially effective, and possibly the most progressive in the world, to eradicate water deprivation under growing water scarcity. These tools are the following. As already mentioned, the Reserve sets aside a minimum amount of water, currently set at 25 litres per capita per day, for basic human needs. The Reserve also includes an ecological element. After allocating the Reserve and water required to meet international obligations, the government authorises water use in four ways. Firstly, all users are, in any case and without registration or payment, authorised to take water for, among other things, "reasonable domestic use, watering gardens and stock watering," but not for commercial purposes, as stipulated in Schedule 1 of the Act. This component of the Act benefits all, including poor people.

Secondly, the legislation authorises the continuation of "existing lawful use" (and thus the inequities in that use). New water uses are authorised by the government through, thirdly, general authorisations or, fourthly, licences. General authorisations concern relatively small uses in situations without current or expected water stress. They apply to a certain area, a particular water resource, a particular category of users, etc. As indicated in the General Authorisation of October 1999, farmers in areas without water stress are authorised to irrigate up to 25 hectares, at 6000 cubic meters per hectare per annum. This situation is applicable to a wide range of formerly disadvantaged farmers. The general authorisation of October 1999 also indicates the water-stressed areas for which the general authorisation does not apply. Evidently, allocation is most critical in these water-stressed areas.

For all new water uses beyond general authorisations, licences are needed. Licences may be issued for a maximum of 40 years. The terms and conditions of a licence are regularly reviewed. Should an amendment of a licence condition severely prejudice the economic viability of an undertaking, the licensee may claim compensation. Licences may be surrendered in order to facilitate the application for a licence for that water allocation by another user and, thus, represent a monetary value. While the issuing of a licence authorises the person or institution to use water, it does not guarantee availability of water.

In the future, the government will call for compulsory licensing of water users in water-stressed areas where there are, for example, problems experienced or expected from over-utilisation and competing water uses. Such calls for compulsory licensing by the Minister will apply to all water users, including those authorised under the continuation of "existing lawful use" component of the Act and those operating under a general authorisation. On the basis of all applications for licences, the responsible authority proposes an allocation schedule. In this, among others,

the authority has to consider how to "allocate to each of the applicants to whom licences ought to be issued in order to redress the results of past racial and gender discrimination in accordance with the constitutional mandate for water reform" (National Water Act, Part 8, Section 45). After further rounds of public comments, a final allocation schedule is compiled. Such compulsory licensing and reallocation, then, is the legal tool par excellence that can be used to allocate (but not guarantee) water to the poor that was claimed by the non-poor before.

DWAF has started a massive campaign to register current water uses that either will have to be licensed or that are generally authorised but still substantial and/ or for which the payment of fees is required. An example of the latter is irrigation use above 50 cubic meters surface water or 10 cubic meters ground water per day. DWAF has invited such water users, including farmers, industry, local authorities, a Water Board or any other recognised Water Services Provider or Water Users' Association, to fill a registration form on their current water use (Department of Water Affairs and Forestry, 12 November 1999).

In the registration, the estimation of quantities of water used lies with the user but can be checked by the water authority. For the moment, the state has limited measuring capacity to prove deviations from the uses as estimated by the user. In the case of agriculture, this use is considered to be a function of the local crop water requirements as calculated in the SAPWAT model, and efficiencies and land size; return flows are not taken into account.

Registration will provide crucial information for future water management. It may reveal whether water that is claimed according to decades-old documents such as permits for mines, or water allocations for irrigation schemes, or even basin-transfers is, in reality, used or not.

Implementation in inequitable society

When the National Water Act was formulated and adopted in the mid-1990s, it critically challenged prevailing inequities in water use by introducing a powerful legal tool with a potential for change. The next hurdle is the implementation of the law, challenging the continuation of these inequities in reality. As "existing lawful use" has been authorised under the new law, the old racist and discriminatory practices that the Act precisely aims to overcome are still legal practice. Examples of the continuation of former discrimination, like using the argument that "water has already been allocated" are reported as the simple and effective negation by the powerful of black claimants of water (Woodhouse and Hassan 1999). The new options under the National Water Act are still largely unknown. Emerging farmers who want to "legalise" their current or intended water use do not know where to go. Persistent accusations of "illegal use" may render black people even hesitant to register current use.

The current campaign for registration of water use would be a first step towards recognising poor people's current water use (and charging fees). However, registration is easy for the organised users who were already registered in the past, like the former Irrigation Boards, industries and mines. But as yet, none of the smallholder schemes has been organised into an association that fulfils the criteria

to be registered as Water Users' Association. Many small schemes, like food gardens supported by a wide range of NGOs, churches, etc., or spontaneous initiatives to start irrigation, function almost unnoticed. If the poor already drop out at the first step to legalise water use, even the limited quantities of water that they use today, risk being allocated to others. Therefore, in provinces like Mpumalanga and the Northern Province, DWAF undertakes specific efforts to compile exhaustive lists of the formerly state- or NGO-supported schemes.

While poor people's basic drinking water rights are well protected in the Reserve, priority allocation of water for agricultural and other productive use by marginal and small farmers has not been stipulated in concrete and operational rules that can be implemented as yet. Such specification needs to go beyond household level, in order to ensure that both men's and women's entitlements to water are considered. The latter will be most relevant, for example, when membership of the future Water Users' Associations is established.

One possible way to translate the basic principle of redressing inequities into concrete pro-poor legislation is to adapt general authorisations and to authorise categorically the use of relatively small quantities of irrigation water by farmers who have limited access to land. For example, Schedule 1 water use is authorised by law without any registration nation-wide. Schedule 1 refers to reasonable personal use and also includes water use for home garden watering, but it explicitly mentions "not for commercial purposes." Even though gardens of the rich may exceed the sizes of vegetable plots in community gardens, the specification "not for commercial purposes" excludes poor and emerging smallholders who are definitely market-oriented and price-oriented, and certainly want to become so if markets were better. That specification could be cancelled.

A similar but more site-specific option would be to extend the existing General Authorisation for irrigation up to 25 hectares in areas without water stress, to those parts of water-stressed basins where water competition is still absent or low. As local variation is huge, many such sites could be identified. This would empower poor farmers especially for future competition. If competition over water is already strong, General Authorisations for specific sites may be most effective and enforceable where competing poor and better-off farmers are grouped together in separate upstream and downstream sites. However, if water competition is between neighbours at the micro-level, larger holders may find ways to become eligible as well, for example, by splitting up their holding administratively and claiming water as many small users. Moreover, poor people's new rights are probably difficult to enforce.

Whatever the most effective legal tool would be to endow the poor with water rights in a general way, this is only one side of the coin. Under competition for water, authorising some is only effective if others are "de-authorised." Voluntary water demand management measures among the better-off are important non-legal tools currently being designed by DWAF. However, in the end, the legal tool of compulsory licensing would be needed as it is binding. Under compulsory licensing, smallholders could get licences for optimal water use while allocations for the non-poor could be reduced.

Measurement and enforcement of water use according to the licences would be a prerequisite. However, the risk exists that the complex procedures for compulsory licensing could be recaptured by the literate, well-informed and organised water users. Therefore, simultaneous efforts are needed to devise enforcement mechanisms. A crucial component of enforcement is the empowerment of poor people themselves: informing them of their rights, building their negotiation capacity, and ensuring their effective inclusion in forums for negotiation over the formal allocation schedule and its later implementation. For the implementing water authority this requires not only a thorough understanding of and building upon current local realities and legal arrangements, but also strong facilitation skills and commitments to the ultimate purpose of the Act. Support from NGOs will be indispensable as well.

Legal and non-legal measures to take water away from current users will critically depend upon the amounts of water at stake. If larger farmers have to cede only some 10 percent of their former use, the job is obviously much easier; compensation procedures, as the National Water Act foresees if the profitability of an enterprise is seriously affected, can be avoided. Reportedly, a number of large farmers in South Africa may well see saving 10 percent of water use as a reasonable measure, if it were needed. A better understanding of the quantities at stake, and national and local sensitisation campaigns for voluntary water use restrictions by large users, are to accompany pro-poor legislation.

Another important direction in which pro-poor legislation will be further specified is through the National Water Resources Strategy and especially the Catchment Management Strategies, which provide a legally binding framework for water management. Catchment Management Strategies, which ultimately will be developed for each of South Africa's 19 Water Management Areas are specific and adapted to the widely varying local conditions and scarcity situation, and should specify water use and needs by poor women and men. They are formulated in close collaboration with water users in the basin through Catchment Management Agencies.

Conclusion

To conclude, if the aim of water management is to eradicate water deprivation, legal tools for priority water allocation to poor people are indispensable. The National Water Act of 1998 provides such tools in its over-arching principle that inequities from the past need to be redressed. However, this has to be translated into more concrete rules for non-domestic water uses as well, and, if there is competition, accompanied by concrete legal tools to take water smoothly away from current large users.

The main challenge for South Africa is the implementation of the new set of pro-poor legal tools and policies. At this stage, inequities could further widen due to the appropriation of the implementation process by the better-off, literate and powerful water users, who find their way to the government anyhow. So implementation of the law needs to be accompanied by massive information, organisation, and empowerment of the masses of poor, illiterate water users, still excluded from communication channels with the government even for simple registration, and hardly aware of their formal rights. Co-operation between the entire government,

DWAF, Catchment Management Agencies, NGOs, poor communities and other water users is clearly needed. Structurally new forms of water governance are warranted.

5. Water allocation to poor women and men: governance

Catchment Management Agencies in South Africa

Today, new forms of governance of water are high on the policy agenda. Key ingredients such as more users' participation, self-financing of water management and better consideration of the hydrological boundaries of basins in management, are all supposed to improve governance of water, besides reducing state expenditures. Such new governance rarely aims at poverty eradication. As the first experiences with public participation and river basin management in South Africa show, the initiative and authority of the government remain pivotal to include poor people structurally in new governance forms and facilitate the implementation of pro-poor economic and legal tools.

South Africa is a pioneer in creating new governance structures for water management by establishing Catchment Management Agencies (CMAs) for gradual delegation of water resource management from the Department of Water Affairs and Forestry to these new agencies. CMAs will function directly under the Minister and will be steered by a Governing Board and Committees that represent public interests. CMAs will be supported by a chief executive officer and technical staff. Initial tasks of the CMA include the development of the above-mentioned Catchment Management Strategy and advisory, monitoring and co-ordinating tasks. Collection of water charges is one of the early tasks to be taken over from DWAF. Once CMAs have proven to be mature and self-financing, responsibilities such as water allocation and licensing will also be handed over. The first two pilot projects to establish CMAs are in the water-stressed and polluted Nkomati and Olifants basins.

Already, since 1994, the South African government has actively promoted users' participation, for example during the formulation of the National Water Act. Regional offices of the DWAF also increasingly involved users. In the Nkomati and Olifants basin, for example, DWAF actively collaborated in public initiatives on issues like pollution by mines and water scarcity for downstream environmental needs. At that time and for those issues, the main actors were white, middle-class industrialists, environmentalists and consultants. In both basins, the establishment of the CMA and formulation of the formal proposal built upon these already ongoing public initiatives. The major challenge was to bring the hitherto excluded black communities on board, both in the composition of the relevant forums and the contents of the proposal.

In the Olifants basin, which covers 50,000 km^2 and has 3.4 million inhabitants, a two-pronged strategy was followed to consult the public and create inclusive forums for the formulation of the proposal. One process focussed on the final output of a written proposal for the CMA and was implemented by a predominantly white consultancy firm; this had to be finalised within a tight time frame of one year and

a half. The second process specifically targeted poor smallholders and was basically implemented by two black consultants. The two very different meanings of "public consultation" that emerged are illustrative for the governance issues at stake in the new water management paradigm.

Negotiating formal stakeholders' agreement

In the first, general process that took place from mid-1999 till end-2000, two rounds of five public meetings were held covering all five proposed sub-catchments throughout the basin. In each of the rounds, about 700 people participated. These meetings were basically one-way information sessions on the general aims and structure of a CMA and proposed sub-catchments. The main language was English, with limited translation into the languages that the majority of participants mastered. Participants' main input was voting on the name of the CMA.

Parallel to these public meetings, a Stakeholder Reference Group was created. Initially, this group was mainly composed of the white, mainly male participants in the earlier public consultation on pollution and environmental water needs. From the first round of public meetings volunteers were invited to participate in the Stakeholder Reference Group as well. This rendered the composition of the Stakeholder Reference Group more race-balanced (but still very male-dominated). In this Stakeholder Reference Group, the discussions on the CMA proposal were slightly more detailed, but still based on the ideas of the consultants, who also wrote all parts. From the consultants' perspective, the process of public participation seemed mainly a matter of negotiating the formally required agreement and endorsement for the proposal by "the" stakeholders. The Stakeholder Reference Group was increasingly shaped and seen as "the stakeholders." The draft proposal of August 2000 admits that during the establishment of this CMA, no attention was paid to gender and poverty issues.

Bottom-up empowerment for improved irrigated agriculture

The second process, which was targeted at poor small-holders, started on the initiative of DWAF half-way through the first process, when it became clear that the public consultations were not sufficiently addressing the problems of previously disadvantaged emerging farmers. The aim was to explore the establishment of a Smallholder Forum in the Olifants basin as a channel to speak out in the CMA (Khumbane et al. 2000). Three hundred and sixty five black people participated in nine workshops. They came from NGOs, women's organisations, farmers' initiatives, including those engaged in land reform, local government and tribal authorities. The discussion, in the local languages, focussed on people's own assessments of key problems in water management for agriculture and livelihoods. It highlighted problems such as the need for land and land reform, markets, training, and better organisation in order to make productive use of water. Cases of competition over water that still reflected the old water laws were brought up as well. The participants designed structures for a Smallholder Forum that is now proposed to become part of the new CMA and will have representation in the CMA Governing Board. In the future, this forum may also serve the wider purpose of better organising emerging farmers

for profitable agriculture, for example by forging better links between traders and producers. In this second process public participation was clearly interpreted as poor farmers' empowerment and structural integration in the CMA forums.

Conclusion

These very first experiences with new forms of basin-based governance in South Africa highlight significant differences in "public participation" and its effectiveness to address water-related poverty issues. Information is an important first step, for which DWAF is now developing multi-media information strategies to reach people effectively nation-wide. But information alone is not enough if poor people's voices in actual water management are to be heard. DWAF keeps the responsibility that the new governance structures encompass forums of poor water users that are based on felt priority problems regarding water and land use and on self-organisation for change. Their concerns should be reflected and integrated in the CMA proposal and later policy documents such as the Catchment Management Strategies. As long as such forums do not exist, which tends to be typically the case for poor people, governments have a role in creating them. Such forums need integrated support not only from the water sector but also from other government agencies and NGOs.

6. Conclusions

There is ample evidence that mainstream economic, legal and governance tools to manage water aggravate poverty by further reducing poor people's beneficial use of water, especially in water scarce areas. Imposing equal treatment for all in unequal society aggravates poverty. Inequities can only be redressed if the new paradigm of water management is adopted that starts with recognising that water is most scarce for poor men and especially poor women. As a corollary, the primary aim is to develop water for both domestic and productive uses as the potentially powerful lever for poverty eradication and gender equity, even more so if effective collaboration is established within and outside the water sector. In order to realise that potential, new policies are needed. New policies and intervention tools are proposed.

1. Economic tools

- Water valuation attaches the highest value to a society that provides for all water-related basic needs of its people. The full range of productive and domestic benefits of water and the distribution of benefits within society are taken into consideration. Benefits accruing to poor men and women are specifically and primarily targeted. This requires the development of economic valuation tools that enable water managers to weigh up the real value of water to poor communities, against the "market value" accorded to water in the wealthier sectors of the communities.

- Infrastructure costs to fulfil basic consumptive needs are fully subsidised up to minimum levels of service. Subsidised programmes to promote the development of appropriate low-cost technologies for poor women and men are reinforced, not swept from the agenda under the pretext of "equal treatment," ignoring the disproportionate benefits the non-poor received from huge subsidies in the recent past. Lessons learned on the smart use of subsidies for sustainable benefit are taken into consideration. Integrated support is provided to poor water users to increase the incomes from water-related production, in order to have sufficient profits from which capital and operational costs can be paid.

2. Legal tools

- In the nation's water law, water is set aside to fulfil basic consumptive and productive needs of poor people first. General principles in the law to redress inequities are translated into operational, effective rules for water allocation to poor users first and foremost. Implementation and enforcement of pro-poor legislation is pursued.

3. Governance tools

- New systems of water governance at basin-level, like the Catchment Management Agencies in South Africa, play an important role in implementing the new water management paradigm. As CMAs and user participation are not intrinsically pro-poor, public consultation processes are explicitly and pro-actively shaped to organise the poor to ensure equal voices to all.

4. Integration

- Water professionals actively co-ordinate and integrate their actions with other government and non-government agencies to create the synergy needed to alleviate water-related poverty. Water ceases to be the exclusive mandate of water professionals. Instead, the overall mandate becomes poverty eradication to which each profession has a contribution to make.

- These changes require inter-departmental liaison-structures from national to local levels, as DWAF now implements. Innovative ways are developed in which a range of professionals use their expertise and develop new knowledge for the benefit of poor people.

CMAs, water managers, development activists and government officials all need to be equipped with the knowledge, tools and methodologies for using water to improve the lives of poor people and of poor women in particular. The continual achievement of these aims also requires the on-going monitoring of the impact of water management decisions on the poorest of the poor. This forms the key performance indicator of any department or body involved in the management of water.

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Section C

Generic issues arising in river-basin management

This section presents five papers about key issues which arise generally in the formulation or operation of integrated river-basin management

These papers address:

water accounting;
constraints affecting transfer of management concepts and methods between countries;
identification and representation of stakeholders;
ways of financing river-basin management organisations;
assessment of institutional systems for water management

Accounting for Changes in Water Use and the Need for Institutional Adaptation

David Molden
Research Leader, Irrigation and Water Resources Programme;
R. Sakthivadivel
Senior Irrigation Engineer, Irrigation and Water Resources Programme;
M. Samad
Research Associate, Policy, Institutions and Management Programme;
International Water Management Institute, Colombo, Sri Lanka

Abstract

A key determinant of high performing water resource systems is an effective institutional arrangement. An essential research question is what is an effective institutional arrangement? We argue that there is no single best institutional model, as institutional requirements vary depending on the phase of development of the basin. Based on water accounting studies we observe that water use patterns can be used to identify stages of river basin development. The hypothesis presented in this paper is that depending on the phase of development, institutions will be concerned with different tasks. Thus an important feature of a well-functioning set of water management institutions is the ability to adapt to changes. We use a water accounting methodology to illustrate the concept of phases of development in river basins. We argue that to meet increases in demand over time, institutions must change their focus from development of infrastructure, to better utilising and conserving water resources, then to improving allocation and regulation of water resources. Institutions must be dynamic entities that change with changing phases of development of the basin. At their inception, serve a single purpose. Then as the basin develops, they either expand their number of functions, or other institutions evolve to fulfil management requirements. These concepts are illustrated in two cases derived from Nepal and China.

1. Preface

Imagine a river basin a long time ago... Before the arrival of humans, the basin's renewable resources could be measured at a point in the river nearby the sea. Now imagine a progression of events in the history of the development of the river basin. At first human demands on the water resource were modest. Water was used for crops, fishing, washing and navigation. With increasing population, there was more demand for food, and river diversion structures were built on tributary streams. Communities built up an agricultural basis for their livelihoods.

Then, as years passed by, many more people settled in the area placing significantly greater demands on water resources, and communities constructed diversion structures along the main river. The area was used to produce food for the entire country, so it was thought wise to construct a dam and reservoir to store and regulate

flows. Initially, some farmers benefited, while water scarcity remained a reality for other less fortunate people in spite of plentiful reservoir supplies. Significant water re-entered the river as drainage return flows, and navigation remained possible. Yet prosperous farmers needed more water to produce more food for the nation, so serious efforts were placed in improving management and serving all users. Return flows dwindled, and navigation was no longer possible.

To further expand irrigated agriculture and to meet urban demands, individuals installed pumps to extract water from aquifers and drains. Conflicts developed as upstream users infringed on the traditional rights of downstream users. Pollution became a concern as urban and industrial effluents increased, and little water remained to dilute flows. Wetlands near the coast dried up. Poor people were left struggling to get sufficient drinking water. Alarmed, communities decided to take action...

2. Introduction

Over the last 50 years, changes in the way humans use water have been enormous. Major driving factors have been a growing population, economic development, improved living standards, and increasing demands. Irrigated agriculture has played a significant role in changing the face of water resource utilisation as dam, diversion, delivery and drainage structures have been developed to store and distribute water for irrigation and to drain out surplus supplies. With more development, we find ourselves in a situation where we have widely different and competing interests in our water resources.

Our working hypothesis is that changing patterns of water use require adaptive institutions for sustainable, equitable, and productive management of basin wide resource. There is no one set of institutional arrangements that is capable to adequately manage the present situation, then meet future needs. An important feature of institutions is the mechanisms they employ to adapt to change.

In order to understand present uses of water, past trends, and future projections, it is essential to understand the physical resource base. Here we present basic concepts of water accounting as a means of providing this understanding. We use water accounting to develop and present various phases of water resource development, and problems that are faced during the various phases. We illustrate these concepts by examples from Nepal and China.

3. Accounting for Water Use

How much water is available for use within basins or sub-basins? Who are the major users of the water resource? How much do they use? Is there scope for water savings, or scope for more development of water resources? These are the types of questions that can be addressed through the IWMI water accounting framework (Molden and Sakthivadivel, 1998).

Water balance and water accounting. Water accounting relies on water balance studies. We define a domain bounded in space and by time. For example, we may

include a portion of a basin over a year's time, bounded spatially so that runoff is captured by the sub-basin, and vertically to include the bottom of the aquifer up to the top of the vegetation canopy. We perform a water balance to quantify water flows across the boundaries including rain, evaporation, surface and subsurface inflows and outflows. Changes in storage internal to the water balance domain, such as changes in reservoir levels or groundwater levels must be considered. Essentially, water accounting divides hydrological variables of discharge, rain and evaporation into water accounting categories (Box 1).

Diversions, depletions, and recycling: Water is diverted to various uses. Water is depleted when it is rendered unavailable for further downstream use—either through evaporation or by directing the water to sinks. Since not all water diverted to a use is depleted, some remains within the basin and is available for further use. Water recycling or reuse is prevalent in water resource systems. City effluents discharged back into river systems are often used again downstream. It is common to underestimate how much reuse exists in river systems, especially in those that are highly stressed.

Accounting for Precipitation: In many analyses of water resources, only the "developed" water supply is considered—supply we tap from rivers by diversion structures. In IWMI's water accounting framework, rain is considered as a supply.

Water commitments. All uses of water in a basin could be captured if the boundaries of a basin were defined to extend to an ideal salt-freshwater interface. Most often it is practical and useful to consider only part of a basin, but when we do this we have to make sure and define commitments of water to downstream uses to meet ecological or other human requirements downstream.

Open and Closed Basins. When all available water has been allocated to various uses we consider the basin to be closed. When there is water remaining in the basin to develop and allocate, we say the basin is open. In many basins, there is ample water during part of a year, and at other parts it is dry. We consider the basin to be seasonally closed.

4. Phases of water resources development

Phases of river basin development are defined and illustrated (Figure 1) using the water accounting methodology, building on work presented by Keller et al, 1998. The rainfall onto a basin or sub-basin plus any trans-basin diversions represents the gross inflow into the basin. Even if all feasible structures were built, in many cases it is not possible to tap the entire amount of gross inflow. In addition, some water may be committed to downstream environmental uses. The amount of water potentially available for depletive use within the domain is the gross inflow less non-utilisable flows, less any water commitments.

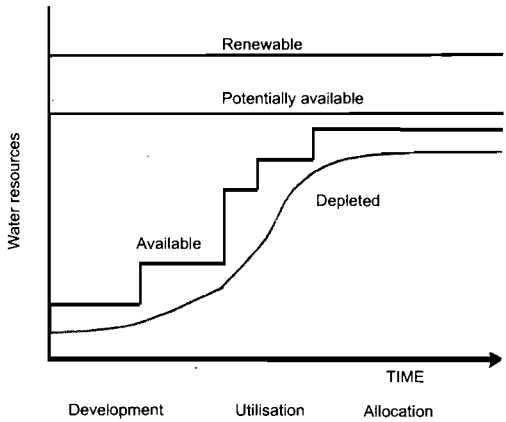
Box 1: Water Accounting Categories

Water Accounting Definitions

- *Gross inflow* is the total amount of water flowing into the water balance domain from precipitation, surface and subsurface sources.
- *Net inflow* is the gross inflow plus any changes in storage.
- *Water depletion* is a use or removal of water from a water basin that renders it unavailable for further use. Water depletion is a key concept for water accounting, as interest focused mostly on the productivity and the derived benefits per unit of water depleted. It is extremely important to distinguish water depletion from water diverted to a service or use as not all water diverted to a use is depleted. Water is depleted by four generic processes:
  - *Evaporation:* water is vaporised from surfaces or transpired by plants.
  - *Flows to sinks:* water flows into a sea, saline groundwater, or other location where it is not readily or economically recovered for reuse.
  - *Pollution:* water quality gets degraded to an extent that it is unfit for certain uses.
  - *Incorporation into a product:* through an industrial, or agricultural process such as bottling water, or incorporation of irrigation water into plant tissues.
- *Process consumption* is that amount of water diverted and depleted to produce a human intended product.
- *Non-process depletion* occurs when water is depleted, but not by the process for which it was intended. Non-process depletion can be either *beneficial*, or *non-beneficial*.
- *Committed water* is that part of outflow from the water balance domain that is committed to other uses such as downstream environmental requirements or downstream water rights.
- *Uncommitted outflow* is water that is not depleted, nor committed and is therefore, available for a use within the domain, but flows out of the basin due to lack of storage or sufficient operational measures. Uncommitted outflow can be classified as *utilisable* or *non-utilisable*. Outflow is utilisable if by improved management of existing facilities it could be consumptively used. Non-utilisable uncommitted outflow exists when the facilities are not sufficient to capture the otherwise utilisable outflow.
- *Available water* is the net inflow minus both the amount of water set aside for committed uses and the non-utilisable uncommitted outflow. It represents the amount of water available for use at the basin, service, or use levels. Available water includes process and non-process depletion, plus utilisable outflows.
- A *closed basin* is one where all available water is depleted. An *open basin* is one where there is still some uncommitted utilisable outflow.
- In a *fully committed basin*, there are no uncommitted outflows. All inflowing water is committed to various uses.

The actual available water at any time in the course of river basin development is a function of the existing infrastructure. With all feasible structures built, the available water is equal to the potentially available water. As time passes, and more infrastructure is built, more water is made available. When a new structure comes on line, there is an increase in the quantum of available water indicated by the stair-step pattern in Figure 1.

Figure 1: Phases of river basin development



As demand increases and more water is made available, more water is depleted. Eventually, the depleted water approaches the available water, and a new structure may be required. In a highly developed basin, depletion approaches the potentially available supplies. In some cases, water depletion even exceeds the potentially available resource—in the long-run, a non-sustainable situation. The potentially available water represents the maximum water that can sustainably be made available, unless more water is brought in through a trans-basin diversion. This is equivalent to a "frontier production function" in the field of economics.

Three important stages can be identified (Figure 1):

1. *Development.* In this phase the amount of naturally occurring water is not a constraint. Rather, expansion in demands drives the need for construction of new infrastructure. Institutions are heavily concerned with building infrastructure for providing supplies. Institutions typically emerge to serve a single function, like construction organisations.

2. *Utilisation.* Significant construction has taken place, and goals are to make the most out of these facilities. Water savings and improved management of water deliveries are important objectives. Managing the supply of water to various uses is a primary concern. Early in this stage, scarcity is not a major problem, and inter-sectoral competition is minimal. Institutions are primarily concerned with sectoral issues such as managing irrigation water, or managing drinking water supplies.

3. *Allocation.* As closure is approached, and depletion approaches the potential available water, there is limited scope for further development. Efforts are placed on increasing the productivity or value of every drop of water. An important means of accomplishing this is to reallocate water from lower to higher valued uses. Managing demand becomes increasingly critical.

Infrastructure construction is limited to those that aid in regulation and control. Little scope remains for "real water savings." Institutions are primarily involved in allocation, conflict resolution, and regulation. Several important management and regulatory functions gain prominence, including inter-sectoral allocation. To effectively carry out these functions, either a single entity emerges (like the Brantas River Basin Organisation in Indonesia), or several inter-linked organisations manage these functions (as in the South Platte River Basin in Colorado). Co-ordination becomes important, involving significant transaction costs.

5. Different Phases – Different Needs

Institutional concerns differ depending on the stage of development. These concerns may exist at all times, but their importance or emphasis may change over time as illustrated in Table 1.

Table 1: Various concerns at different phases of river basin development

Development	Utilisation	Allocation
Construction	Improving O&M services	Shifting to higher value uses
Managing supply distribution	Investing in O&M	Managing demand
Low value of water	Increasing value of water	High value of water
Large structures	Modernisation/rehabilitation	Measurement, regulating
Utilising groundwater	Conjunctive management	Regulating groundwater
Diluting pollution	Emerging pollution/salinity	Cleaning up pollution
Fewer water conflicts	Within-system conflicts	Between-system conflicts
Economic water scarcity	Localised water scarcity	Physical water scarcity
Water data – not so important	System water delivery data important	Basin water accounting data important
Including/excluding poor in development of facilities	Including poor in O&M decision making	Cutting off water to poor

In the development phase, infrastructure construction plays a dominant role. Institutions in the last 50 years have been set up to build major dams, canals, drinking water treatment and wastewater plants. Some agencies are dominated by civil engineers who have the important job of getting high quality work done quickly. Examples include the Mahaveli Development Authority or Pakistan's Water and Power Development Administration. In Nepal's East Rapti Basin, building infrastructure is a major concern of residents, government agencies, and donors.

Constructing canals and managing canal water are two different types of tasks. Infrastructure projects, especially those serving large areas and numerous people are difficult to manage. The task is to provide water service to people with varying levels of expectations and demands subject to variations in climate. Even in ideal situations, this can take a long time to learn how to do. In the early stage, water utilisation may not be so effective. Reliable and equitable service deliveries can be difficult standards to reach. As a consequence, water scarcity for individuals may be a reality because water is poorly managed, or construction quality or design is poor. Responses vary. Some institutions quickly adapt, and improve water delivery service. In other cases, problems persist. In response, people under their own initiative, develop alternative decentralised sources like groundwater, small ponds, or drains.

Eventually through better service, reuse, local initiatives; and with growing demands, the physical supply of water becomes limiting. Water depletion approaches available supplies. There are two typical responses. If there is more water remaining for development (available water < potentially available water), exploitation through more infrastructure development is possible. In the development and early utilisation stages, developing more supplies may be an economically attractive solution compared to more careful management. Later, as the easier locations are exploited, or as concerns about environment increase, infrastructure development gets more costly. Finally, during the allocation phase, the water resource limits. Different kinds of infrastructure development prevail: measurement and regulation structures to control water become more important; rehabilitation and modernisation efforts are common; there may be scope for transbasin diversions.

Over time, the value of water increases. Early, when water is plentiful, water has low value, but when the basin is closed, and demands for a scarce resource intensify the value of water can shoot up dramatically. This leads to a situation where early in the phases of development we are more concerned with developing supply of low valued water; while later in the development process, managing demand prevails. When low valued water is plentiful, conflicts can be mitigated with more supplies. As supplies become limiting, the potential for conflict increases.

Scarcity takes on different characteristics during various phases of development. Initially, scarcity is felt because there is no way to tap water. "Water, water everywhere but not a drop to drink..." is a reality for many people who do not have the technology to access water. In the utilisation phase, the technology may be present, but when it is poorly managed, people feel water scarcity. This is common where head-tail problems exist. Water accounting examples from Sri Lanka show that there is sufficient water, but due to poor management, people still feel scarcity (Molden and Sakthivadivel, 1998). During the allocation phase, the absolute supply of the physical resource limits.

Water scarcity in its various forms during the advancing phases of development has implications for poverty. During the development phase, an important consideration is the identification of beneficiaries. Will infrastructure benefit poor people? Will more powerful people capture benefits? The problems change during the utilisation phase. Even though conveyance structures exist, management may

not fit the demands of the poor. Are the voices of disadvantaged people heard when making management decisions? During the allocation phase, water is reallocated amongst sectors and people. When water moves away from agriculture to cities and industries, will the poor and less powerful be able to maintain their right to water; or capture the economic gains when water moves to higher valued uses?

Environmental concerns also change over time. During development stages, huge changes in nature can take place. During the utilisation phase, water use and depletion intensifies, further removing water that has environmental functions. A solution to scarcity is to tap into natural heritage sites for more water, resulting in damaged wetlands. During early phases of development, dilution can be sufficient to solve pollution problems. During allocation phases, dilution is not an option, because there simply is not enough water. Clean-up at the source becomes increasingly critical.

In the allocation phase, a host of potential problems exist: pollution, conflict management, resource overdraft. Managing more and different types of information becomes increasingly important. Information needs at the development phase are different. For design, information on river flows to assess supply, and climate and population to assess demands are necessary. During the utilisation phase, more information is needed on the delivery of water services.

6. Adaptive Institutions

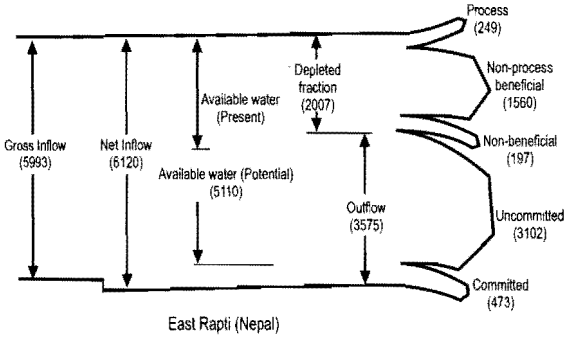
If early in the development phase, we try to design an institutional framework that deals with all these issues—pollution, poverty, allocation, regulation, construction—it is likely that we would fail. At certain phases of development, some of these are not major concerns. It is probably right that there are construction agencies to make sure that there is safe and sound construction. It is probably not right that the same institutional set-up is used to manage service delivery. A different set of rules is required, different skills are required. And those who manage service delivery are probably not appropriate to regulate allocation and pollution of resources when these problems emerge.

The implication is that water resource management institutions must adapt to meet different challenges as patterns of water use change. Common water problems are seen because agencies, at one time competent to carry out tasks, do not change. When evaluating an institution, we may find that they do 7 out of 10 tasks fairly well. The seven may not be so important, while the three missing ones, may be critical. When analysing institutions then, we need to understand the mechanisms that exist to adapt to change. Are there rules to change rules?

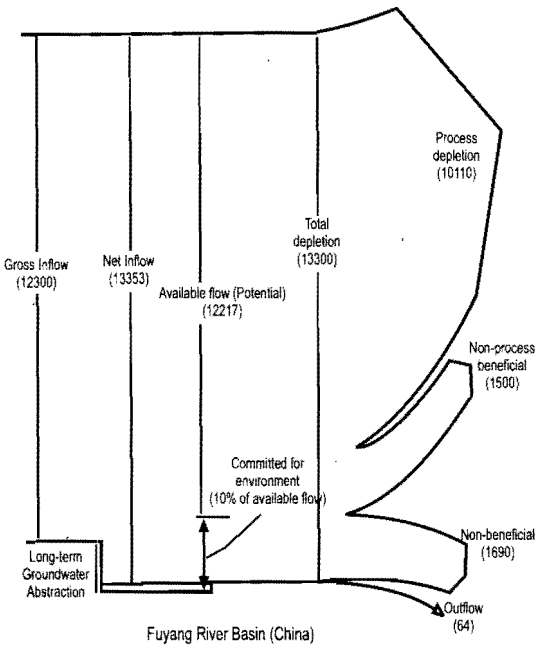
7. Examples

Let us explore two examples—one taken from Nepal, and one from China to illustrate these concepts. The water accounting finger diagrams are given in Figure 2. The Nepalese example illustrates a case of a basin in the development phase, while the Chinese basin is closed, and is clearly in an allocation phase. Basic information on the two basins is presented in Table 2.

Figure 2: Water accounting finger diagrams



East Rapti (Nepal)



Fuyang River Basin (China)

All units $10^6 m^3$

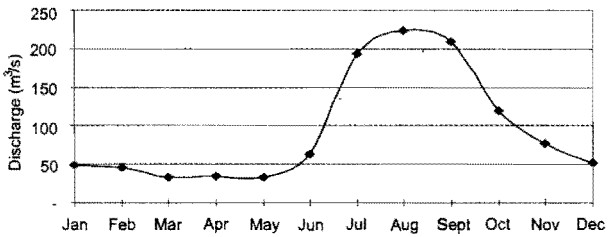
Table 2: Basin characteristics

Particulars	Fuyang River Basin China	East Rapti Nepal
Type of basin	Sub-basin of Huihe Southern Basin	Sub-basin of Narayani Basin
Basin area	22814 sq. km.	312.0 sq. km.
Land use cover		More than 60% forest
Mean annual precipitation	569.2 mm	1866 mm
Average annual potential evapotranspiration	800 mm.	1460 mm
Population density	685/sq. km.	212/sq. km.
Percent involved in agriculture	-	80 percent
Farm size per household	-	0.9 ha
Major crops grown	Wheat and corn, cotton, oil bearing crops	Wheat, rice and maize
Average yields/ha	4.26 t/ha – wheat 4.90 t/ha – corn	1.85 to 2.5 t/ha
Major issues	1. Physical water scarcity 2. Inter-sectoral competition for water 3. Water pollution problem due to rural industrialisation 4. Over-exploitation of groundwater	1. Concern about impacts of increased diversion on natural habitat. 2. Population resettlement and its impact on present water use patterns. 3. Soil degradation in catchment and sedimentation 4. Seasonal scarcity

7.1 East Rapti, Nepal

East Rapti River Basin (ERB) is a part of the Chitwan valley within the inner tarai of Nepal, draining an area of 3,120 sq. km. The East Rapti river originates from the Mahabarat range of mountains (MSL 1,500 m), traverses 122 km and meets the Narayani River, one of the four major rivers in Nepal, at MSL 140 m. The Narayani, called the Gandak in India, eventually discharges into the Ganges River. Forests cover 60% of the area. The average annual rainfall is 1,937 mm, while the average annual potential evapotranspiration for the basin is 1,460 mm. Rainfall is concentrated during six months of monsoon period from middle of May to end of October. July and August are the rainiest months receiving nearly half the annual rainfall. Rainfall during the dry period of six months is only 7 percent of annual rainfall. The river hydrograph at the confluence of the Narayani River is presented in Figure 3.

Figure 3: The long-term average monthly discharges at the confluence point



The area has a growing population, urban and industrial base. Most people remain engaged in agriculture. The Nepal Water Supply Corporation is engaged in constructing water supply and sanitation facilities to serve the needs of growing cities and villages. Irrigation projects are aimed at rehabilitating farmer managed irrigation systems, or recently in rehabilitating then turning-over agency run systems to farmers.

There is no major dam or storage facility along the East Rapti. Farmers have constructed several small diversion structures along the main river and its tributaries. Government agencies have built a few diversion structures, and have recently been involved in the modernisation of farmer constructed works.

There is one major transbasin diversion project where water from the Kulekhani reservoirs flows through a hydroelectric station into the East Rapti. The purpose of this project is power generation rather than storage augmentation for the East Rapti.

7.2 Fuyang, Hebei, China

Fuyang River Basin (FRB), a sub-basin of Haihe Southern Basin in Hebei province of North China, drains an area of 22,814 sq. km. The basin is divided into three broad regions: Fuyang river mountainous area, Fuxi plain and the Hufu inter-zone plain. The annual mean precipitation for the basin is 569 mm.

In contrast to the East Rapti, the Fuyang River Basin is heavily equipped with a large number of storage structures. In FRB, there are 3 large reservoirs, 11 medium reservoirs and 212 small reservoirs. These protect from floods, supply water for irrigation, industry, domestic and power production. Three-quarters of water is allocated to agricultural use, 15 percent for industry, and 10 percent for domestic use.

Differences in water accounting indicators are striking (Table 3). At Fuyang, 109 percent of available water is depleted showing that there is now over exploitation. At East Rapti, this indicator is only 39 percent, meaning that the amount of water in the basin is not constraining future water resource development. This is further

illustrated by considering the ratio of uncommitted outflow to available water—nearly 0 at Fuyang, and 61 percent at East Rapti. At Fuyang, process depletion (by industries, cities, and agriculture) is 83 percent of the available water, while at East Rapti this is only 5 percent. At Fuyang, water resources are heavily developed and effectively placed in process use, while the process fraction for East Rapti indicates that humans have harnessed very little of the water. Productivity of water in agriculture has reached high levels in Fuyang, while at East Rapti it remains quite low. One possible explanation is that with increasing competition for water, the value of water increases, which exerts pressure to increase productivity of water in agriculture.

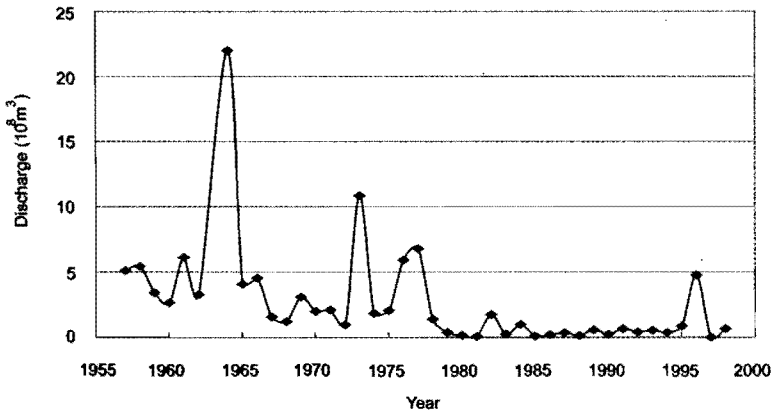
According to historical records, during 1950s and 1960s, Fuyang River was an important shipping channel for Hebei province. In contrast, from 1990s onwards, the river had over 300 dry days annually. The outflows from the basin dramatically decreased from the late 1970s to less than 100 mm^3 with no outflow in 1997 (Figure 4). The basin has become a closed basin for all practical purposes.

Table 3: Water accounting indicators

	Unit	Fuyang River Basin China	East Rapti Nepal
Depletion/available water – DF_{Avail}	%	109	39
Process/consumption/ Avail water – PF_{Avail}	%	83	5
Non-process beneficial use – BF_{Avail}	%	12	31
Non-process non-beneficial use – NBF_{Avail}	%	14	4
Uncommitted outflow/avail water	%	0.5	61
Committed outflow/avail water	%	01.0*	9
Productivity of water depleted by agriculture	US$/$m^3$	0.29	0.09

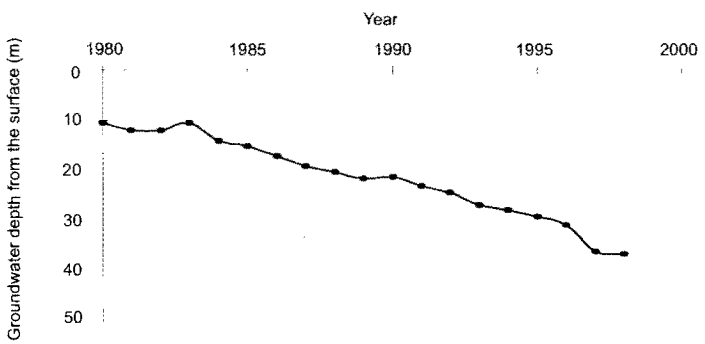
*not supplied.

Figure 4: Variations of discharge measured at Aixinzhuang Hydrology Station from 1957 to 1998



In Fuyang, groundwater accounts for 80 percent of supply, while at East Rapti, groundwater remains a relatively minor source although considerable groundwater potential exists. As a conscious allocation decision, water managers of Fuyang have allowed cities and industries first priority on reservoir water, and have supported farmers in their efforts to tap groundwater. Groundwater overdraft led to a dramatic drop of groundwater level, especially in the recent two decades (Figure 5). The groundwater table dropped at a rate of 0.68 m/year for the county located at the upstream and at a rate exceeding 1 m/year for the middle and downstream counties. There is apparently no institutional mechanism for dealing with this groundwater overdraft problem.

Figure 5: Variations of groundwater depth from the surface, 1980 to 1998, Jiuzhou Station, Renxian County, Hebei Province



For Nepal, groundwater has been recognised as an important resource. But in spite of an ample groundwater resource, and funding for development efforts, groundwater development has remained limited. Institutional mechanisms to support groundwater development have not yet been effective.

Environmental considerations differ in the two areas. In the East Rapti Basin, non-process depletion by natural vegetation accounts for depletion of 35 percent of the water, a large portion in comparison to Fuyang (26%). An important feature of the East Rapti basin is the Chitwan National Park, an important nature reserve and popular tourist destination, situated near the tail end of the basin. Maintaining flows in the East Rapti is essential in maintaining the river ecosystem of the park. Efforts to build more diversion structures along the East Rapti have been hampered in part because of concerns about the river habitat of the Chitwan National Park. There have been no estimates of the flows required for environmental maintenance.

In the Fuyang Basin, people are alarmed at the levels of pollution in the water system. Dilution no longer works, as flows are too small to carry out excess pollutants. Industries continue to discharge polluted effluents. Salinity levels are also rising from agricultural practices. Institutions are at least showing some concern, but it is clear that they do not have the necessary clout to adequately deal with the problem.

In Fuyang, productivity levels are quite high giving evidence that water management in agriculture is effective at least promoting productive agriculture. In East Rapti, cropping intensity is quite high, but crop yields remain low. Farmer constructed and managed systems in this area have often been cited as model examples for irrigation management, while agency constructed systems struggle. Management transfer efforts are aimed at improving the quality of delivery services. Rehabilitation and modernisation of farmer managed systems is an important concern in the area to promote higher productivity.

In spite of ample water in East Rapti, many farmers do not have water during the dry months for crop—water scarcity is a reality for them. Within the Fuyang Basin, the amount of water limits the amount of productivity in the basin. They have met a stage of absolute, physical water scarcity.

Within the Fuyang River, institutions for providing water delivery services seem well-developed. Institutions for regulation of pollution and groundwater seem inadequate. At East Rapti, institutions for construction are active. It was recognised that this setup is not the best for managing water delivery services. Government agencies are still struggling to find the right formula for improved water management within government built irrigation systems. Mechanisms for allocation and regulation seem of little concern now, except for the major issue of allocation between water for food and water for nature. It is questionable whether existing institutions are equipped to handle this problem.

8. Summary and Conclusions

The growing recognition of a river basin as the most appropriate unit for the development and management of water resources has prompted the search for appropriate institutional arrangements for river basin management. This paper has argued that there is no single "best" institutional model. Rather, institutional requirements differ with the different phases of development of the river basin. Thus, a clear specification of the stage of development of the river basin is crucial in understanding or formulating institutional arrangements for river basin management. This paper outlines a framework to define the phases of development of a river basin on the basis of water accounting. The ideas presented in the paper are preliminary and research is underway to develop the methodology and test it empirically under various conditions.

We demonstrated that as the river basin progresses from an "open" to a "closed" basin, three phases can be identified: development, utilisation and allocation. These are not mutually exclusive and some overlap of functions may occur. At the early stages of development, institutional arrangements focus on a single or very limited set of objectives. Very often they are involved in developing infrastructure to supply water. Later, more concern is placed on managing water within various sectors. With increasing scarcity brought on by more development, competition increases, the value of water increases, and a host of other issues including environmental concerns, pollution, and groundwater overdraft may arise. Over time they need to deal with multiple functions that require complex institutional arrangements that involve several organisations, and function in the realm of a broader and often

conflicting set of national objectives. Thus, institutions are dynamic entities that need to cater to different management demands as water use changes with the progression of time. Finally, a key feature of an effective institutional design is the ability to adapt to changing needs.

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Limits to Leapfrogging: Issues in Transposing Successful River Basin Management Institutions in the Developing World

Tushaar Shah
Research Leader, Policy Institutions and Management;
Ian Makin
Research Leader, Applied Information and Modeling Systems;
R Sakthivadivel
Senior Irrigation Engineer, Irrigation and Water Resources Programme;
International Water Management Institute, Colombo, Sri Lanka

Abstract

Many developed countries such as the USA, France, and Australia have evolved highly advanced and resilient institutional regimes for Integrated River Basin Management (IRBM); but this has taken decades or even centuries of gradual change to evolve. An issue which has held great appeal to policymakers, donors and social researchers is: might it be possible for the developing countries of today to do an 'institutional leap-frog', as it were, to quickly approach a stage at which developed-country basin institutions find themselves today. This paper reviews the difficulties that developing countries might face in making such a leap-frog because of the vast and fundamental differences in four realities that matter in their institutional evolution: hydrological and climatic, demographic, socio-economic, and the reality of the way their water sectors are organised. The paper suggests that problems that evolved basin institutions in the developed world have successfully resolved—pollution, sectoral allocation, etc—are not the uppermost in the priorities of many developing country policymakers and people; and the problems that are uppermost to them—such as groundwater over-exploitation, using irrigation to promote the livelihoods and food security of the poor—have either remained unresolved in the developed world, or are rendered irrelevant by their evolutionary process. There is thus the problem of 'contextual fit.' This does not mean that the experience of river basin management in the developed world is irrelevant; but it does mean that uncritical imposition of developed-country institutional models in developing-country river basin contexts may prove dysfunctional or even counter-productive.

1. Backdrop

Management becomes important as a productive resource becomes scarce; and there is hardly a situation in which this is truer than in the case of the water resource. For a long time now, water policies of many emerging nations have been focussed on developing the resource; and optimising was directed at the efficiency of water infrastructure rather than water itself. As water has became increasingly scarce, optimising is now being increasingly directed to improving the productivity of water itself. Increasingly, the river basin is emerging as the unit of management of land, water and other natural resources in an integrated fashion. Many developed

countries such as the USA, France, and Australia have evolved highly advanced and resilient institutional regimes for Integrated River Basin Management (IRBM); but this has taken decades—in Europe and centuries in the USA—of gradual change to evolve. An issue which has held great appeal to policymakers and social researchers is this:

Is it necessary that developing countries in Asia and Africa should take all that long in crafting such institutional regimes? Or might it be possible for them to do an "institutional leap-frog," as it were, to a stage at which developed country basin institutions are today?

A textbook case of institutional reform for IRBM in recent times has been the Murray-Darling basin in Australia, where sweeping changes have been made and enforced since 1990. And transferring the lessons of success in IRBM—from Murray-Darling to Mahaveli, and Mississippi to Mekong—has emerged as a growth industry.

This paper attempts a broad-brush approach to understanding the material differences in the contexts of the developed-country river basins, from where institutional models emerge, and the developing-country river basin context in which these are applied. The idea is not to undermine the significance of the lessons from success but to emphasise the need for sagacity and critical analysis in assessing what will work and what will not, given the differences in the context. The phrase "Institutional change" is used to describe how communities, government and society change recurrent patterns of behaviour and interactions in coping with water scarcity and its socio-ecological ill-effects. It involves understanding laws and rule-making, roles, policies and institutional arrangements at different levels. The over-arching premise is that the effectiveness of a pattern of institutional development is determined by at least four realities of a river basin: hydro-geological reality, demographic reality, socio-economic reality, and the organisation of the water sector. By implication, institutional arrangements that have proved effective with one set of these realities may require major adaptation before they become appropriate to the needs of a river basin context defined by an alternative set of these realities.

Integrated River Basin Management is a powerful idiom, and will increasingly dominate natural resource management discussion in the developed as well as developing world. In its broadest sense, a basin or catchment is visualised as

> *"an inter-connected machine or system which transforms natural inputs of solar energy, atmospheric precipitation, nutrients and other environmental factors, along with man-made inputs of labour, capital, materials and energy, into output products such as food, fibre, timber, building materials, fuels, minerals, natural vegetation and wildlife, recreational and aesthetic amenities, buildings and development sites, as well as water in desirable quality and quantity."* (Burton 1986, cited in Hu 1999:324).

River-basin management as a notion goes far beyond traditional land and water management and

> *"includes significant parts of land-use planning, agricultural policy and erosion control, environment management and other policy areas. It covers all human activities that use or affect fresh water systems. To put it briefly, RBM is the management of water systems as part of the broader natural environment and in relation to their socio-economic environment."* (Mostert et al 1999:3).

Institutional discussions on IRBM have tended invariably—and probably erroneously—to gravitate around three models of strategic organisations for managing river basins:

- the *hydrological model,* in which a river basin organisation/authority, cutting across administrative boundaries, takes over all charge of water resource management;
- the *administrative model,* prevailing in many developing countries, in which water management is the responsibility of territorial organisations unrelated to hydrological boundaries; and
- *co-ordinating mechanisms* superimposed on the administrative organisations to achieve basin management goals.

Each has advantages and disadvantages: the hydrological model effectively deals with upstream-downstream issues that the administrative organisation is generally unable to deal with; however, hydrological organisations tend typically to focus on water and overlook land management issues. River Basin Commissions, as a hybrid, might combine the advantages of both, but at least in the developing country context, they often command little authority, and are therefore confined to lowest-common-denominator solutions (Mostert et al 1999). In many developing countries today, institutional reform for RBM is confined almost wholly to the creation of the basin-level organisation—the implicit assumption being that mere formation of the appropriate organisation will result in IRBM, an assumption whose validity has been repeatedly refuted.

In the developed world, the discussion has been much broader and has veered around initiatives in four aspects of natural resource governance:

[a] some mechanism for basin level negotiation and co-ordination fortified with adequate authority and resources, and a broad mandate considered appropriate to the basin's context;

[b] legal and regulatory reform;

[c] redesigning economic instruments of policy (transfer prices, taxes, subsidies) in harmony with national policy goals;

[d] redesign of economic institutions (including utilities, service providers, property rights; water markets, Irrigation Management Transfer to user organisations).

Countries like the USA have achieved, over long periods, high levels of integration even without a central basin organisation (see, for example, Svendsen 2000).

2. Applying the lessons of the Murray-Darling to the developing world

The Murray-Darling River system, as a recent case of accelerated institutional reform, has appropriately emerged as a model of institutional structure for IRBM. The basin encompasses over 75 percent of the State of New South Wales, 56 percent of the State of Victoria, all of the Australian Capital Territory, and small parts of Queensland and South Australia, a vast region of the south-eastern parts of the continent. Already, several case studies of the Murray-Darling are available; and it is not our intention to review these. In brief, the institutional innovations of the Murray-Darling basin management regime include:

[a] the Murray-Darling Ministerial Council as the top-level policymaking and co-ordinating mechanism; the Murray-Darling Basin Commission as the operating organisation; and several Catchment Management Agencies that are responsible for day-to-day management of water;

[b] a system of permits for diversions that encompasses all uses except the water needed for domestic use, livestock production, and irrigation of up to 2 ha which are recognised as a prior right (Hatton MacDonald and Young 2000 :10), and exempted from legal as well as permit system;

[c] an effective cap on water diversions at 1993–94 levels of development to ensure adequate environmental supplies, accompanied by a system of volumetric licensing to users that raises the scope for large-scale water trade across states and sectors;

[d] consumption based, full-cost-recovery pricing (Hatton MacDonald and Young 2000: 14);

[e] a system of "salinity credits" that permits trade in salinity;

[f] explicit mechanisms for water allocation for environmental needs;

[g] a legal regime that separates water rights from land rights;

[h] privatisation of service providers such as Murray Irrigation Ltd and Victoria's Rural Water Corporation (Malano et al 1999).

The Murray-Darling RBM regime clearly represents a highly evolved form of institutional arrangement and effectively addresses all major problems that a mature river basin would face. As alluded to earlier, exploring whether developed-country basin institutions— particularly, Murray-Darling experience—can be replicated in a developing-country context has fascinated many researchers in recent years. An entire issue of Water International (vol. 24, no 4, 1999) was devoted to it in 1999.

The results of these investigations have not been very encouraging. For example, Hu explored the applicability of Murray-Darling experience in the Chinese context and concluded negatively because of: (1) difficulty of co-ordinating authorities at different levels; (2) unclear ownership of resources; (3) small farming scales; and (4) poor education of resource users. (Hu 1999 : 323).

In a similar vein, Malano, Bryant and Turral (1999) ask: "Can Australian experiences be transferred to Vietnam?" Their conclusion is less emphatic than Hu's, but all their evidence suggests that it will be long before Vietnam becomes really ready for the Murray-Darling prescription; and that "context, hydrological and socio-economic, defines the detail and balance that is required.." (p: 313). The new water law of Vietnam contains provisions to adopt an integrated river basin approach. The World Bank as well as ADB have apparently held up funding to Vietnam until it forms the National Water Council to implement it. The Ministry of Agriculture and Rural Development, which is at present in charge of water, does not relish the responsibility of IRBM. The progress in stakeholder participation, another Murray-Darling prescription, has been slow to say the least. Farmers view irrigation provision as a government responsibility; even so, irrigation charges in Vietnam are high by Asian standards. Yet, presumably under donor pressure, the government tried to eliminate irrigation subsidies, but this was followed by massive popular unrest in 1998, whereupon, the Government had to restore the subsidies.

Can the Australian success in enforcing the "user pays" principle be transferred to the Solomon Islands? Hunt explored this issue in a recent study and concluded that such transfer "is not sustainably viable" on account of huge differences in political structures, national priorities, living standards, cultural traits, technological development, literacy levels, financial and infrastructure growth, and change-management competency. All these differences result in the absence of what Hunt calls a "contextual fit" between the policy development and the respective policy application environment. (Hunt 1999 : 302)

"If there is any conclusion that springs from a comparative study of river systems, it is that no two are the same" (Gilbert White cited in Jacobs 1999). Each river basin must differ from any other in a thousand respects; but that does not mean that lessons of success in one are of no value to another; it does mean though that uncritical "copycat" replication of successful institutional models—either by enthusiastic national governments or at the behest of enthusiastic donors—is a sure formula for failure. The history of institutional reform in developing-country water sectors is dotted with failures of such copycat reform.

Integrated river basin management is not a new idea, even in developing countries. India tried to transpose the TVA (Tennessee Valley Authority) model tried in the USA by constituting the Damodar Valley Authority, which was a resounding failure. Catchment management committees were established in China way back in the 1950s in some of the major river basins such as the Yangtse and Yellow River to plan and exploit water resources, generate electricity, mitigate flood damage, and provide facilities for navigation (Hu 1999: 327). But all these institutions shed their broad agenda and ended up focusing on irrigation, the purpose that was most central to their domains at those times.

In Sri Lanka, a Water Resources Board was established as early as 1964 to promote integrated water resources planning, river basin and trans-basin development and to tackle water pollution; however, the Board never worked on its broad mandate and instead, took to hydrological investigations and drilling tubewells.[1] Such examples can be multiplied easily; the point is: in learning useful lessons from success cases for making meaningful reform in developing countries, it is important to understand critical differences between the two worlds that have material significance for what will work and what will not. We pose that, in understanding the applicability of institutional innovations, it is critical to take into account four types of material differences between the developed- and developing-country realities:

[a] hydrology and climate;

[b] demographics;

[c] socio-economics; and

[d] organisation of the water sector.

We briefly outline these material differences in the following sections.

3. Hydrology of the developing world

Historically, agriculture advanced early in arid climates such as those of Egypt and Iraq; but industrial development began early in the temperate and humid climates of Europe, North America and Japan. Some arid areas where significant wealth creation and accumulation has occurred—as in West Asia—are typically rich in mineral and oil resources. Today, however, the bulk of the developing world, where rainfall tends to be low and water scarcity is a major emerging constraint to progress is in the arid or semi-arid[2] parts of the world. Figures 1 and 2, showing the global distributions of mean annual rainfall and potential evapotranspiration, help to illustrate some major climatic differences between developed countries (mostly in the temperate latitudes) and developing countries (mostly in the tropical and sub-tropical regions).

Sutcliffe (1995) pointed out that developing countries also happen to be concentrated in parts of the world with more extreme climates when compared to the regions occupied by today's developed countries. Figure 1 illustrates the

[1]Another round of reform has just begun in Sri Lanka. In 1990, a draft law made provision for bulk water allocation and included the establishment of a National Water Resources Council to do what the Water Resources Board could not; but the law could be submitted to the Parliament only in 1995 for the lack of consensus in the cabinet as well as amongst the myriad agencies dealing with water (Birch and Taylor 1999:331).

[2]Referring to regions like India and West Africa, which are humid for a small part of the year but arid during the rest of the year.

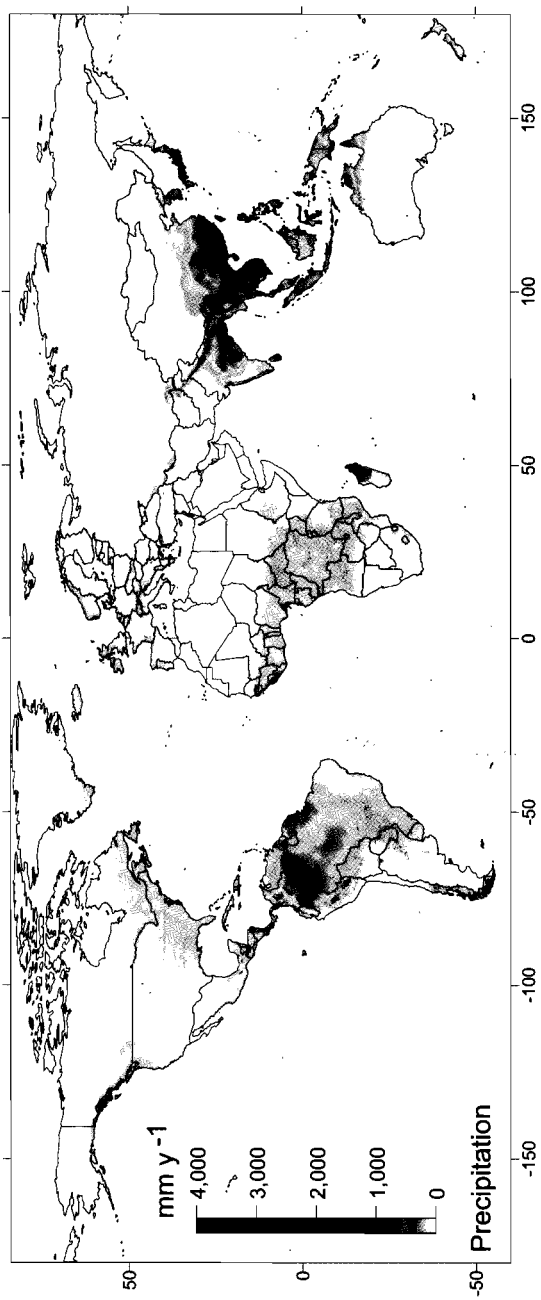


Figure 1: Global distribution of mean annual rainfall

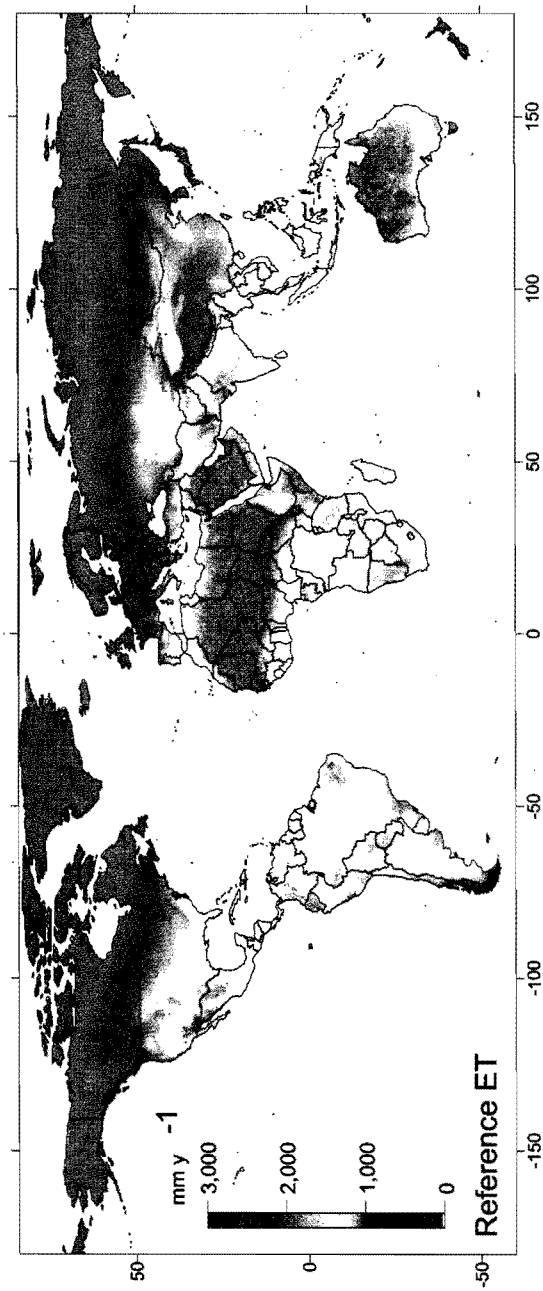


Figure 2: Global distribution of mean annual potential evapotranspiration

enough of it from evapotranspiration to last from October until April–May, the months that mark the period of highest water stress. Botswana receives all of its 350–500 mm rainfall during November–March, the period which also coincides with the highest evaporation, resulting in little or no runoff (Sutcliffe 1995: 69).

Humid areas typically have higher stream densities than are found in the arid and semi-arid areas, which means that, ceteris paribus, a higher proportion of precipitation in the arid and semi-arid areas runs off in sheet flow before forming into streams, and is thereby subject to higher ET (evapotranspiration) losses (Figure 2). Other things also are not quite the same; the developing world—especially, South Asia and much of Africa—around the tropics has higher mean temperatures for more of the year than the developed world. And, for equivalent levels of precipitation, runoff and the need for irrigation tends to be greater in arid and semi-arid areas than in humid areas (Sutcliffe 1995:64).

The climate and hydrological conditions, combined with demography (discussed in the following section), explain why decentralised institutions for water management have historically evolved in many parts of the developing world. The profusion of small tanks in India's southern peninsula and Sri Lanka can be viewed as the response of communities in the catchment areas to stake their claim on their rainfall. Even today, one collective maintenance task carried out by many south Indian tank communities before the start of the monsoon is cleaning and deepening of the channels that feed rainwater runoff to their tanks. Village people here recognise that if they do not capture runoff in artificial streams, most of it will be lost before it reaches their tanks.

4. Demographics

Many parts of the developed world have extreme climates too; however, over time, population and urbanisation in these parts have tended to concentrate in wet areas or on downstream reaches of rivers near coastal areas, where water can be supplied through large-scale diversion structures. As Figure 3 shows, except in Europe, most of the developed countries have low population densities throughout, with urban agglomerations near the coasts and rural population along rivers or irrigation systems. Here, the competition is for large accumulated bodies of "diverted water." Since catchment areas have relatively sparse populations, the downstream water-harvesting structures have large catchment areas that are virtually free from competition.

But this is not the case in some of the most densely populated regions of the world. In India, for instance, population density is high—approaching 600 persons per km^2 in the water-rich Ganga basin; and seldom less than 350–400 even in semi-arid western India and hard-rock peninsular India. Population density is high both upstream and downstream of dams. The same is true for much of China; the North China plains have much less water than South China; but their population density is around the same. One might argue that the cause of intensive groundwater development in South Asia and China is that most people in these regions cannot be downstream of large dams; and by sinking tubewells people upstream are, in a sense, challenging the basic inequity inherent in the pattern of large irrigation projects that usurp the

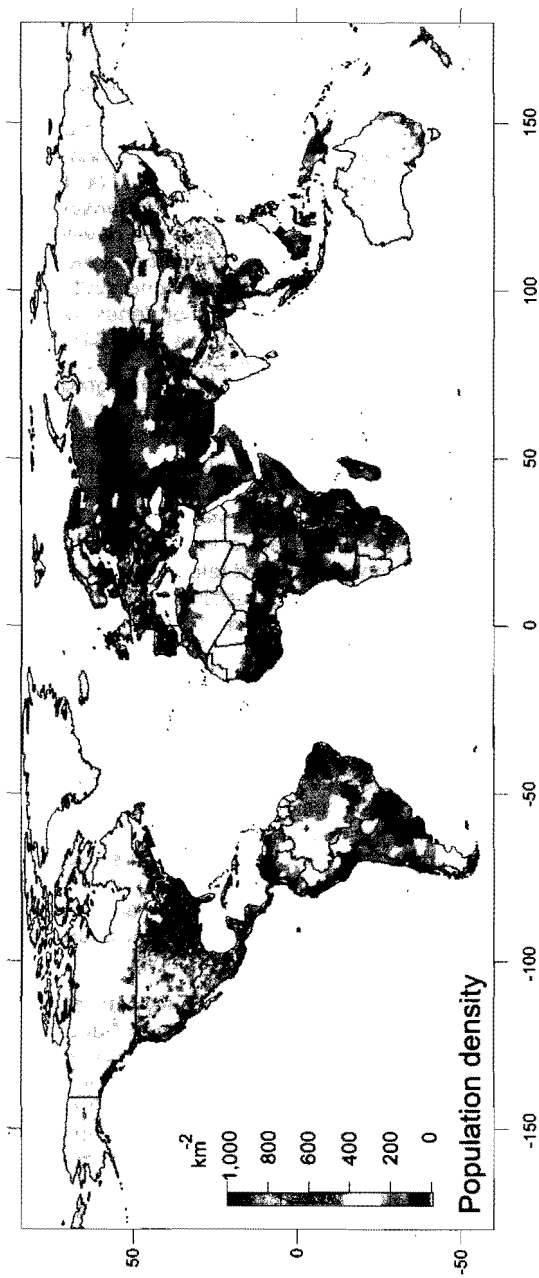


Figure 3: Global distribution of population density

rainfall precipitation of populous upstream catchment areas to bequeath it to a small number of canal irrigators.

All these factors have had implications for the kind of water institutions that have evolved historically in the developed and developing world. For example, the system of rights based on riparian doctrine and on the doctrine of prior appropriation is alien to the cultures of many developing countries because the largest majority, by far, depend upon rainfall and local water-harvesting and storage structures. Riparian rights or prior allocation become operative only along the streams and rivers, where the bulk of the irrigators and water users tend to be concentrated in countries like the USA or Australia. But these make no sense, for example, for some 20 million persons pumping groundwater in South Asia; or the communities that use over 300,000 tanks in South India or 7 million ponds in China.

Because large proportions of the population in the developing world depend upon rain and on local storage, the people's notions of ownership and rights relate more easily to precipitation than large-scale public diversions. Egypt gets less than 10 percent of its water from rainfall; yet Egyptians consider the rainwater to be truly their own. In Asia, where population densities are commonly as high in the catchment areas of the basin, as along the stream and river channels, the implicit primacy of the right of communities over precipitation rather than over diversions is for example widely accepted. Indeed, in recent years, a popular slogan in western India is "rain on your roof, stays in your house; rain on your field stays in your field; and rain in your village stays in your village." In the Western countries, upstream-downstream conflicts are important because most water users think of users upstream as their rivals. In the World Water Forum that met at The Hague in March 2000, the slogan that the Delhi-based Centre for Science and Environment popularised was "Everyone Lives Downstream," which is eminently sensible if all or a majority of people in a basin depend for their water needs directly upon rainfall.

The IRBM discussion talks very little of the enormous amount of work on farming in the semi-arid tropics, done by national and international centres such as ICRISAT[3]. As the Global Water Partnership (2000: 25) notes: "Most water management, including the literature on IWRM, tends to focus on the 'blue water'[4], thus neglecting rain and soil-water management. Management of 'green water' flows holds significant potential for water savings." This is because there is little real "dryland farming" of the Indian and West African variety in the developed world; but making the best use of soil moisture is a critical issue in many African and Asian countries. Europe, Canada, New Zealand, and USA do have rain-fed farming; but this is not quite the same as dry farming in western Rajasthan or sub-Saharan Africa; in many of these

[3]International Crop Research Institute for the Semi-Arid Tropics

[4]"Blue water" is water existing in bodies such as rivers or lakes, or pumped from aquifers. "Green water" is soil water extracted and transpired by plants.

countries, favourable rainfall and climate conditions result in favourable soil-moisture regimes that make irrigation unnecessary for growing good crops.

The conventional notion of irrigation is one of controlled supply of water to meet the full scientific requirements of plants precisely when needed. But the irrigation that is most widely practised in South Asia and amongst smallholder farmers in Africa is supplemental irrigation designed to increase the productivity of "green water". Green water is the precipitation used directly for crop production and thus "lost" in evaporation; "blue water" pumped out from wells is as important in South Asia and North China as the part that flows into rivers and canal systems.[5] This is quite unlike the situation in many developed country river basins. In these the bulk of economic water demands have been met from development of "blue" surface water and where, with the closure of these basins, the focus of basin management is on raising the productivity of blue surface water, largely without regard to green water.

Uniformly high population density, combined with unhelpful climate and hydrology, has a profound impact on the objectives of water management in developing-country river basins. In recent years, IWMI's water accounting work (Molden and Sakthivadivel 1999: 58–60) has made much contribution to understanding water productivity in the basin context.[6] Although IWMI's focus has been on productivity of water in agriculture, the framework can be easily generalised to develop a notion of basin-level water productivity in terms of a social welfare function for all stakeholders in a river basin constituting a basin community. Under this broad conception.

Basin welfare productivity of water = Basin welfare/Available water

Water productivity understood thus could be enhanced by

[a] enhancing productivity in each use; and

[b] constantly reallocating water amongst alternative uses—irrigation, domestic, industrial, and environmental—so that the marginal

[5]This distinction between 'green' and 'blue' water is extremely important for developing countries in the semi-arid tropics. Terrestrial ecosystems are 'green water' dependent; aquatic ecosystems are blue water dependent (GWP 2000:24).

[6]Standard definitions used in IWMI water accounting work (Molden and Sakthivadivel 1999) are: Gross inflow: total amount of water flowing into a domain from precipitation, surface and sub-surface sources; Net inflow: gross inflow +change in storage; Depletion: use or removal of water from a domain that renders it unavailable for or unsuitable for further use; Beneficial depletion: depletion that generates welfare; Process depletion: depletion in private economic uses; Non-process depletion : depletion in non-private, socially valued uses; Non-beneficial depletion: depletion that generates no economic or non-economic, private or social benefit; Committed water: outflow committed to other or downstream uses; Uncommitted outflow: outflows by default which are not used to create any value, private or social; Available water: net inflow –committed outflow-non-utilisable uncommitted outflow. Non-depletive uses: uses that create value without resulting in depletion.

contribution to overall welfare by water allocated to all uses remains equal.

Using the IWMI water accounting framework, this welfare productivity measure can be written in several alternative ways to highlight the importance of different water use strategies[7]. But for highlighting the difference between developed and developing world, a useful way to write the welfare productivity ratio is:

Basin welfare/Available water =[Basin welfare/Diversions] * [Diversions/Available water]

In relatively water-abundant humid regions, with low population density in the catchment areas and dense human settlements near the coasts and along rivers, river-basin management seeks to maximise basin welfare productivity by increasing [Basin welfare/Diversions]. Allocation of diverted water amongst alternative uses is a crucial function in basin-level water management in such conditions. Here, reservoirs have large free catchments; and ET in catchment areas is often not high; therefore, the need for active human intervention to maximise [Diversions/available water] is not great.

In water-scarce tropical countries with high population density everywhere, as in South Asia and China, maximising basin welfare involves working on both the components. Increasing the productivity of diverted water is certainly important; but equally important is the need to maximise the proportion of precipitation and inflows into a basin that can be diverted before they are lost to non-beneficial depletion.

It is against this backdrop that we need to consider the growing mass movement for rainwater harvesting and groundwater recharge in western India (Shah 2000). The region has amongst the highest windspeeds encountered anywhere in the world; it has high mean temperatures for nine months; rainfall varies between 300–800 mm/year; and population density is 300–500 per km^2 in the catchment areas as well as in the downstream areas. The greatest challenge for rural communities is surviving the annual pre-monsoon drought in April and May, which is made infinitely more daunting by regular failure of monsoon rains. During the pre-monsoon months, leave alone growing crops; ensuring adequate drinking water for humans and cattle is the great challenge, especially in the catchment areas of river basins. While government investment programmes concentrated on building large reservoirs downstream to support irrigation and municipal water supplies to towns, the problems of the people living in the catchment areas remained unaddressed.

Disenchanted with government and public systems, NGOs and communities began to find their own solutions. The past decade has witnessed a massive popular awakening as the result of the efforts of NGOs like Tarun Bharat Sangh, Pradan, and of religious organisations such as the Swadhyaya Pariwar. This has taken the form of rainwater conservation and groundwater recharge work on a scale that governments or public agencies would not be able to manage. The basic motivation

[7]For example, by writing Basin welfare/available water = (Basin welfare/total depletion) *(total depletion/ total diversion) *(total diversion/water available), we can signify alternative routes to water productivity.

that has been driving the movement is to ensure availability of domestic water supply for two months before the monsoon and for one or two crop-saving waterings from wells; and there are indications that the movement may well meet this challenge.

Government agencies and scientists (hydrologists in particular) have been dubious about this mass movement, their argument being that rainwater harvesting structures upstream merely transfer water; these reduce the input into the reservoirs downstream, thereby reducing their productivity. But this argument does not resonate with the communities, especially in the upstream areas, which fail to see why they cannot meet their basic water domestic needs instead of feeding reservoirs to irrigate relatively small areas of paddy or cotton. In defence of this popular movement, the Delhi-based Centre for Science and Environment has asked: what does India need more—Irrigation or Drought-proofing? In reply, it has suggested that by a total rethink on "appropriate" river-basin management, India can trade drought-proofing over vast areas by sacrificing irrigation of small areas.

It has also adduced evidence to show that diverting rainwater in a large number of small water-harvesting structures in a catchment captures and stores more of the scarce precipitation, closer to the communities in these parts of the world, than having a large reservoir downstream (Agarwal 2000).[8] This is because water collected over larger watersheds will have to flow over a larger area before it is collected and a large part will be lost in small puddles and depressions, as soil moisture and evaporation. Much before irrigated crop production, semi-arid India needs drinking water for its dispersed rural population during the nine months without rainfall. Many Indian observers think that the answer is not piped water supply schemes but decentralised rainwater harvesting. Agarwal's Centre for Science and Environment has estimated the average area needed per village to capture sufficient water to meet every household's drinking and cooking water requirement in the various regions with varying climate, precipitation and demographic conditions. The average for India as a whole was all of 1.14 ha/village in a normal year and 2.28 ha/village in a drought year!

5. Organisation of the water sector

Developed-country water sectors which have evolved over decades of public intervention tend to be highly organised and formalised with the bulk of the water delivered—and most of the users served — by "service providers" in the organised

[8]For instance, Agarwal cites evidence from the Negev desert in Israel to show that 3000 micro-catchments of 0.1 ha capture 5 times more water than a single catchment of 300 ha, and this multiple increases in a drought period (p: 9). He also cites results by Michael Evanari, an Israeli scientist that show that 'While a 1 ha watershed in the Negev yielded as much as 95 m^3 of water per ha per year, a 345 ha watershed yielded only 24 m^3/ha/year. In other words, as much as 75 percent of the water that could be collected was lost. This loss was even higher in a drought year.' Agarwal cites Evenari: "...during drought years with less than 50 mm of rainfall, watersheds larger than 50 ha will not produce any appreciable water yield while small natural watersheds will yield 20–40 m^3/ha, and micro-catchments (smaller than 0.1 ha) as much as 80–100 m^3/ha."

sector. In low-income countries, a vast majority of water users—the poorest ones—get their water directly from rain and from local private or community storage without any significant mediation from public agencies or organised service providers. The notion of water service providers is alien to a majority of rural South Asians and Africans. As a society evolves and its economy as well as water sector mature, the bulk of the water delivered to ultimate users is produced, developed, planned, allocated—in general, managed—by formal organisations, businesses or utilities. In Israel, for example, 70 percent of the water supply in the country is managed by Mekorot, a state-owned water company that operates the National Water Carrier—the pipeline system that moves water from Lake Galilee to the Negev desert, and is in urban water retail, desalination and sewerage treatment businesses (Saleth and Dinar 2000:185). When the bulk of the users and uses are served through the formal sector, resource governance becomes feasible, even simple. If a basin management regime wants to increase the water price to domestic users by 5 percent, or make a law intended to change the way business is done, it can do so with the confidence that it will stick. But this is not true when the bulk of the water users and uses are served by an informal sector where "service providers" are not even registered.

In comparing the Australian success with containing agricultural pollution of water with the Chinese situation, Hu (1999:327) laments that the small number of large Australian farmers are served by a range of local organisations—such as sugar, rice, cattle associations—which serve as vehicles not only for new knowledge and technical advice but also for implementing new rules and laws; but in China, "given the small scale of farming units and the large number of farmers, it is difficult to control chemical and pesticide application, removal of vegetation, erosion and water resource exploitation." In South Africa, over 90 percent of water is managed by formal organisations, including the Water Boards, but 90 percent of rural people, the black irrigators in former homelands are almost wholly in the informal sector, far out of the reach of the public systems.

Ignoring the scale and complexity of dealing with the informal water sectors in the developing world can lead to misleading analysis. In the perspective of Saleth and Dinar (2000: 186), for example, the institutional reform challenge in South Africa "lies in translating the provision of its water law and water policy without creating much uncertainty among private investors." In our view, these are easily done; the real challenge the government of South Africa is struggling with is of reaching the reform to the black communities in the former homelands, who operate in the informal water sector. And hard as the government is trying, this is not proving to be easy. About the process of Catchment Management Agency (CMA) formation in Olifants, South Africa, Merrey (2000:9) writes:

> *"... rural communities were unaware of the provisions of the new water law and the CMA process, despite the efforts to inform people and offer them opportunities to express their views. Small-scale farmers had not heard about the CMA.... [But] the Irrigation Boards providing water to large commercial farmers were participating actively in the process..."*

Small number of large stakeholders are easy to work with; the ball game changes fundamentally once we have to deal with a huge number of tiny stakeholders.

One way the informal sector can be "formalised" is through grassroots user organisations; and the global Irrigation Management Transfer (IMT) initiatives to organise irrigators into water user associations is partly motivated by the need to bring them into the formal sector. But in this too, small number of large users in the developed world have an advantage over large numbers of small users in the developing world. All manner of user associations form spontaneously in countries like the USA and Australia. These institutional models are constantly being tried out in developing countries but, here, these generally break down when faced with large numbers of small stakeholders who face such diverse constraints in their livelihood systems that they are at best apathetic towards each of them.

Thus, for example, irrigation management transfer to Water User Organisations has unambiguously succeeded in the USA, New Zealand, Colombia, Turkey, and Mexico, all situations of medium to large commercial or export farmers who run their farms as wealth-creating enterprises. In contrast, nowhere in low-income Asia, barring a few "islands of excellence," including the much-researched Philippines, has IMT held out the promise of long-term sustainability. White commercial farmers in South Africa took to Irrigation Boards like ducks to water; in African smallholder black irrigation schemes, there seems little chance that IMT will take off at all unless it is preceded by a wide-ranging intervention to make smallholder farming itself viable (see e.g. Shah, van Koppen, Merrey, de Lange, and Samad 2000).

One standard refrain of institutional discussions in the water sector is get water law and get it "right." It is often the case, however, that the problem is not passing a law but in enforcing it in a society with a large number of tiny stakeholders operating in the informal sector with little or no linkage with meso- and macro-level resource governance structures. This is why many governments in Asia readily pass Acts but spend years before converting these into laws.

There are also cases of countries which have passed laws, and these have come totally unstuck. Sri Lanka has been debating a water law—which has "all the right ingredients" (Saleth and Dinar 2000)—since the early 1980s but is yet to enact it. This is presumably because it is difficult to figure how to make all the "right ingredients"—water permit systems, full-cost pricing, water courts, explicit water policy statement—actually work in ways that make significant difference to the management of water resource in a country where 50–70 percent of the rural people acquire their water not through water supply service utilities/ companies but straight from nature or from local storage in small community tanks.

India adopted a water policy in 1987; but nothing changed as a consequence; and it is now working on a new one. Many Indian states have likewise been debating groundwater laws for 30 years; a dozen or so drafts are in circulation; the legislative assembly of Gujarat, the state with most severe groundwater overdraft problems, passed a bill as far back as in 1974; but the Chief Minister refused to make it into a law. And his reasons were convincing: firstly, he was unable to see how the law could be effectively enforced on a million small private pumpers scattered throughout

a huge countryside; secondly, he was certain that it would become one more instrument of rent-seeking for the local bureaucracy (Shah 1993).

"Get the price right" is another old prescription to make water an economic good. Now that water scarcity in many parts of the world is real, it would be naïve to question the value of pricing, not so much for revenue collection but to signal the scarcity value of water to users. There can be no serious debate on whether the view of water as a "scarce but free" resource is tenable in today's context. The real issue is making the price of water stick in a situation where a majority of users are in the informal sector and do not go to anyone except the rain-gods for getting their water.

Even in canal irrigation systems in South Asia, which are in the formal sector, many political leaders and senior administrators would become open to volumetric pricing of water to promote efficient use, if only the logistics of doing so were simple and cost-effective, what with the large number of small irrigators in the commands of Asian systems. After all, paying high prices for high quality irrigation service is common for millions of resource-poor buyers of pump irrigation in India, Pakistan, Bangladesh, and Nepal; but most people would avoid paying the full-cost price if not paying were an option, as is the case in many developing country water sectors.

That high transaction cost of monitoring water use and collecting water charge is the central issue in water pricing, rather than the politicians' propensity towards giving away largesse, will soon be evident in South Africa, where the new pricing policy will be easy to enforce on large commercial farmers, for whom the transaction cost of monitoring and collection will be low, rather than areas of black irrigation, which represent the developing-country picture in general, dominated as these are by large numbers of small users.

Developed-country institutions have not solved the problem of serving or regulating large numbers of small users particularly well; indeed, they have not yet found satisfactory ways of dealing with moderate numbers of large users. In New South Wales, Queensland and Victoria, the existing law confers on every occupier of land the right to take and use water for domestic consumptive purposes, watering stock, irrigating home gardens and non-commercial crops on a maximum of 2 ha (Hatton MacDonald and Young 2000: 24). If this exemption were applied to India, it would cover over 80 percent of all land and over 90 percent of all people; and in South Africa, it would cover 90 percent of all users though only 10 percent of land and water. In South Asia, South-East Asia and North China, groundwater is the most valuable and threatened resource; protecting ground-water from over-development is probably among the top three priorities in this region; yet doing so is proving to be a challenge precisely because groundwater is in the informal sector.

In the question of how best to deal with South Asia's 20 million tubewell owners in the informal sector, the experiences of Murray-Darling or Mississippi do not have many practical lessons to offer. Even in "highly evolved" river basins, sustainable management of groundwater is at best problematic, and at worst, as hopeless as in India and Pakistan. Murray-Darling has tried groundwater regulation but it is not certain if it has worked. Access to groundwater in New South Wales is regulated by licences under the Water Administration Act of 1986; however,

> *"over much of New South Wales, undeveloped licences were not cancelled. In retrospect, this has proved an administrative disaster as, in a number of areas, the total volume of licences issued is well in excess of estimated sustained yield."* (Hatton MacDonald and Young 2000:23).

In California's Central Valley, groundwater over-exploitation is a 60-year-old problem; yet in his case study of basin management, Svendsen (2000) concludes that

"Groundwater is the most lightly planned and regulated segment of the state's water resources. There is little control over abstractions and, on average, the state is in a serious overdraft situation."

Even in middle-income countries, where major institutional reforms have been initiated in recent years, groundwater over-exploitation has defied solution. Spain, one of the European countries that suffer agricultural over-exploitation of groundwater, has instituted sweeping reforms that will affect surface water but have little to do with groundwater (Saleth and Dinar 2000). Mexico's aquifers too are amongst the most over-developed; IWMI researchers based in Guanajuato state, one of Mexico's agriculturally dynamic regions, found water tables in 10 aquifers they studied declining at average annual rates of 1.79–3.3 m/year during recent years (Wester, Pimentel and Scott, 1999:9). An institutional solution is being tried here; the establishment of Aquifer Management Councils called COTAS (Consejos Técnicos de Aguas) in Mexico as part of its water reforms and under the new Mexican water law are a notable development. IWMI researchers in Guanajuato are, however, sceptical: "...several factors bode ill for their (COTAS') future effectiveness in arresting groundwater depletion..."

Finally, for top echelons of national decision-makers, it is always easy to take hard decisions, which do not affect a large proportion of a nation's population in a seriously adverse manner. Political leaders and water-sector leaders in emerging economies constantly face pressures to be myopic and adopt postures that are at odds with the ideal of integrated RBM. The most powerful and compelling pressures emerge from their own internal social realities. In low-income agrarian societies like in South Asia and much of Africa, food security and poverty alleviation will continue to remain prime concerns for decades to come.

When several poor states are involved in a basin—such as India, Nepal, and Bangladesh in the Ganga-Meghana-Brahmaputra basin, or the Central Asian states in the Aral Sea—co-ordinating mechanisms tend to operate at sub-optimal levels because national leaders are under pressure to maximise their national interests. It has been argued that the Aral Sea crisis is the outcome of the compelling need of the political leaders in the Central Asian states to ensure food security as well as water-intensive cotton cultivation for export, both at once; and a major move to reverse the desiccation of the Aral Sea, the Amu Darya and the Syr Darya, will have to wait until something changes the dominant perception of the political leadership in Turkmenistan and Uzbekistan that cessation of cotton monoculture will have politically and socially destabilising consequences.

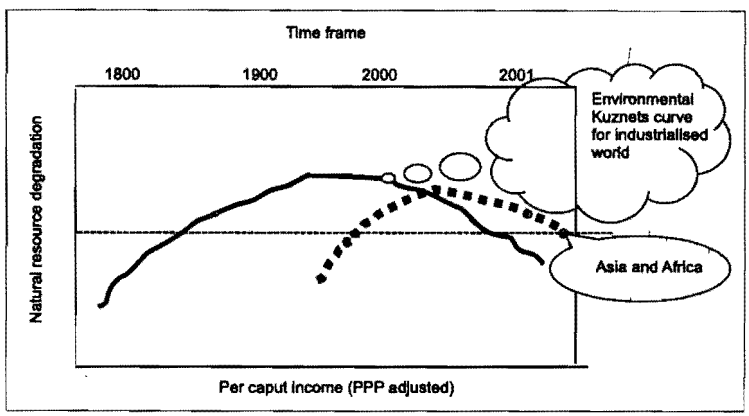
6. Stage of socio-economic development

What factors might influence the pace of institutional change in developing-country water sectors? Saleth and Dinar (2000) suggest that as water scarcity intensifies, opportunity costs imposed by missing or malfunctioning institutions will increase and transaction costs of institutional change will decline, which together will determine the pace of institutional change in developing countries. A competing hypothesis is offered by the application of Kuznets' curve to natural resource management by societies. Recently, there have been attempts to fit an environmental Kuznets curve to deforestation using cross-country data (Bhattarai and Hammig 2000).

The environmental Kuznets curve (ECC) poses an inverted U relationship between economic growth and environmental degradation (Figure 4). The core hypothesis is that, as economies grow, they use natural resources as a factor of wealth creation; but as per capita real income grows, demand for environmental amenity grows and there is greater demand and support for environmental protection.

Although the empirical results of some of this econometric work are far from conclusive, intuitively, it seems compelling to suppose that the income elasticity of demand for environmental amenity is lower at low per capita incomes (as in Bangladesh and Burkina Faso) than at high per capita incomes; and therefore, that highly evolved economies of the Western world would have greater demand, capacity and collective will to fix the environmental problems from natural resource mismanagement than low-income emerging economies. In many Western countries, where per capita income growth to present levels took 200 years or more, the ECC-effect too took centuries to work out. Historical evidence suggests deforestation in Europe was at its peak at the time of the Industrial Revolution; and the area under forests began to increase long after economic prosperity ensued (Bhattarai and Hammig 2000).

Figure 4: Relationship between level of economic growth and natural resource degradation



Much the same relationship seems to hold in the case of water resource management, too. Countries with highly developed water institutions are also those which have evolved industrially. In contrast, it is difficult to find a low-income agrarian society, which has highly developed water institutions. Interestingly, some sketchy evidence suggests that the period of decline followed by upswing gets telescoped in economies like Japan and Taiwan that have grown their industrial output and employment rapidly over a relatively short period.

In Table 1, we present the data set for 57 countries organised around their per capita water and arable land availability. The figures alongside the country names are their respective per capita CO_2 emissions, which is one of the best co-relates of GDP per capita as well as Human Development Index. Mean per capita availability of water and arable land along with CO_2 emission is used to divide the countries into eight categories.

Countries in categories B1, C1 and D1 are poor in water and/or arable land resources; but these are rapidly becoming post-agrarian societies where pressure on water and land from irrigated farming will rapidly ease. The social and economic costs of fixing water mismanagement in these countries already are or will soon be within acceptable limits.

It is notable that A1 represents the category of countries from which most models of effective water institutions emerge, and these are offered to countries in D2 category which have the least water, land and CO_2 emissions. A1 are amongst the best endowed countries with both water and land; as a result, despite being highly industrialised (as indicated by their high CO_2 emissions), these still have large, wealth-creating agriculture and agro-industries sectors that absorb a very small proportion of their populations.

In D2 category, poor land and water resource endowments combine with high population pressure; but ironically, their most critical problem is their low CO_2 emission. Industrial growth, urbanisation and transfer of people from agricultural to off-farm livelihoods seems the only way pressure on land and water will ease. Many of these countries will, over the coming decades, more likely take the Kuznets-curve route that Japan and Taiwan took than the one that the Australia and USA took.

In Taiwan, where rapid industrial growth and urbanisation have resulted in 40 percent decline in irrigated areas over recent decades, the popular outlook towards water management issues has undergone fundamental transformation. Over 90 percent of Taiwan's irrigators have become part-time farmers, and income from industrial employment far outweighs agricultural incomes; there have been major increases in demand for environmental amenity and in the touristic value of former irrigation structures; all these have resulted in substantial private initiatives and investments in improving water quality and aquatic ecology. Taiwan has amongst the highest population densities we find anywhere in the world; yet its water institutions will soon approach those in high-income western countries rather than low-income Asian countries, which share high population density with Taiwan.

Table 1: Natural resource availability and economic growth

	Per cap water> mean (10460 m³); Countries with high and low CO_2 emissions/capita		Per cap water< mean (10460 m³); Countries with high and low CO_2 emissions/capita	
	A1	A2	B1	B2
Per cap arable land> mean (0.37 ha)	Australia: 4.61	Argentina: 1.01	Denmark: 2.95	Sudan: 0.1
	Canada: 3.73	Brazil: 0.46	Greece: 2.09	Syria: 0.83
	USA: 5.37		Kazakhastan: 2.89	Zambia: 0.08
	New Zealand: 2.18		Libya: 2.18	Turkey: 0.78
	Hungary: 1.59		Spain: 1.6	Afghanistan: 0.02
	C1	C2	D1	D2
Per cap arable land< mean (0.37 ha)	Malaysia: 1.58	Cambodia: 0.01	Switzerland: 1.68	Zimbabwe: 0.45
	Sweden: 1.67	Chile: 0.92	South Africa: 2.1	Tanzania: 0.02
	Vietnam: 1.77	Indonesia: 0.33	Singapore: 5.32	Sri Lanka: 0.11
		Laos: 0.02	Saudi Arabia: 3.88	Senegal: 0.11
		Mexico: 1.02	Oman: 1.85	Philippines: 0.25
			Japan: 2.53	Peru: 0.3
			Italy: 1.92	Pakistan: 0.18
			N. Korea: 2.46	Nepal: 0.02
			S. Korea: 3.07	Kenya: 0.07
			Israel: 2.5	India: 0.29
			Belgium: 2.86	Ethiopia: 0.02
			France: 1.69	Egypt: 0.42
				China: 0.74
				Botswana: 0.37
				Bangladesh: 0.05
				Iraq: 1.21
				Iran: 1.15
				Syria: 0.83

Source: Engelman Robert et al (2000).

The Kuznets curve hypothesis looks at the relationship only from the angle of demand for environmental amenity. But there is also the supply side to it; much larger volume and quality of resources are applied to natural resource management in high-income countries than in low-income countries. Consider the budget of the water departments: California State Department of Water Resources has 2000 employees, mostly professionals, who operate an annual budget of US$1 billion (Svendsen 2000); Gujarat Department of Water Resources probably employs as many engineers but operates a budget of less than US$ 10 million. The upshot of this discussion is that, over a decadal timeframe, economic growth is probably both the cause as well as response to the problem of natural resource mismanagement; and, if the experience of Japan and Taiwan is any guide, the period over which the interaction between the two plays out need not run into centuries as it did in the case of Europe, but it can be telescoped from centuries to decades.

7. Conclusion

In this paper, we have made an attempt to explore why efforts to transfer the institutional models of river-basin management from developed countries to developing ones have not met with desired success. The contexts in which reforms are tried in developing countries are vastly different—in their hydrologic and climatic conditions, in their demographics, in their socio-economic conditions as well as in the way their water sectors are currently organised—from the context of the countries in which the models first succeeded. Successful institutional reforms in the water sector world-wide have tended to have common over-arching patterns. They have focussed largely on management of surface water bodies; they have aimed at improving the productivity of publicly diverted large water bodies; they have largely ignored groundwater and have not had to contend with dominant informal water sectors; they have centrally been about "blue water" productivity and have largely ignored "green water."

The problems that successful institutional models have resolved—water quality, wet lands, sediment build up in the upper parts of the river, maintaining navigation use, dealing with occasional floods—are often not of paramount interest in the developing country contexts. And the problems that developing countries find critical and insurmountable have either remained unresolved in developed-country river basins, such as groundwater over-exploitation, or are rendered irrelevant by their evolutionary process, as in using irrigation as a means to provide poor people with livelihoods and food security. This does not by any means imply that developed-country experience has no lessons to offer to the developing world; drawing such a conclusion would be naïve in the extreme. What it does mean, however, is that imposing institutional models uncritically in vastly different socio-ecological contexts can be dysfunctional and even counter-productive.

What it also means is that we need to take a broader view of institutional change. An extraordinary aspect of the institutional discussion in the global water sector is how very narrowly it has focussed on things that governments can do: make laws, set up regulatory organisations, turn over irrigation systems, and specify property rights. A recent review of institutional changes in the global water sector in 11 countries by Saleth and Dinar (2000), for example, treats water law, water policy

and water administration, as the three pillars of institutional analysis. This makes water purely the government's business, quite contrary to the slogan popularised by the World Water Council to make "Water Everyone's Business!" If institutional change is about how societies adapt to new demands, its study has to deal with more than what just the governments do; people, businesses, exchange institutions, civil society institutions, religions and movements—all these must be covered in the ambit of institutional analysis (see, e.g. Mestre 1997 cited in Merrey 2000:5).

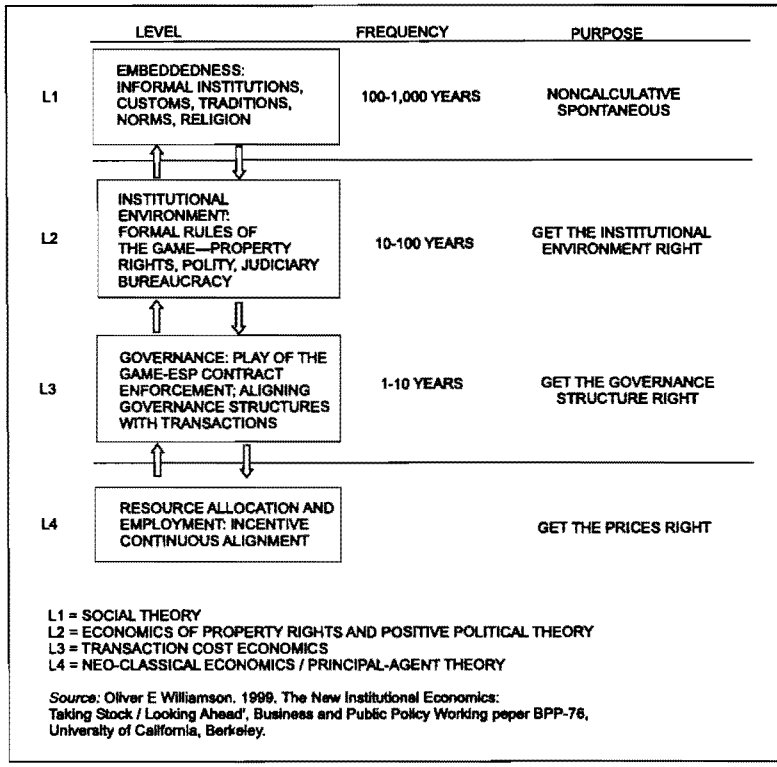
Which elements of the Murray-Darling experience can be sensibly applied in which developing-country context is certainly an important and interesting analytical enterprise; but equally, or even more, important is the need to listen to voices from the grassroots. If people living, for example in the Deduru Oya basin in Sri Lanka, are facing water scarcity, they are sure going to begin to do something about it; likewise, if the government of South Africa withdraws from the management of smallholder irrigation schemes in the Olifants basin, the smallholders will soon respond in some way. What institutional reform makes best sense in Deduru Oya or Olifants should best emerge from understanding the respective realities of these basins; a broad understanding of what has worked elsewhere including in the developed world might offer a good backdrop to the design of institutional interventions. But it might be unrealistic to expect much more; copycat institutional reform would be outright disastrous.

In understanding how societies adapt their institutions to changing demands, Nobel Laureate Oliver Williamson (1999) suggests the criticality of four levels of social analysis as outlined in Figure 5. The top level is referred to as the social embededness level where customs, traditions, mores and religion are located. Institutions at this level change very slowly because of the spontaneous origin of these practices in which "deliberative choice of a calculative kind is minimally implicated." At the second level—where the institutional environment of a society is involved—evolutionary processes play a big role; but opportunities for design present themselves through formal rules, constitutions, laws, property rights; the challenge here is getting the rules of the game right. The definition and enforcement of property rights and contract laws are critical features here. Also critical is understanding how things actually work—'warts and all'—in some settings, but not in others.

However, it is one thing to get the rules of the game (institutional environment) right; it is quite another to get the play of the game (enforcement of contracts/property rights) right. Which leads to the third level of institutional analysis: transaction costs of enforcement of contracts and property rights, and the governance structures through which this is done. Governance—through markets, hybrids, firms, bureaus—is an effort to craft order, thereby to mitigate conflict and realise mutual gains; and good governance structures craft order by reshaping incentives, which leads to the fourth level of social analysis—getting the incentives right.

Discussion of water policy and institutions in the developing-country context has focussed a g-reat deal on levels 2, 3 and 4 and little on level 1; more, it has tended to underplay the interactions between levels. Many populous developing countries will feel a lot wiser about IRBM if we learn more about how level 1 operates in their respective contexts and how the interaction between 2 and 3, and 3 and 4 can

Figure 5: Four levels of institutional change that explain how societies adapt to new demands



work better. How to create property rights that affect users' behaviour is more important than exhortations that clear property rights be created; understanding how to enforce a groundwater law meaningfully on 20 million private pumpers scattered throughout the South Asian countryside is more helpful than pushing a groundwater law; how to monitor water use and collect canal irrigation charges cost-effectively is more in order than discussing whether irrigation subsidies should be eliminated.

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Stakeholder Identification and Participation

Barbara van Koppen
Co-ordinator, Gender, Poverty, and Water Project,
International Water Management Institute, Colombo, Sri Lanka

Abstract

The paper discusses reasons why stakeholder identification and stakeholder participation have become important issues in water management in recent times. Three levels of possible application of these concepts are described: in accounting for the uses of water; in analysing the legal and institutional frameworks within which water is used and managed; and in addressing problems of exclusion (and inclusion) of specific and especially of disadvantaged social groups. In conclusion the general inadequacy and imprecision of the stakeholder concept are discussed, while noting its main value as a way of linking analyses based on the physical resources with those based on social goals, and of resolving some of the tensions between these approaches.

1. Introduction

Stakeholder identification and participation in basin-level water management, if taken literally, encompasses nothing less than water, people, and society. "Being a stakeholder" expresses an interest of a person, a social entity, or even an entity like "environment," vis-à-vis water. "Identification" relates to a systematic effort to spot the range of entities with stakes, according to a specific definition. "Participation" is equally broad, ranging from passively being informed to core decision-making (Pretty 1995). So the concept of stakeholder identification and participation remains as nebulous as concepts like sustainability.

Analytically, there are two solutions for too broadly defined concepts: either one defines the concept more precisely or one replaces it by better ones. This paper presents some arguments that would justify either choice. Firstly, a sketch is given of three more concrete definitions and applications of "stakeholder identification and participation," which are relevant in the context of this workshop on basin-level water management: identifying all water users in a basin; stakeholder identification and participation in basin-level water governance; and poverty and gender analysis. Secondly, it is argued why "stakeholder identification and participation" could be replaced by other approaches to link the resource and the people that lead to more insightful analysis and more realistic policy recommendations.

2. Identifying all water users in a basin: water accounting

Water use is an obvious stake in water. Identification of people from that perspective is meaningful. Stakeholder identification along these lines builds upon and refines what is assessed in water accounting: current water use, water demand and (emerging) competition. Water accounting itself usually does not extend beyond

averages and sector levels, while making crude assumptions about future demand. Extended and deepened stakeholder analysis can further elaborate intra-sector distribution of water and unmet water needs, which would be important for poverty analysis. It can better analyse the broader developments in society in which water is used and future demands can be assessed, etc. Existing or expected competing demands and conflicts that are brought to the surface by water accounting are also important pointers for in-depth analysis of the water users involved, the nature of the conflict, ways in which negotiations take place, or not, etc.

More sophisticated stakeholder analysis of water use, demand, and conflict is basically endless; it covers all historical, economic, social, technical, cultural and political dimensions of water use. This will also highlight other boundaries than basin-boundaries (Schlager and Blomquist 2000) and not only include the stakes of end-users of water, but also those with stakes as water managers, service providers, technology developers, regulators, policy makers etc. In fact, the very concept of stakeholder identification becomes rather redundant for such in-depth social analysis.

Such all-basin identification of "stakes" of water use is mainly analytical and informs policy or decision-making at best indirectly; the "participation" part is elaborated less, or not at all. This is the opposite of the next application.

3. Stakeholder identification and participation in basin-level water governance: legal and institutional issues

The emphasis on "stakeholder participation" is paramount in the context of water governance. Here stakeholder identification and participation are part of the institutional and legal analysis. Related to this are financing issues: stakes in water are the basis for charges. "Stakeholder identification and participation" are the business of water policymakers, managers, and others; researchers would address the underlying issues of governance and inclusion and exclusion processes. Possible topics are the following.

"Stakeholder identification and participation" is a typical endeavour in situations in which new forms of governance are explored which often entail new relationships between the state and other stakeholders. Today, there are many such ventures in which the roles, networks, and powers of governmental and non-governmental actors are newly negotiated and articulated, up to the basin level. They are induced by new water-related problems, such as pollution or upstream-downstream competition. Or the devolution of state tasks to private entities and pricing policies, or general claims for more democratic decision-making require new forms of water governance.

At the one end of the continuum of new forms of governance are people's initiatives outside the government, if not against the state. Examples where individuals take the initiative are the river parliaments in India, or an initiative in a small watershed in the USA to ensure the breeding of a particular species of fish throughout the basin (Heikkila 2000). Such spontaneous initiatives that tend to be led by the middle-classes are accompanied by further organisation into

NGOs, forums, etc., and by the development of relationships with the various state agencies. The claim of being a "stakeholder" justifies the claim for more decision-making power; this is negotiated.

At the other end of new governance forms are the initiatives taken by international or national groupings within or near the state itself, to involve stakeholders in new ways, for example to address better the complexities of water problems and ensure better informed decisions. An example of state-initiated stakeholder identification and participation is the establishment of the Catchment Management Agencies in South Africa, for which public consultation is required according to the National Water Act 1998. New communication channels are to be structured between the government and the public in which governmental decision-making authority is shared in new ways. Being recognised as "a stakeholder" is the first step of inclusion in the new decision-making networks. Stakeholders are defined as "anyone interested in or affected by a proposed undertaking" (Department of Water Affairs and Forestry, South Africa, 1999).

Although representation along class, race, and gender lines in these new structures initiated by the state is often a pertinent goal, there are major bottlenecks to achieve this objective. New forms of governance build upon existing forms and networks, which often are already biased. Moreover, especially when time schedules are tight, there is the strong tendency, also for legitimate reasons, to include de facto the more resourceful, and leaders among newly entering groups. A poor black woman is still not reached. This practical issue is illustrated in the Guide Four for Public Participation for Catchment Management Agencies and Water Users' Associations of the Department of Water Affairs and Forestry, South Africa (1999):

> *"... every sector has what can be termed 'key' stakeholders. They are either influential people, respected people, spokespeople for their sectors, people with authority to say 'yes' or 'no,' people whose local knowledge is important, people who want to derail the process for personal gain, and all those who think that they are key stakeholders."*

Even if expansion of existing networks is actively promoted in an initial stage, there is the moment when the networks are consolidated and less open to new entrants. However, if representation is the aim, continuous efforts for further inclusion need to be designed and institutionalised. The following, third application of stakeholder identification and participation tries to fill this gap.

4. Inclusion of specific water user groups: poverty and gender analysis

Stakeholder identification and participation can also focus on specific water user groups that tend to be marginalised. Such analysis would ultimately contribute to their more effective inclusion. This is a route to go if goals like poverty alleviation or gender equity through water management are to be reached. Water is perhaps the most critical resource, besides land, for the agriculture-dependent poor—the world's majority of poor people. Improved water management probably represents the most ignored and untapped potential for agriculture-based poverty alleviation, in

combination with improved seeds (as Lipton (1999) argues for tropical food staples) and marketing (Shah et al. 2000).

In this application of stakeholder identification and participation, the links between the resource water, people, and the ultimate beneficial goals for society (a world with less poverty) are most explicit. While the current and potential stakes are convincing for this group of stakeholders, concrete stakeholder identification has only just started in global debates, whereas participation is still at the initial stage of establishing communication, especially in the productive water use sector. It is clear that simply reducing poor people to "water users" will not do the analytical job needed. Poverty and water deprivation are issues of taller order both in analysis and policy and intervention. Some of the topics of poverty and gender analysis are:

- identifying poor people and assessing the nature of poverty processes and gender inequities;
- assessing poor women's and men's potentials and constraints in accessing appropriate technologies for managing water and making more productive use of water for higher incomes, in the wider socio-economic, cultural, and political context;
- analysing class- and gender-based conflicts and competition in water use and possible axes of action for more effective inclusion in existing or new forms of decision-making networks regarding water;
- designing integrated support systems to alleviate water-related poverty.

5. A people focus, or a resource focus?

The three above mentioned applications illustrate the variation of interpretations of stakeholder identification and participation. For any other application, the concept of stakeholder identification and participation would become much more useful if 'stakes', 'participation' and the purpose and context within which stakeholders are identified for participation are made explicit.

The question remains where further specifications of stakeholder identification and participation finally would lead. Even with the best specifications, the concept of stakeholder remains a-historic and individualistic and easily assumes equality among all stakeholders and their participation. Vague concepts may give good space for creative use, but as a tool for social analysis stakeholder identification and participation is weak. In all above mentioned applications, the whole concept of "stakeholder" quickly evaporates, except as an object of study in governance and inclusion and exclusion processes.

The main merit of the concept of "stakeholder" may be that it links resources with people. Having a stake in resource use and management says something about the two completely different "animals": natural resources and people. This link between the resource focus and the people or livelihood focus is a variation

age-old theme of the tension between technical and social perspectives. But even in this respect, the concept is not very helpful, as already become clear for poverty analysis. Reducing people to individual users or managers of a natural resource, however important that use is, is inadequate to capture the many other dimensions of society in which water use and management are embedded. The concept of "stakeholder" is also unlikely to trigger the search for more creative ways to deal with this tension. Non-trivial issue-based analysis and dialogue from various perspectives and disciplinary angles do better.

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Financing River-Basin Organisations

Charles L Abernethy
Irrigation Consultant,
Colombo, Sri Lanka

Abstract

The paper considers how reliable sources of funding can be found, for new river-basin management organisations, if these are established in the economic conditions of developing countries. These questions are considered against the general context of the gradual global movement towards the "users pay" concept, which is already familiar in the irrigation sub-sector in many countries. Aspects discussed include the types of costs that will have to be met, possible sources of funds and the difficulties or constraints associated with them, methods by which the liability for payments can be assessed, methods available for compliance on the income side and for control and accountability on the expenditure side, and the impacts that charging systems may be expected to cause.

1. Introduction: uses and demands for water

It has become quite widely accepted that countries should be aiming towards comprehensive management of water resources through organisations based on river basins or aquifers. (There may be other ways of managing the resources of a basin, but this paper addresses the specific situation where a country has decided that it wants to assign an organisation for this management purpose.) Such organisations will not develop effectively unless they can be provided with adequate financial resources.

In this respect, the experiences of the richer countries may not offer much useful guidance to the developing countries, especially the poorest ones. Their patterns of water use are radically different. Table 1 shows the breakdown at the broadest level, among the three biggest user sectors. In the rich countries, industrial users predominate. In the poorest countries, the industrial category is not yet very significant, whereas as much as 89 percent of all the water abstracted is used for agriculture.

Table 1: Sectoral consumption of water

Units: % of annual freshwater abstractions

Sector ▸	Agriculture	Domestic	Industry
Wealth category ▾			
Low income	89	4	7
Lower middle income	74	8	18
Upper middle income	73	12	15
High income	40	15	45

These patterns of use illustrate two obvious factors that have great influence on the financing situation. Firstly, in a basin where the majority of users are small agriculturists, they are usually extremely numerous, forming a large majority of the people in the poorest countries. Secondly, the productivity of water used in agriculture is usually very much lower than that of water used in industry. So when we deal with industry we are usually dealing with a relatively smaller number of people who are engaged in relatively profitable activities, while, when we deal with agricultural users (in developing countries), we are probably dealing with large numbers of people whose financial resources are very meagre.

We can note also (although it is far beyond the scope of this paper) that the low productivity of irrigated agriculture has well-known links with the agricultural production policies of rich countries, with market access problems for poor countries, and other issues of global scale which no developing country can modify much by its own choice of policies.

Domestic water supply is different again. We cannot compare it with other types of use on the basis of productivity. Domestic use is essential for human health and indeed for survival. So we supply water for social objectives as well as for productive objectives, and these are not really comparable in a financial sense.

Even that distinction is not as clear as we might like. The four basic human needs for water—drinking, washing, cooking, and sanitation—are certainly essential, but domestic uses of water can include many non-essential uses. When we compare the consumption patterns of the rich and poor countries, this becomes very evident. As Table 2 shows, in the rich countries the amount of domestic water consumed per person is very much higher than in the poorest countries. Also, within each country there are similar variations of consumption, related to poverty or affluence.

Table 2: Abstractions per person

Units: m^3/person/year abstracted from the natural systems

Sector ▸	Agriculture	Domestic	Industry
Wealth category ▾			
Low income	332	16.4	26.7
Lower middle income	339	36.3	81.7
Upper middle income	332	55.9	68.9
High income	386	146.5	442.2

In Table 2, we see that in the poorest countries the abstractions for personal use are minimal. We may estimate the basic needs at about 30 m^3/person/y, so the figure of 16.4 indicates that many people are obliged to satisfy those needs in ways that do not reach the formal statistical system. These are people who have to bathe in open bodies of water, carry household water from local streams, and in other such ways that are omitted from the data.

Table 2 also shows that, around the world, the gross amounts of water extracted for agriculture are quite similar. Here again we see that (although irrigated agriculture

is often blamed for water scarcity) the uses in poor countries are lower than in rich ones. We can also relate these figures to basic human needs. At the minimal nutritional levels required for sustaining human health, in a society where the basic food is a cereal crop such as rice or wheat or maize, it takes in the order of 300 m^3/person/y to grow that food if the water is applied very efficiently.

Of course that figure does not reflect directly the abstractions from the natural river systems, since much is supplied by rain, and also most of the irrigation water is not applied at highest efficiency; nevertheless, the need to satisfy a certain basic food requirement applies to us all, and it is good to note that this need is in the order of ten times bigger than our basic need for domestic water.

These widely differing patterns of water abstraction and use have various implications for the effectiveness of financial policies as charging tools. In the affluent countries, where personal domestic consumption is very much more than the amount required for satisfying the four basic needs, a charging policy may have significant impacts on consumption. A high charge may make people reduce frivolous or non-essential uses of water, or may just make them more conscious about water costs, and therefore induce them to change their behaviour, in ways such as becoming quicker to attend to leakages.

But in countries, or families, where domestic consumption consists simply of satisfying basic needs, a charging policy is not so likely to have those impacts. Supplying a basic need such as drinking is not something about which the "user" can exercise much choice. If the cost increases, the basic consumption will have to stay roughly the same. Any financial effect on that user will appear in some other direction, by not spending on some other item that must appear as less vital.

When we look at the productive applications of water, we can find many illustrations of the relatively low financial productivity of agricultural water. For example, Schiffler and others (1994) analysed the economics of water uses in Jordan, a country with one of the world's lowest levels of water resources per person. They reported that the average productivity of water in industry was 11.2 dinars / m^3 (about 16.8 US dollars / m^3 at the bank exchange rate then) whereas the average productivity of water in agriculture was 0.28 dinars / m^3, or 2.5 percent of the industrial level.

Within the agricultural sector, there are further huge variations of productivity. The productivity of basic cereal crops in the developing countries is usually around the equivalent of a few US cents per cubic metre, while fruit and vegetable crops, especially those for export, may show productivity as much as 100 times greater than the cereals. In the Jordan case, Schiffler and others found that that the productivity of grapes was 130 times more than that of wheat.

So here again we have the problem of basic needs. In the poorer countries, or poorer environments within any country, these low-productivity cereal crops—rice, wheat, maize especially—dominate the agricultural scene, and are not necessarily grown for the market. In the studies of five small irrigation systems reported by PMI-Burkina Faso (1997), it was found that the proportion of products marketed was 25.6 percent. In the system with least road access, this fell as low as 5.3 percent. The rest was household consumption.

To the users in those villages, the financial productivity of water must seem an utterly irrelevant concept. The idea makes sense (to the user of water) only in the context of marketable alternatives. Of course there is a governmental or "public interest" viewpoint that may suggest something else, concerning optimal uses of a scarce national resource. But if we feel that we may be moving towards any kind of user-based financing system, it seems that we have to try to understand how these things seem from the users' perspective.

Briscoe (1997) has emphasised particularly the idea that there can be a high opportunity cost associated with agricultural uses of water. The nub of this argument is that, where water is not abundant, low-productivity applications of it, for example to grow cereal crops, deny that water to higher-value potential users. He points out that prices charged to agricultural users are, typically, around 10 percent of those charged to urban and industrial users for comparable volumes delivered.

This is an argument that is easier to act upon in a mixed agricultural/industrial economy (or "middle-income" economy), such as some of those in South America; but it seems to carry less weight in countries where 89 percent of the utilisation is agricultural and the opportunities for transfers of use are correspondingly few. The concept of opportunity cost depends on the existence of such opportunities.

On the other hand, it is not safe for poor countries to treat the opportunity cost argument as irrelevant to their situation. In recent times, several countries in east and south-east Asia (Thailand is an example) experienced rapid economic growth continuously for more than a decade. A consequence of this was the arrival of many new investment opportunities, some of which would depend on transferring of water from a traditional low-productivity use into one of the new uses where its value (in economic productivity terms) would be some orders of magnitude more. In the absence of sound institutional mechanisms for responding to these opportunities through orderly, voluntary transfers and compensation of the prior users, these changes have occurred but sometimes at high social cost.

In the agricultural sector of developing countries, the problems of how to finance irrigation services, and how to collect irrigation service fees from users of agricultural water, have been prominent issues throughout the 1980s and 1990s. It cannot yet be said that the issues are satisfactorily solved. This experience should make us aware that the establishment of new basin organisations in developing countries is going to face similar difficulties.

Financing urban domestic water supplies is not any easier than financing irrigated agriculture. The World Bank (1993) reported its experience in lending for water projects in these terms (referring mainly to non-agricultural uses):

> *"The Bank has maintained the policy that cost recovery should be sufficient to pay both for operations and maintenance and for a fair return on capital investment... cost recovery was rated as unsatisfactory in 80 of 114 projects. And, in 78 percent of countries receiving water supply and sanitation loans, financial covenants were not fulfilled. In 49 of the 120 water supply and sanitation projects, fees were not raised enough to meet financial requirements due to government constraints."*

We can perhaps make a guess, that these problems of investment projects whose cost-recovery conditions are not implemented in reality, happen because such projects are prepared in the bureaucratic domain, and subsequently meet strong resistances in the political domain, due to neglect (in project preparation) of the weight of the people's views. This can only increase, as more countries are inclining towards democratic modes of government.

2. Components of costs

The financing question, for river-basin organisations, depends of course on the tasks that each country may decide its river basin organisations should perform. The scope of basin organisations falls into three broad categories, which may overlap in some countries:

- regulatory organisations, which oversee the management of water, and make rules which service-providing organisations have to follow, but have no other role in service provision;
- organisations which own the principal structures and facilities for water supply, but do not provide water supply services directly;
- organisations that provide water supply services directly to the users.

It may appear that the first of these, regulation only, is a relatively cheap alternative. If we adopt that kind of organisation, perhaps if the budgetary issue will be small and easily manageable. But that is not the case. If regulation is to be done well, it needs a significant amount of finance. A short list of the primary regulatory functions would include:

- monitoring of the quantity and quality of water in all rivers and other natural water bodies in the basin;
- conserving and protecting the watershed;
- making rules about abstraction, uses, disposal and pollution;
- supervising the application of a system of water abstraction rights or licences;
- ensuring compliance with rules through monitoring of activities, public information programmes, court processes, etc.

These tasks amount to a quite formidable financial commitment. They are most urgent in basins where water resources per person are already low. On the other hand, an organisation which has no service delivery function does not have a direct customer base from which a proportion of funds can be sought. These considerations show that the design of basin organisations cannot be separated from the question of how they will be financed, at a level sufficient for them to discharge the tasks that are assigned to them.

The movement towards establishing river-basin management organisations is coming at a time when governments, in both rich and poor countries, have been trying to reduce the amounts they budget for providing water services; so the idea that these organisations might be funded from the budget of a central government ministry may not be received well in many countries. In the developing countries, the main feature of this trend has been the numerous programmes of irrigation management transfer, which began in a few countries such as the Philippines and Colombia in the middle 1970s and have since become very general, indicating a widespread perception that central subsidising of water services is difficult to sustain.

The experience of irrigation management transfers in the past 20 years has however shown some of the difficulties that can occur when governments try to transfer the responsibility for certain tasks and their related expenditures from a service-providing organisation (such as a government irrigation department) to an organisation of service-receivers.

We can distinguish four kinds of costs that are faced by water organisations which are service providers:

- capital investment (constructing facilities for capture, conveyance and distribution of water; purchasing equipment; providing the buildings and other hardware of the management systems);
- major repairs and renewals of equipment and infrastructure;
- direct recurring costs (operation and maintenance);
- overhead costs (sustaining an administrative structure, including probably higher and remoter organisational levels, national, regional, etc).

An economist might say that the first two of these belong together as one "capital" category. But it seems better to make them distinct, as they usually happen far apart in time, and by the time when the need for renewals becomes urgent, the fact of the initial capital investment has usually caused great changes in the economic condition of the users.

In irrigation management transfer, governments typically aim to transfer to organisations of the service-receivers the responsibility for some or all of the third cost category, operation and maintenance, but usually the first and fourth categories are not transferred. The responsibility for the second category is often left unclear, and has been a source of problems in a number of such transfer programmes, because it creates doubt about the borderlines between the two parties.

The overhead costs of governmental irrigation organisations are not often discussed in the relevant literature. This could be because they are very large. Especially in Asia, government irrigation organisations are among the strongest and most long-lived organisations, and have developed large superstructures, often based in capital cities far away from their client populations. This seems to make the overhead cost a special one, which is not likely to be transferable to the individual end-users.

3. Regulation and service-delivery functions

Let us look now at the three different modes of basin organisation which were identified at the beginning of the preceding section. In the developing countries, we can usually find existing organisations that exercise the functions of service-delivery for each specific use category. These are often quite old organisations, which have developed a variety of specialist skills and have large professional work-forces. It seems unlikely that governments will abolish them. It seems unlikely, therefore, that basin management organisations will evolve towards direct service-provision to the ordinary citizens. A more probable path of evolution will be towards basin organisations taking up the regulatory functions, while direct service-delivery will remain the task of other organisations which manage urban water supply, agricultural water supply, hydropower, and other specific services to people, to companies and to other user organisations.

In theory, then, the service-providing organisations should become more clearly service-oriented, should behave more commercially, should become more subject to compliance with laws about pollution and other adverse social consequences of their activities, and (depending on the politics of the country) may be considered for privatisation; while the regulatory organisation exists in the public domain to ensure good laws, allocation of resources by administering a water-rights or licence system, conservation and protection of water sources, and compliance with all this.

That still leaves open the very difficult question of who should undertake new capital investments. Will it be the service-providers, or the basin organisations? There are strong arguments both ways. But it seems clear that this issue will be a vital one in determining the character of a basin organisation, and its relationships with service-providing organisations. If basin organisations are going to be constructors of major new facilities, their financial requirements will be much heavier than if they are purely regulators.

It seems that the primary reason why we need basin organisations, as the prospects of water deficits appear in an increasing number of countries, is for establishing compliance with a body of rules that will enable the people at large, through institutions, to regain some kind of control over the diminishing quality and quantity of water in their rivers. If we take that view, then perhaps we will think that this is a sufficiently huge and important task, and that we should not give the same organisation more conventional tasks, such as construction of major facilities, or even ownership of facilities that exist already.

One of the problems of establishing basin-management organisations is that there is clearly a potential conflict with existing organs of local government, which almost everywhere have boundaries that are different from the boundaries of river-basins. It is said sometimes that, since provinces or other local government units are responsible for achieving development within their specific boundaries, they must have control over such a major development factor as water. There is certainly much force in that argument. However, the separation of regulatory and service-delivery functions opens the way to escape from this problem. It is possible then to organise the regulatory functions on a river-basin (or aquifer) basis, while the

service-delivery functions can be organised on a different basis which may conform more nearly to the boundaries of local or provincial governments.

4. Sources of funds

The Dublin and Rio Conferences of 1992 enjoined us to regard water as an economic good. That seems to mean that users of it should pay for it according to the amount that they use. The way ahead, according to this view, seems to involve finance coming primarily from users of water, paying to service-providing organisations. In that pattern, it would seem practicable to finance regulatory basin organisations through some system of levies on the income of the service-providers.

On the other hand, it is difficult to see that service-providing organisations, in the poorer countries, are going to be able to behave commercially, and at the same time invest substantially in new capital facilities. The low profitability of the prime user, irrigated agriculture, indicates that, for many countries, this is not an immediate prospect.

Probably, too, the phrase "economic good" suggests that the prices we pay for water services should somehow reflect the sort of factors that usually influence prices of other economic goods. For example, if water is an economic good we might expect its price to rise in times and places of scarcity, and to fall in circumstances of low quality.

Concepts like this, however satisfactory they are economically, face many difficulties from the social and political angles. Water has been treated for long as an aspect of welfare provision, and in many places long periods of provision of water at zero price, or extremely low price, have promoted high effective demand, which is now very difficult to reduce.

However, there seem to be few alternative routes available for financing the activities. Either they must be financed from user charges, or they must be financed from central government budgets, or they will probably not happen effectively at all. The problem of central government funding, for the poorer countries at least, is that there is very little of it available, and there is strong competition for that little amount. We can see from the fate of (for example) hydrological data-collecting organisations, which in many countries have become weak and inadequate for their tasks, that centrally-funded organisations which are doing things that do not have direct popular appeal are likely to be left on the sidelines in the budget contest. Funding of river basin organisations this way may well make them unstable, and unable to pursue consistent long-range planning.

In Europe, there has been a trend in recent years towards the use of abstraction licences as a means of raising a significant proportion of the funds needed for sustaining regulatory organisations. This becomes possible when the regulatory function is clearly separated from the service-provision function. Regulatory organisations assess the available quantities of water, and issue licences accordingly. In that system, the service-providing organisation can be just another holder of an abstraction licence.

Abstraction fees are not the same as user fees. A service-providing organisation may pay abstraction fees to the regulatory organisation, and then sell the water to ordinary people or businesses, charging them a user fee, which exceeds the abstraction fee in order to cover the costs and financial risks of delivering the water. In such systems, licence fees may be graded according to scarcity.

Buckland and Zabel (1998) describe the workings of these systems, and report abstraction fees that are typically around the equivalent of 1–2 US cents/m^3, but in some cases significantly more. In some countries the product of abstraction fees is sufficient to cover the cost of all regulatory functions.

In a licence fee system, there are two ways of charging the user. The charge may be based on the measured actual consumption of water, or it may be based on the amount allowed by the licence. The system of measuring actual amounts involves a higher level of regular metering of the users, whereas the licence-amount method can be implemented with only occasional checks, to ensure that the conditions of the licence are not exceeded. If the cost of abstraction licences is set high enough, they can have an effect on the consumption of water. In the German state of Hamburg, for example, a relatively high abstraction fee for groundwater licences caused about a third of the licences to be renounced, and handed back to the regulatory organisation, which could then re-issue them to others.

There are other possible sources of revenue for a basin organisation. We may note three principal areas:

- waste-water disposal charges;
- pollution charges;
- charges for other permits for other water-based activities, such as fishing, navigation, recreation, etc.

5. Methods of assessment

Funding of regulatory organisations from abstraction charges, user charges, or from (for example) a small percentage levy on the user charges collected by the service-providing organisations, does not necessarily mean that all categories of users pay at similar rates. When we examine current charging practices, world-wide, we find a tendency to charge agricultural users much less, and industrial users much more, than the average.

This leads us to the question, how should charges be assessed? If basin organisations are to draw their funding ultimately from user charges, how will those charges be calculated?

This is related to other issues, about the impacts that we may want a charging system to have upon patterns of water consumption. It also brings in some very complicated issues related to the quantity, quality and locations of disposal flows, returning to the natural system after use.

Industrial users are accustomed to pay for measured quantities of water delivered to their premises. Urban users in the better-off suburbs also probably pay on the basis of measured volumes, and poorer users, especially the very poor, also pay, though probably not for measured flows but for volumes brought by water-carriers.

But the biggest users in the poor countries, the farmers, generally do not pay by volume at all. In the countries where irrigation service fees are levied, the overwhelming majority pay an amount that is based on land area. There are many variants of this, such as seasonal differences, crop differences, and so on; but the central point about the dominant current practice is that the marginal price, the cost to the farmer for taking more water, is normally zero.

Countries vary in the way they account for water that flows back to the river systems after use. In virtually all the uses of water, there is some "return flow," but the amount of this varies, and in many uses it is difficult to measure it. Briscoe says that

> *"...taking the US as an example, consumptive use as a percentage of withdrawals was 56 percent for irrigation, compared with 17 percent for urban water supplies, 16 percent for industry and just 3 percent for thermoelectric power."*

The United Kingdom, following the logic of these different levels of consumption and return, adopted a classification of use types into four bands, according to their average proportions of return flow. In such a system, users who consume a large fraction of what they abstract (such as irrigation) are charged more heavily than users with a high return percentage (such as power generation). There are of course quality aspects in relation to these return flows as well, which can be dealt with by the different mechanism of pollution charges.

In developing countries, water charges do not vary, generally, according to scarcity of the commodity. Water prices are usually calculated on some basis that is related to the cost of delivering it. That means that it stays the same, and does not respond to variations in available resources. In many countries, charging scales are centrally or provincially determined for large sets of irrigation systems, so that systems with water abundance and systems with local water scarcity are obliged to charge their users the same price.

Indeed, when we look at inter-country comparisons, although the variations in charging practices are enormous, there are signs of a correlation between scarcity and price policy, but it is a correlation that is opposite to economic logic. Some of the lowest charges (even when comparisons are based on purchasing power parity) are found in dry countries such as Egypt or Iran, while high charges can be found in much wetter places. This presumably represents a socio-political logic instead, which may well be stronger than economics.

There are even cases where the cost of taking water for irrigation becomes lower in the driest, hottest time of the year. The middle Niger river is such a case, simply because at that time the river level is comparatively high and the cost of pumping water to adjacent land is therefore less. This kind of anomaly results from basing

charges only on the cost of service delivery, which is effectively unrelated to scarcity, and often is only weakly related to quality, or to demand.

A river-basin organisation could reduce some of these anomalies. In many countries, water has been made legally the property of the state. It is possible, therefore, for a river-basin organisation to charge the service-providing organisations on the basis of the measured amounts that they extract from the natural system (as in the European examples of abstraction licences, noted earlier). Each basin organisation can devise its own level of charge, related to the amounts of water which it has available for abstraction. It is possible for those charges to be varied along some seasonal or even monthly scale. In this way, a basin organisation could exert some pressure on the service delivery organisations to look for ways of moderating their rates of water use, while at the same time improving its own financial independence.

6. Collection

The compliance problem, in respect of irrigation service fees, became famous during the 1980s. The Philippines, especially, made the "viability index" a central feature of its institutional reforms: this index is the ratio between fees collected and the costs of operation and maintenance. Field officials of the government agency could receive bonuses depending on the percentage of fees actually collected.

Studies of the costs of fee collection show that they can be a significant proportion of the total amount collected. "Passive" collection, meaning the kind of system where each user is expected to bring the fee to the collection office, seems prone to abuses, or at least to long delays of payment, which present serious cash-flow difficulties to service-providing organisations. "Active" fee collection, using paid collectors who visit houses or farms, incurs a significant wage cost. Both methods need accounting staff and certain facilities. Some studies of irrigation service fee collection have found the cost to be occasionally as high as 15 percent of the collected amounts.

How will river-basin organisations minimise these linked problems of compliance, delayed payment, and collection cost? The answer to this seems to be (as for some of the other issues raised above) that the separation of regulatory from service-delivery functions should substantially reduce this problem. The service-deliverer must have a direct relationship with the water users, and indeed the trend towards user-controlled service organisations assists this. The regulatory organisation on the other hand has different duties, and should collect its fees from a few major sources, principally the service-delivery organisations, but also including any others to which it grants permission for abstractions, pollution permits, or other water-related activities. On the whole, passive modes of collection may be sufficient for this.

7. Control of expenditure

As river-basin organisations come into existence in an increasing number of countries, we will face another kind of issue: how will their expenditure levels be controlled? These organisations should become, as far as possible, responsive to the interests of their own stakeholders. But the stakeholders are very diverse.

Everybody is a water user; and most of us are water users in several different modes. Some may want new storage facilities to be built; others would prefer that costs be kept down as far as possible. The interests of birds, fishes and other wildlife have to be accommodated somehow, along with other non-economic aspects of water, such as landscape beauty, waterfalls, and the like. All of these things tend to have cost connotations in some way.

These matters cannot be satisfactorily resolved by creating river-basin organisations that are firmly embedded in the governmental bureaucracy. A different and more responsive kind of organisation is needed, which will be accountable to some council in which all principal stakeholders have a voice.

In these conditions, control of expenditure can be done transparently, with budgets approved in advance not by finance ministries, but by the people of the basin who will have to bear most of the costs and receive the consequent benefits.

8. Impacts of charging

The Economist, reporting after the World Water Forum, said,

> "*whether it is Australia or Rajasthan, once people understand the true cost of water services, they will conserve water, and even help to dig ditches if necessary. In return, they will want transparent prices and better service from both governments and private firms.*"

That is a clear statement of the standard economic view of the impacts of water charges: consumption will reduce, capital costs will be partially taken up by users, and customer pressures will cause organisational behaviour to improve. Is it true?

It is quite difficult to reconcile this optimistic view of the power of economics, with the findings from the detailed work of PMI-Niger (Abernethy and others, 2000). There, in a country that is at or near the bottom of the *per capita* wealth scale and other human development scales, the irrigation service fees are among the highest in the world. On the whole, fee collection rates are high. Farmers pay 20 percent of their gross crop value in fees. If the foregoing quotation is true, water should be used very efficiently in these circumstances. But the water productivity was found to be equivalent only to 20 US cents / m^3, in terms of gross product value, at Purchasing Power Parity (less than 5 US cents / m^3, at nominal bank exchange rate). No signs of reduction in water consumption could be detected over ten seasons of monitoring.

There seem to be three sources of the difference between these observations and the view quoted earlier. Firstly, *The Economist* was drawing lessons primarily from urban cases. Secondly, water is only one input to a production process, whether in agriculture or industry, and it is generally not a replaceable input; so if the user thinks that more water is necessary in order to realise the benefits of other inputs, that user will probably apply the extra water. But it seems likely that the third reason is the most influential. This is, that farmers in Niger, as in most other developing countries, do not pay for the quantity of water they use. They pay heavily, but the charge is area-based, so the marginal cost of taking more water is zero. Urban

users, whose quantitative needs are smaller and more measurable, normally are not in that situation. For them, the marginal cost of increasing their usage of water may be quite high.

This problem, that the major users of water (farmers) have no direct incentive to reduce their consumption, is not likely to change in the near future. Although we can measure pipe flow volumes acceptably, and the equipment cost for doing so is quite tolerable, devices for measuring flow volumes (as distinct from flow rates) in open channels are not available at the scales and costs required for the small land units typical of developing countries, especially in Asia. So the impacts of charging in metered urban systems can be quite different from those in smallholder irrigation.

One proposed approach to this problem is by charging, not to individuals, but to groups, for example to all the farmers along a single common channel. There is as yet little evidence that this is effective. At the level of the individual, it does not alter the incentive much. If there are fifty farmers sharing a metered source, each may calculate that, by taking an extra cubic metre of water he or she will obtain all the benefit of using it, but will pay only one-fiftieth of its cost.

For a financial system to have a strong impact on water abstractions, it must also be designed to give incentive to the service-delivery organisations to reduce the conveyance losses in their systems. Both urban water-supply organisations, and irrigation departments have until recently shown poor records and lack of concern about reducing losses. This is another area where separation of river-basin management from service-delivery is helpful.

If the service-delivery organisation has to buy the right to abstract water, it will be more strongly motivated to ensure that as much of that water as possible reaches a customer. Water leaking from a canal or a pipe, in that system, means a direct financial loss to the service-delivery organisation. The separation also makes it easier to include in the financing arrangements some reflection of the value of leakage water that can be recovered by pumping from aquifers, which varies greatly according to factors like location, quality and aquifer depth.

There is also the problem of equity. As we move more towards the principle of payment for water services, can we feel sure that the poorer sections of society will have adequate access to water? Briscoe (1997) put this problem clearly:

> "*The inequities of existing command-and-control mechanisms for water allocation in irrigated agriculture have been widely documented...Because water has rarely been formally managed as an economic good in developing countries, however, there is little information on the equity effects of a market-oriented management system.*"

We can, however, feel relatively confident that there are better chances for restoring equity, under river-basin management organisations, than under the present systems of management. Traditional water rights have been rapidly eroded by the political and economic changes of the past two or three decades, and relatively few countries have succeeded in supporting the traditional systems, or in replacing them by modern systems based on water rights that are legally enforceable by

their users. Basin management offers a way of redressing this situation, either through rights or licences. It would seem reasonable to accept the need for some payment, or increase of existing payments, in return for a better guarantee of supply or abstraction rights.

However, we should also note the need for good, transparent public information programmes when such a policy change is under consideration. If public opinion is not prepared for such changes of traditional patterns, and informed about the benefits that they are intended to bring, they are likely to be rejected.

Charges, or increases of charges, are never going to be popular. It is futile to hope for that. However sound our economic logic is, however much we may feel that a charge system can reduce distributional inequities, or improve water-use efficiencies, there will not be demonstrators in the streets demanding the introduction of such charges. It is good to keep this point in mind, as we think about possible beneficial impacts of charging policies.

The equity question can be regarded as yet another argument for keeping a separation between the regulatory and service-delivery functions. Research on equity effects will probably continue to be necessary for quite a long time. River-basin organisations should take some responsibility for monitoring these effects, and for encouraging the necessary research. They should be in the position to adjust their regulations, and the constraints on the service-delivery organisations, so as to take account of the need to limit the degree of inequity that may exist, and particularly to ensure access for all up to a certain basic level.

9. Conclusions

River-basin organisations offer a promising way towards better and more equitable management of water resources. They need to be adequately financed, and it is better that their finance should be generated locally from among the users of their services, who should also have an effective voice in influencing their policies, than that their finance and policy should be determined centrally.

The ways of generating sufficient finance, in the case of poorer countries, are not yet sure, because of the weak financial situation of agricultural users, who account for the overwhelming majority of water consumption in most countries. The lessons that can be learned from the financing systems of richer countries are of limited relevance, because of the different balance of user types.

Current systems of charging for water services have many defects. Irrigation charges are usually area-based, not volume-based, so they give no incentive for water-saving, neither for the service-delivery organisation to reduce leakages nor for the end-user to improve application efficiency. Charging rates are usually calculated on the basis of the cost of providing water delivery service, and sustaining a supply organisation, but do not often reflect the scarcity or abundance of the water resource, or the quality of the water. Often economic logic is reversed, as poor city-dwellers pay more for low-quality domestic water.

Systems of abstraction licences may be the most easily implemented,method of addressing simultaneously these various problems, especially:

- to sustain the kind of organisation that is needed;
- to give firm legality to long-standing traditional users;
- to protect principles of equity during rapid socio-economic changes; and
- to make possible more flexible systems of charging that will reflect scarcity and quality, and will follow some progressive scale so that basic needs (both personal water use and food production) can be satisfied at rates that are less than those charged for levels of use which exceed the fundamental human requirements.

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Framework for Assessment of Institutional Frameworks for Integrated Water Resources Management

Paul van Hofwegen
International Institute for Infrastructure, Hydraulic and Environmental Engineering, Delft, the Netherlands

Abstract

Integrated water resources management (IWRM) is the management of surface and subsurface water in qualitative, quantitative and ecological senses from a multi-disciplinary perspective, and focussed on the needs and requirements of society at large regarding water. IWRM requires a platform for weighing of all relevant interests and decision-making on use of water and water systems in the river basin. Ideally, all interests are represented in this platform and it requires decision, control and sanctioning powers under governance of government to protect the interest of society at large. A minimum set of institutional conditions should be met to allow such IWRM platforms to operate successfully. A framework with guidelines for application has been developed to assess the required capacity-building interventions to arrive at these conditions and to establish such platforms. This framework is based on a development process with and by the stakeholders to come from an identified present water resources management situation to some desired integrated water resources management situation. It is a compromise between the present and an "ideal" IWRM situation, as a result of a negotiation process in which policymakers, water resources and water utility managers and stakeholders are involved.

During development, the guidelines for assessment of the institutional framework were tested in three pilot cases: in Guatemala, Jamaica, and Colombia. After their acceptance the Inter-American Development Bank (IDB) applied these guidelines in, among others, Honduras, Dominican Republic and Costa Rica. This paper describes briefly the methodology and its theoretical framework underlying these guidelines and elaborates on the experience with and outcome of their application.

1. Introduction

International awareness about the importance of water resources management is growing. Originally the approach was very sub-sectoral, mostly in relation to water supply, sanitation and irrigation. There is however, a growing consensus that Integrated Water Resources Management (IWRM) is necessary for sustainable resource use for all the sub-sectors and to protect the environment.

The aim of IWRM is to discard the one-sided management perspective of single interests of one sub-sector by one government agency and to strive for a participatory multi-sided management perspective of all interests in management of water resources. IWRM therefore takes account of all natural aspects of the water resources, all sectoral interests and stakeholders, the spatial and temporal variation of resources and demands, relevant policy frameworks and all institutional levels.

The Inter-American Development Bank (IDB) developed a strategy for IWRM which aims to help borrowing member countries to shift from a sectoral, development-based focus to an integrated, management-based approach. One key principle of this strategy is an increased emphasis on institutional issues and capacity building. This requires an analytical framework for the assessment of the institutional setting for integrated water resources management that the bank could use for the incorporation of capacity-building considerations in future IDB water-related projects.

This paper describes an overview of the framework and the guidelines as developed for project teams, bank officers and government agencies to facilitate the process of project formulation and monitoring (van Hofwegen and Jaspers, 1999, 2000).

2. Framework for assessment of institutional frameworks

2.1 Need for integrated water resources management

Actions to use or control water for specific purposes are aimed at security, social well-being, economic gain and the preservation of ecosystems. These activities of use and control can create problems that may be classified as externality, open access, public interest and scarcity problems (Lord and Israel, 1996).

Externality problems exist when actions of one party affect the well-being of a second party, and the first party cannot itself gain by considering this effect and modifying its behaviour accordingly. Open access problems exist when the use of the resource is open to all, and when the rate of use of that resource affects the amount that can be used. Public interest problems relate to the necessity to provide a particular good to all in equal amounts. No one can be excluded from consuming it, and the cost of providing it to one is as great as the cost of providing it to all. The problem is that these goods are likely to be under-provided because no one will undertake to produce them, since they cannot be withheld from others, thus cannot be sold to make profit. Government thus must provide these goods. Scarcity problems exist when the users want more of a good than the quantity available at a given price. Economic markets handle scarcity by allowing competition, in which those with the most purchasing power, and to whom the resource is most valuable, will bid it away from others. To safeguard the low-income strata of society and the environmental needs, the negative effect of scarcity is commonly dealt with by non-market institutions such as river basin councils or the government.

Solving these problems requires establishment or changes of water use rules that must occur at water resource level. Creating an effective set of water resource management rules requires action at the water policy and law level. These higher level actions are important because ineffective rules and ineffective accountability and policing mechanisms assure that water use and control problems cannot be solved.

2.2 Interests

There are many interests in water. Interests in water means the benefit obtained or preserved by individuals, groups or nations with the presence, use and control of water.

Interests can be classified as those of the first and second order. Interests of the first order are essential conditions for life (human, animal and plant) in that water system. Interests of the second order are those that can be prioritised after being weighed on their economic, ecological and social values.

Government has the "care function" as for management of water resources. First-order interests are interests of society and therefore require to be represented by government. Second-order interests are interests of individuals, groups, or parts of society, and can best be represented by their stakeholders.

First and second order interests are different in place because of different physical, hydrological, cultural and socio-economic conditions. As development goes on, especially second-order interests will change. This means that interests are site-specific and time-specific, and site-specific approaches are therefore warranted.

In water resources allocation there is general agreement that the supply of water for basic human needs has priority. In this respect the equity principle plays a major role. Another priority is the requirement to maintain essential life support ecosystems. These can be considered first- order priorities. All other needs for industry, agriculture or other societal needs should be prioritised according to socio-economic criteria, by which water is considered an economic good. Although cost-recovery and economic pricing are overriding principles, pricing and tariff regulations within sub-sectors are considered necessary where equity or social well-being are at risk and environment is endangered.

2.3 Generally accepted principles

Another clear consensus is the need for adequate participatory approaches to planning and management, and mechanisms for accountability and democratic control. This is closely related to the principle of decision-making at the lowest appropriate level (subsidiarity), which also implies that some decisions (for instance, on the sharing of international waters) should be taken at the highest level. In that case, mechanisms of democratic control and stakeholder participation clearly operate at the highest level of government.

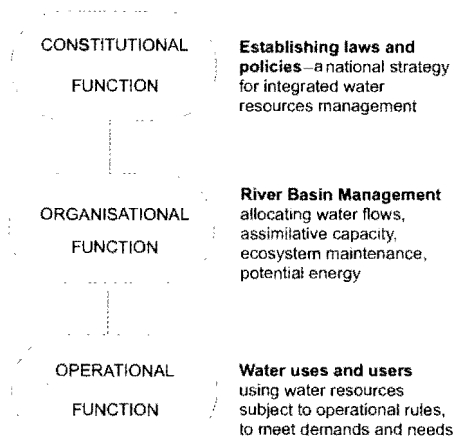
The river basin is the logical unit for water resources management. In many cases this has led to the decentralisation of management to river basin level. But one should not forget the role of central government. River basin management is largely an operational matter, whereby water allocation, water quality management, cost recovery and stakeholder involvement are essential components. However, the river basin authority is not a legislator and not responsible for policymaking and the setting of objectives and constraints to operational management.

Central government has an important role in IWRM in policymaking, legislation, strategic planning, establishment of the appropriate legal and institutional framework, capacity building, and supervision of decentralised and privatised institutions in water resources management. In addition, government should provide the protocols for information exchange (on water resources, water use and infrastructure), should provide adequate databases required for strategic planning and should prepare integrated river basins plans in response to its policy guidelines and constraints.

2.4 Functions and functional levels in IWRM

IWRM means decision-making concerning development and management of water resources for various uses. In this decision making process it takes into account the needs and desires of all the different uses, users and stakeholders. To pursue IWRM three functions are considered (figure 1): the operational or water use function, the organisational or water resource management function, and the constitutional or water policy and law function (Lord and Israel, 1996). The operational function is focussed at use or control of water for specific purposes to fulfil specific needs and demands. These include water supply and sanitation, irrigation and drainage, flood protection, hydropower, industrial supplies, tourism and recreation, fisheries, navigation and the preservation or rehabilitation of ecosystems.

Figure 1: Functions in integrated water resources management



To minimise the problems and conflicts of these different uses and users, co-ordination of water use and water allocation is required. Solving these problems also requires establishment or changes of water use rules. This is the organisational function. It involves co-ordination, planning, decision-making and policing of water use and users in water systems (river basins, aquifers).

To make the organisational function possible an enabling environment has to be created. This requires water policies, institutional development policies, including human resources development and normative and executive legislation. This is the constitutional function. These higher level actions are important because ineffective rules, accountability and policing mechanisms assure that water use and control problems cannot be solved (IDB 1997).

IWRM requires a good performance at al these functional levels. Development towards IWRM, therefore, needs to address these levels in a holistic way. These

development efforts are called capacity building. To make a proper assessment of required capacity building interventions the following framework is proposed.

2.5 The framework

The analytical framework is based on a cyclic development process to come from an identified present water resources management situation to some desired integrated water resources management situation. The desired IWRM situation is a compromise between the present and the ideal IWRM situation as an instantaneous complete introduction of IWRM is unrealistic and maybe undesirable to expect. This compromise will be the result of a negotiation process in which policymakers, water resources and water utility managers and stakeholders are involved. The outcome will be determined by technical, financial and political attainability under prevailing socio-economic conditions. With changing conditions the desired IWRM situation will change. This process contains the following major steps (figure 2):

- Assessment of the present situation and trends,
- Formulation of a desired IWRM situation based on an "ideal" or eventual IWRM situation,
- Formulation of interventions to arrive at the desired IWRM situation,
- Establishment of a monitoring system to see whether the interventions are being carried out properly and whether they really contribute to the achievement of the IWRM goals.

The framework and the guidelines are developed for the three functional levels: constitutional, organisational and operational.

2.6 The "Ideal" IWRM situation

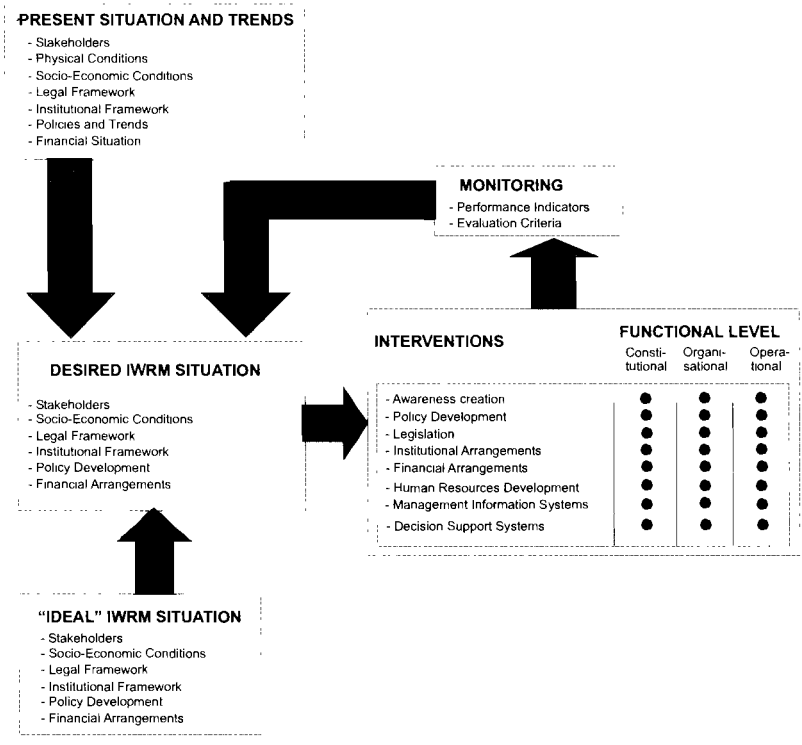
In the framework an "ideal" IWRM situation is formulated that should give direction to the process of integration of the management of water resources. In an ideal IWRM situation the water resource is managed on (sub-) basin level in a sustainable way. The water related interests of all stakeholders are considered in decision making on water use. All stakeholders are aware of the potential of the water source and the impact of their use on the other stakeholders. Decisions on water use and associated cost of service provision are made in a participatory manner according criteria agreed and accepted by all stakeholders. Implementation of IWRM is done at the least cost in a transparent way with effective accountability mechanisms in place.

The "ideal" IWRM situation is derived from the theory on IWRM and the internationally accepted and applied principles on water policies. Use has been made of regional and local water policy documents aiming at IWRM. (IDB 1997, Worldbank 1993, ADB 1996, South Africa 1997, the Netherlands 1997). The "ideal" IWRM situation does not exist. Local and regional conditions will determine what the most appropriate situation will or should be. The ideal situation is only presented to provide

an orientation in formulation of the desired IWRM situation. Conscious choices must be made to deviate from the ideal situation. This not only helps to increase understanding of the implications of IWRM, but it also generates (in the end product) a better sense of participation and belonging. It allows for active contributions to the formulation process, as the desirable IWRM situation will be used to define gaps in different arrangements, which in turn could be used for formulation of interventions.

Before IWRM can be successfully carried out, a set of institutional conditions must be met. These requirements are at the three functional levels and will be discussed in the following chapter.

Figure 2: Analytical framework for the assessment of the institutional setting and capacity building requirements for integrated water resources management



3. IWRM requirements for the functional levels

IWRM is a process of assignment of functions to water systems, the setting of norms, enforcement (policing) and management. It includes gathering information, analysis of physical and socio-economic processes, weighing of interests and decision making related to availability, development and use of water resources. This means that IWRM requires:

- a platform for weighing of all relevant interests and decision making on use of water and water systems in the river basin;
- this platform should represent all interests and be under governance of government to protect the interest of society at large;
- this platform should have decision, control and sanctioning powers;

A minimum set of conditions should be met to allow such IWRM platforms to operate successfully. These conditions are related to constitutional, organisational and operational functions. For all these functions it is required that the respective authorities have the mandate and the resources (financial and human) to carry out their tasks in development and implementing IWRM.

3.1 The Constitutional Function: Water Policy And Law

The main purpose of the constitutional function is to create an enabling environment for the IWRM platform with appropriate policy and legal frameworks, which gives the boundary conditions for effective implementation of the organisational and operational functions. Constitutional functions include policy development based on clear principles, development of normative and executive legislation and development of human resources development strategies. An important aspect to be arranged at this functional level is the degree level of participation of the private sector in all three functional levels.

IWRM requires from the constitutional function a system that:

- enables effective development and implementation of laws and regulations,
- enables effective constitution and development of relevant institutions,
- regulates decision making based on interests of all stakeholders,
- enables all stakeholders to participate in decision making,
- provides quantitative and qualitative standards for use,
- provides quantitative and qualitative standards for effluents,
- enables and regulates effective control and sanctioning of violations,

- enables implementing agencies to take the necessary steps to secure and conserve the resource,
- provides effective and transparent accountability mechanisms,
- provides sufficient capable people to meet the IWRM demands of policymaking, adapting legislation and all other activities,
- enables and regulates private sector participation.

3.2 The Organisational Function: Integrated Water Resources Management

The organisational function is integrated water resources management. The ultimate goal of the management process is to allocate water in quantity and quality terms for different purposes. The process involves resource assessments, planning, decision making, implementation and policing on allocations and use of water resources with and based on the interest of stakeholders. These processes are time and location specific. The activities are highly multidisciplinary, involving engineers in hydrology, hydraulics, construction, water supply, sanitation, hydropower, irrigation, and non-engineers such as: environmentalists, ecologists, lawyers, economists, sociologists, agriculturists, politicians and representatives of interested parties, pressure groups, and water users.

The development of an integrated water resources management capacity and capability is both a top-down and bottom-up process. The top-down process is a result of the execution of the care function of government. Government has to impose measures and regulations to protect the interest of society through protection of resources, ecosystems and socio-economic well-being of the people. Government executes this task through policy development and creation of legal and institutional frameworks for use and management of water resources.

The bottom up approach originates from the operational level where different and sometimes conflicting use and control interests need to be protected. This bottom up process is to be carried out in the enabling environment as created by government. As this is a process of learning, correcting and adjusting, the frameworks as imposed by the constitutional level should leave enough room for refining and adjusting. This means that only main policies and major concepts are regulated in law and the interest groups are given the opportunity to formulate their own way of co-ordination and operation. This, of course, should be done under tutelage of government.

3.3 Platform for co-ordination and decision making

The development efforts should be focussed at the creation of a platform for weighing interests and decision making on water use and control. To be successful this platform should have the support of the stakeholders. A consultation process before establishment of such platform is warranted.

The platform should have a decision-making capacity on river basin level that reflects the interests of different uses and users. The great lines for decision-making procedures should be part of the regulatory framework prepared by government. This should include a clear regulatory framework with norms and standards for decision making.

An effective and transparent accountability mechanism is essential for effective management. This includes accountability to the operational level to see whether the service agreements are being carried out, and to the constitutional level to ensure that societies' interests (wise use of resources) are not violated. Such accountability mechanisms require the platform to have power to control and sanction violations. These accountability mechanisms and policing powers have to be regulated in legislation from government.

3.4 Data availability

An effective IWRM system requires reliable information on the availability, use and quality of surface and groundwater in the basin. Databases, observation networks and inspection systems are to be made accessible, improved or developed. Good access to these data allows analysis of various options or scenarios for interventions in development and use of water. Sufficient capable and motivated people with the appropriate tools are required to meet these IWRM demands for planning, management, control and development. Identification and development of people and tools for management are part of the development process of the platform that also requires consent and support from the different stakeholders as important cost can be involved.

The legal and institutional framework in which the platform is to be developed and will operate is to be created at constitutional level. At constitutional level also the policies are set for development of capable and motivated staff.

3.5 IWRM requirements at organisational functional level

The basic function at organisational level is to co-ordinate between the different interests and to decide on the different uses of water. An effective organisational function requires:

- a decision making capacity on (sub-) river basin level which reflects the interests of different uses and users,
- a clear regulatory framework with norms and standards for decision making,
- a system that provides reliable information on the availability, use and quality of surface water and groundwater in the (sub-) basin,
- a system that allows analysis of several scenarios for interventions in use of water at basin level,

- an effective and transparent accountability mechanism,
- power to control and sanction violations,
- sufficient capable people to meet the IWRM demands on planning and management, control and development.

4. The operational function: water services

In IWRM a distinction is to be made between the management of the water resource and the delivery of water services, both of which are necessary in each country. Usually the planning, development and management of the water resource must be a government responsibility to ensure that public interests are served. In contrast, specific water services are generally best delivered by autonomous and accountable public, private or co-operative agencies with scope for increased private sector participation.

Manipulation of flows and (ground) water levels, to provide these services, requires an hydraulic infrastructure, whose development and management costs need to be recovered from the beneficiaries or from the community at large, if the system is to be sustainable.

Sustainability requires among others, adequate funding for operation, maintenance and management of the system. The costs for services are in principle to be recovered from those who benefit from the provision of those services. This requires an identification of beneficiaries and clients for the services provided. Clients are only willing to pay for services if these are reliable and considered not too expensive. Often government subsidies are provided to reduce the cost for the clients or to stimulate certain developments. However, this usually reduces the incentive for the managing agency for optimal performance of service delivery and effective and efficient use of resources. Financial autonomy of the managing agency that is fully accountable to the clients is a prerequisite for system sustainability.

4.1 Service orientation

The provision of the services requires an infrastructure that needs to be planned, designed, constructed, operated, maintained and after some time replaced or modernised. At the onset of development, the infrastructure is designed to provide a certain level of service. The cost of service provision is directly related to the level of service provided. The higher the level of service, the more management efforts and Infrastructural requirements are needed, the higher the cost. In a situation where clients fully pay for the cost, the level of service must then be balanced against the associated cost in a consultative process with the clients and other stakeholders. They will agree on the level of service and its associated cost. The results are included in a service agreement between the service provider and the client. These agreements can only be successfully carried out if transparent and effective accountability mechanisms and accountancy systems are in place (van Hofwegen and Schultz, 1997). These also constitute part of the service agreement.

4.2 Water management services

Water management is the manipulation of surface or subsurface flows, levels and quality of water to serve either one or a combination of the following purposes:

- water supply for agriculture, domestic, municipal and industrial use, recreation and environmental protection;
- drainage of urban and rural areas;
- flood protection for urban and rural areas;
- control or maintenance of water quality.

These manipulations are carried out by individuals or organisations in a provision of public or private services on a local, regional and international scale and are mutually interactive.

The nature of water as a resource and its multiple use requires co-ordinated efforts to manage the different and often conflicting manipulations needed to fulfil the demands for the different purposes. These management efforts are offered as services and can be carried out by one or more institutions that can be either government, semi-government, private or users' organisations.

It happens that different organisations are involved in the provision of one service. Typical for such situations is the provision of irrigation water for agriculture not directly to the individual clients but through a water user's association.

4.3 The clients

In water management different services are provided for different client groups. The nature of the service determines whether the clients are clearly identifiable individuals who can voluntarily use or reject the services without doing harm to others. In water supply the transaction of a certain volume of water can be demanded or rejected without harming another water user (provided water is not a constraining factor).

However, flood protection, drainage and water treatment are water management activities that are of public nature and cannot be accepted or rejected by individuals. It is clear that water services are not always provided to identifiable individuals. Clear definition of the clients is necessary to decide with whom to enter into a service agreement, who is to be charged, and where to send the bill.

4.4 Development of the service relationships

As described above, the service relations and the services provided need to be clearly defined and transparent administration and effective accountability mechanisms need to be introduced. These are the main ingredients of the service agreements (van Hofwegen and Malano, 1997).

4.5 IWRM requirements at operational functional level

Effective operational functioning within an IWRM context requires a management system that responds to societal needs. This means that for water services the system should enable, provide or regulate:

- effective control of the service providers by users/clients and the IWRM Platform
- representation of clients' interests at and by the managing agency
- cost recovery by the service provider
- negotiations between the managing agency/service provider and its clients on the level of service it provides and recovery of its associated cost
- assessment of the demands, actual use and availability of water (quantitative and qualitative)
- power at the service provider to control and sanction violations
- sufficient capable people to meet the IWRM demands, planning, development and management of services provided
- a system that allows market incentives to make most economic use of water through participation of the private sector

5. Assessment of the institutional framework—process and tools

Assessment of the institutional framework requires a process, to come from an identified present water resources management situation to a desired integrated water resources management situation. The steps in this process are: identification of the present situation, formulation of a desired IWRM situation, formulation of interventions to arrive at the desired IWRM situation and establishment of a monitoring system to see whether the interventions are being carried out properly and whether they really contribute to the achievement of the IWRM goals.

The assessment process is using 10 steps that have been based on the experience gained from the test cases in Guatemala, Colombia, and Jamaica. In this chapter these steps are elaborated and tools which have been used successfully in these case studies are presented.

5.1 Step 1: existing water management situation

The present situation on water resources use and management should be well known before any intervention directing to IWRM can be made. Understanding the water situation is a prerequisite for assessment and analysis of the institutional framework and the (potential) water use conflicts between stakeholders. It appeared essential to have a basic document on the present water management situation to

start the institutional assessment process. Such a document will represent an experts opinion and will not necessarily be complete, accurate and representing the opinions, desires and aspirations of all stakeholders.

Important aspects to be dealt with are: water availability and water use, stakeholders, physical conditions, socio-economic conditions, legal framework, institutional framework, policies and trends and the financial situation. Experts are assigned to prepare such a (desk study) report describing the existing water management situation combined with registered problems (quantity, quality and environment). The report serves as a general background document for the following steps and has to be disseminated accordingly.

Physical conditions

The assessment of the physical conditions concentrates on the temporal and spatial availability and use of water (quantitative and qualitative). It requires information on the climate and meteorology, hydrology and hydro-geology, aquatic ecosystems, abstractions and influents and the availability and capacity of storage facilities.

As in IWRM water is managed on basin or sub-basin level, use of water resources, water distribution per sector and the resulting water balance have to be identified per basin or sub-basin. This is essential information for IWRM so the existence of observation networks and data bases, the levels of processing and the accessibility to these datasets and should be included in the inventory.

For the inventory a clear distinction has to be made between the different levels: national, basin and sub-basin level. At national level the inventory should limit itself to the water balance in the different basins. Such water balance provides insight into whether and when the basin is in a surplus or deficit condition. Temporal surplus conditions provide the opportunity to overcome temporal deficit conditions by creation of storage facilities. During deficit conditions the occurrence of major conflicts in interest will be most prominent both in quantitative and qualitative sense.

At basin or sub-basin levels a more detailed inventory can be required. For such an inventory a water use flow diagram can be most helpful. Such a diagram provides not only the uses and users but also their inter-dependencies with regard to water quantitative and qualitative aspects.

Stakeholders and interest groups

Stakeholders are people or groups of people with a legitimate interest. Legitimate interests are formulated in the by-laws of the interest group where the stakeholder is regarded as a private entity/body. Stakeholders are not the same as interest groups. Interest groups represent all kind of interests: public, private, environmental, social etc. If they are organised and have statutes or by-laws they represent legitimate interests (GO's, NGO's, professional organisations, commercial organisations, users associations) and as such become stakeholders.

In IWRM the stakeholders can be classified as follows:

- water users — consumptive and non-consumptive uses
- water polluters — agriculture, industry, domestic etc.
- water managers — organisational and operational level
- water policy and law makers — constitutional level
- society — general interests represented by government and specific interests represented by NGOs

It depends on the socio-economic and the political situation whether all the interests are represented. So it is important to assess which stakeholders' interests are considered and which are not considered, but are important for sustainability.

A water use (flow) diagram can be most helpful in identifying the stakeholders. Water use will be different for each basin. Therefore, stakeholders have to be identified on basin level.

Inventory of water problems

In this stage the inventory of water problems limits itself to those generally known and registered at the main stakeholders. The basin water balances and the water use flow diagram can again be most useful to put the registered problems into the basin perspective. The type of problems that not only concern water quantity, quality and environmental issues (erosion, siltation salinity etc.) but also relate to navigation, recreation and other uses. This inventory will be used in the second step as a starting point for an analysis of the problems and identification of other interest groups and stakeholders.

Water rights and water allocation

In most of the countries water is considered a public good, but individuals can obtain private rights over water by tradition. Existing water rights are often a main constraint and a source of many problems in the optimisation and introduction of IWRM. The system of water rights (surface water and groundwater) their acquisition and conditionalities, their transferability and the system of water right administration should be clearly presented. Especially in water market systems a sound administration and a system of approval of transfers is required. If not available, planning of water will become very difficult.

Water allocation between different uses and users is an organisational function. The introduction and development of IWRM could learn much from the present water allocation system, the conditions and procedures and actors in the decision-making process. A good description will, therefore, be very valuable especially for the analysis of water quantity related conflicts or problems. These aspects can be verified in the stakeholder interviews in the next step.

Description of socio-economic and financial environment:

Many of the problems identified above will be said to be due to the actual financial and social situation. Lack of infrastructure and maintenance, lack of good management, and the difficulty of having effective cost recovery are usually blamed on lack of financial resources. Therefore, it is important to have insight into the budget allocation mechanisms, budget constraints, cost recovery mechanisms, subsidies, price and tariff structures, collection mechanisms, collection efficiencies, capability and willingness to pay for the various uses. These mechanisms should be identified in general terms per sub-sector or use.

Existing water policies and strategies

In many countries the water sector is under debate due to problems experienced and the commitment of governments to the outcome of the international conferences. Though often not yet formulated, many countries are in the process of policy development. These policies deal with principles like: equitable and socially acceptable water distribution (priorities, redistribution to marginal groups: poor, women etc.), water as a scarce, finite and economic good (efficient water use, cost recovery, pricing mechanisms and tariff structures, transferability of water rights, rate of commercialisation), water management at the lowest appropriate level and on hydrological boundaries (delegation and decentralisation, water users participation, involvement, water management by and for water users), integrated planning arrangements and other co-ordination efforts, private sector participation, and environmental protection. An inventory of these policies indicates the level of awareness and commitment at constitutional functional level.

Lack of these means either that there are no problems, lack of awareness or lack of political will.

Legal framework

An inventory with an explanation of principles is required of existing water laws (and other relevant environmental legislation), water regulations and relevant environmental regulations and decrees and by-laws of water authorities and river catchment agencies. It is important to indicate, whether and how the above mentioned focal policy aspects are incorporated in the legislation such as equitable water distribution, pricing, delegation and decentralisation, participation, integrated planning, and environmental protection.

Especially in countries where water policies are changing, legislation will be under reconsideration or in the process of change. Therefore, it is necessary not only to present the existing legislation but also the adjustments envisaged. When legislation is in a process of change this indicates that on constitutional level they are aware that present legislation does not satisfy the needs. It is of great value to describe the background of these changes and the direction of the change.

Special attention is to be paid to "trial" legislation where government has given mandate to certain management entities to work with legislation under design in pilot areas, for example, IWRM or basin level management.

Relevant water institutions

Relevant water institutions are those institutions that with regard to water and water management either formulate policies and laws, do or are involved in water planning, co-ordinate water uses and users, provide water services or make use of water services. These can be government, semi-government or private institutions on national, basin or use level. A water use flow diagram can give an indication of water users, service providers and co-ordinators.

Past and present experience in IWRM

It is important to know what has been tried in the past to overcome certain problems encountered and to what extent these interventions have been successful or not. A description is desired of lessons learned from local experiences of earlier and/or present interventions in the field of integrated water resources management and reasons for success or failure.

5.2 Step 2: stakeholder selection

A first inventory of stakeholders will be made in step one. These stakeholders will be the obvious operators of water services, co-ordination bodies and policy and lawmakers. For the further process a selection of stakeholders has to be made to avoid duplication. Also some stakeholders might have been overlooked in the first study. Therefore, an independent team is formed to identify and select relevant stakeholders from the categories: water policymakers, water managers, water service providers, water using agencies, water using groups, water users and other potential interest holders at constitutional, organisational and operational levels. These stakeholders will be approached for in depth interviews.

5.3 Step 3: stakeholder interviews

Experts carry out an elaborate procedure of interviewing the selected stakeholders applying the guidelines for interviews. These guidelines are in the format of a questionnaire which contain questions relating to the stakeholders interviewed and their perception of the existing situation and what they consider to be the desired IWRM situation. During this interview previously overlooked stakeholders can be identified through the identification of parties that negatively influence the implementation of the stakeholder's duties.

A different set of questions under the issues in the matrix is used for all three functional levels. They are organised under the headings: stakeholders, awareness, policy, legal framework, institutional framework, financial arrangements, human resources development, management information systems and decision support systems.

The selected stakeholders will be invited to answer the questions during the interview. Guidelines for interviews have been prepared (Van Hofwegen and Jaspers 1999). The interviews should provide information on the situation of water management and indicate the conflicts and the level of agreement and disagreement between

the stakeholders. It is, therefore, important that the interviews are made by specialists who understand the meaning, purpose and operationalisation of IWRM and the potential problems and conflicts that might be encountered.

A second part of the interview aims to obtain a description of the stakeholder's concept for improvement of the existing water resources situation, towards more integrated water resources management. The following aspects and principles should be included:

- Equitable and socially acceptable water distribution
- Efficient and economically sustainable water use
- Delegation, decentralisation and other devolution of authority
- Participation of stakeholders
- Integrated planning
- Private sector participation
- Environmental protection

It is obvious that no guidelines can be prepared on how the IWRM situation should be as this is location and time specific. However, to give direction to the process on formulation of a desired IWRM situation, an "ideal" IWRM situation is formulated where in relation to all the points raised during the interview, a clarification is given on how the situation would look like under ideal conditions.

The formulation of the desired situation by the individual stakeholders provides information on what they consider the main constraints and what should be changed and what they see as being realistic and attainable in their present situation.

The "ideal" IWRM situation is derived from the theory on IWRM and the internationally accepted and applied principles on water policies. It does not exist but is only presented to provide an orientation in formulation of the desired IWRM situation. Conscious choices must be made to deviate from the ideal situation. This allows for active contribution to the formulation process, as the desirable IWRM situation will be used to define gaps in existing arrangements, which in turn could be used for formulation of interventions (steps 4–6).

5.4 Step 4: analysis of stakeholder opinions

The guidelines are presented in the format of a matrix where through sets of questions for different stakeholders the present and desired situation for each of these stakeholders on the various levels are identified. The outcome of all the interviews will be collected and an inventory will be made of agreements and disagreements between the different stakeholders on the present situation, the problems and constraints and the steps to be taken to come to a better water management. The results of the interviews are described in a report and

disseminated with the background document to the interviewed stakeholders. These stakeholders should also be invited to the workshops that follow in the process.

5.5 Step 5: workshop 1—problem identification

The first workshop to which all the relevant stakeholders are invited deals with the assessment of the existing water resources management situation and problem identification according to the perception of the stakeholders. The steps 1-4 were focussing on individual stakeholders and their interests. Their agreements and disagreements as formulated in the analysis report in step 4 are an interpretation of the "expert". Therefore, it is important that all the relevant stakeholders recognise their problems and those of others.

The purpose of the first workshop is to confront the different stakeholders with the perception of other stakeholders and to obtain consensus between all different stakeholders of what the real problems are and which should be addressed. The analysis report will be used as a reference and will be improved in accordance with the outcome of the workshop. The agreed set of problems will then be used as an input for the further stages on formulation of a desired IWRM situation and necessary interventions. During the test cases it proved to be a very fruitful method to arrive at a set of most important problems.

Important is that the workshop will be organised under the auspices of acknowledged and accepted authorities as participants will only take such an activity serious if the result will contribute to the process of change. This means that the outcome should be included in the policy development process, implementation process or operationalisation of water resource management.

5.6 Step 6: workshop 2—formulation of desired IWRM situation and interventions

The second workshop (one to three months after the first workshop) will elaborate extensively on the principles of integrated water resources management and will further result in the formulation of a desired water resources management situation in that specific country or river (sub-) basin and the set of interventions that will be needed to achieve that.

This workshop is indicative and the outcome provides directions for constitutional, organisational and operational interventions. The outcome should be seen as an input for national policy and decision makers on the one hand, and as a framework for defining interventions at the three levels. It is, therefore, important that the status of the outcome is valued in this light.

In case these guidelines are applied for specific project work, an additional step in this workshop is required to analyse which, if any, of the above formulated interventions should be promoted in the context of this specific project and which interventions better to leave for other projects or sets of activities.

5.7 Step 7: preliminary country/basin/sub-basin report

Based on the foregoing steps the experts will draft a preliminary country document comprising:

- assessment of existing water management situation
- complete problem inventory
- desired water resources management situation
- proposed set of general and specific interventions needed to reach the desired situation

5.8 Step 8: dissemination and comments

The draft country/basin/sub-basin report is disseminated and a thorough procedure for collecting comments from the different stakeholders at the different levels is followed.

5.9 Step 9: final country/basin/sub-basin report

Experts draft a final country/basin/sub-basin report which is offered to the government and financing agencies for endorsement and inclusion into the strategy and/or into specific water related projects for the specific country.

5.10 Step 10: Monitoring procedure

A monitoring procedure is developed to see whether the interventions are taking place and whether the envisaged results are achieved.

6. Application of guidelines and lessons learned

These guidelines have been developed in an interactive process, which included field tests in three countries (Colombia, Guatemala and Jamaica). The use of the guidelines initiates a process towards balancing the interests of different stakeholders in water. The guidelines can be applied in different stages of the project cycle: sector policymaking, sector planning, institutional design and management arrangements for the sector and for specific projects. Its use should result in an agreement on what the problems and conflicts are and how these can be resolved. The process in itself is cyclic and by monitoring the effectiveness of the interventions new problems and constraints can be identified and corrective actions or new solutions have to be sought. The following points require attention in the application of the guidelines:

1. The use of the guidelines has to be regarded as the initiation of the process towards IWRM attached to projects envisaged. The first cycle of the process results in a set of interventions necessary to achieve the desired IWRM situation. These interventions can be included in the

project design. These projects can be sectoral on regional or (sub-) basin scale or sub-sectoral and on local scale.

2. The application of the framework is most effective in programmes aiming at sector wide institutional change and development because the aim of the programme coincides with the purpose of the guidelines. Moreover, the programme is most likely to be supported by the main stakeholders, making the possibilities for interventions wider and necessary adjustments in legal and institutional frameworks less complicated.

   The guidelines can also be applied in relation to local projects in physical infrastructure. The project should be of such scale that different stakeholders can and will be influenced and conflicts of interest on local and (sub-) basin scale are foreseen. However, in this case the focus of the project is on the physical works and institutional change is a derivative of such a project. The possibilities for interventions will also be limited by the room provided in legislation as it can hardly be expected that for only one such project legislation will be amended.

3. It is important to notice that, on the local scale, the situation is not always perceived as problematic. However, it is the duty of government to foresee possible negative effects for, and conflicts with, the interest of society. In such cases government should take appropriate action through awareness creation and, in a later stage, should participate as a stakeholder in the formulation of interventions using the proposed framework.

4. The guidelines can be applied at different levels of scale: sub-basin, basin and national level. For whatever level of scale these guidelines are applied, it is crucial to identify and engage all relevant stakeholders at the three functional levels. Leaving out some stakeholders might lead to non-acceptance of the outcome of the process and obstruction of the further development of IWRM. Therefore, these exercises cannot be done through desk studies.

5. It is advisable to engage independent local experts and preferably not from within the government. Independence should take away bias towards selection of stakeholders in the process. Government officials are likely to focus on official government policies and government agencies limiting the marsgins of problem identification and solving.

6. During the tests it became clear that the interview procedure required more emphasis. The purpose of the interviews is to obtain the opinion of the individual stakeholders or their representatives. The guidelines for the interviews are meant to be a tool for the interviewer to structure the interview and to interact with the stakeholder on the different issues raised. The guidelines should not be handled as questionnaires to be handed over to the stakeholder to be filled as then the sensitive issues

will not surface. This means that besides a good understanding of IWRM, good communication skills are required for the interviewer. It also emphasises the necessity for good, clear and field tested guidelines.

7. The workshops proved to be an effective tool to obtain consensus on what the problems and conflicts are and what steps should be taken to resolve them. On several occasions it seemed to be the first time that different stakeholders were sitting in one room discussing their problems! However, to deal with problem identification and resolution in one workshop was too much asked for. Several workshops with different focus are needed e.g. one workshop on problem identification and one on solutions and interventions.

8. Clear prospects for the stakeholders are a necessary condition for the stakeholders to participate actively. The idea that problems are being inventoried and ways are sought to solve them leads to expectations that follow up will be given. Therefore the framework of this process must be made clear from the onset. Active participation also depends on the authority of the initiator of the process. For example, the role of the Inter-American Development Bank as initiator and organiser of the workshops appeared to be crucial in all the test cases.

9. Some understanding of IWRM and private sector participation (PSP) among the participants in the process is a condition for a good outcome. The first inventory should identify the level of awareness and knowledge on IWRM and PSP. If necessary awareness and knowledge can be raised through information and education and training programmes.

10. A basic requirement for IWRM is the preparedness to reflect on principles of active democracy, because IWRM is about weighing private and public interests and therefore a matter of compromises. Outcomes of democratic processes should be respected and solutions should not be forced.

11. In most cases the scale of the process will not be sufficiently known. In such case step one of the process (inventory) can be separated from the remainder. The outcome of step one should then include a cost estimate for one cycle of the process.

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Section D

Case studies of national river basins

In this section, actual experiences of river-basin management systems are described and analysed
These examples come from countries at widely different stages of economic development
The case studies in this section refer to river basins which lie entirely within national boundaries

The seven papers present management systems from Mexico, Turkey, Indonesia, France, Australia, and the United States

Managing the Water Transition in the Lerma-Chapala Basin, Mexico

Philippus Wester
Visiting Researcher, Irrigation and Water Engineering Group, Wageningen University
Martin Burton
Director Water, Information Training and Development (ITAD)
Eduardo Mestre-Rodríguez
Permanent Technical Secretary, Latin American Network of River Basin Organisations

Abstract

The Lerma-Chapala basin in central Mexico, with a catchment area of some 54,300 km² and serving a population of over 15 million, is one of the most over-committed basins in the world. Its total water depletion exceeds annual renewable water by 10% on average. To counter this over-exploitation several institutional innovations have occurred in the basin, while water reforms at the national level have also significantly altered the arrangements for water management in the basin. These changes reflect the adaptive capacity of Mexico to manage the transition from supply to demand management. This paper analyses this transition through assessing the effectiveness of the institutional arrangements for water management in the Lerma-Chapala basin in addressing the negative impacts of basin closure. Special attention is paid to stakeholder participation in the Lerma-Chapala River Basin Council and basin-wide water allocation mechanisms. The analysis shows that, while basin level co-ordination mechanisms are clearly necessary, and promising progress has been made, more drastic changes are needed to ensure sustainable water management. In particular, access to water by poor farmers needs to be safeguarded, the overdraft of the basin's aquifers remedied, user representation in basin-level decision-making improved and mechanisms for compensating farmers for the transfer of water out of the agricultural sector drawn up. Lastly, decision-making power and control over financial resources need to be further decentralised to the basin and state levels to enable sustainable water management.

1. Introduction

The recognition that effective water management requires a basin perspective is long-standing and widespread. Especially in closing[1] river basins, where increasing water over-exploitation results in a complex interplay among declines in water quality,

[1]Seckler (1996) coined this term to characterise river basins with no utilisable outflows, i.e. where the use of water that renders it unavailable for further use is approaching or equal to the level of annual renewable water. This definition differs from the hydrologic definition of a closed basin, where there are outflows but these go only to internal seas, lakes or other sinks.

increasing water over-exploitation results in a complex interplay among declines in water quality, intersectoral water transfers, threats to human health, inequitable water allocation and reduced access to water by poor people, the need for effective institutional arrangements is urgent (Vermillion and Merrey 1998). In this regard, Turton and Ohlsson (2000) posit that water scarcity per se is not the key issue, but rather whether a society has the adaptive capacity to cope with the challenges water scarcity poses. They argue that two institutional transitions (need to) occur in the water sector as water becomes more scarce: the first when water abundance turns to water shortage and the second when water shortage turns to water over-exploitation.

The first transition, which occurs when water demand due to population growth overtakes the readily available supply of water, triggers the construction of significant hydraulic infrastructure, usually by the government, to mobilise more water. Reisner (1993) terms this transition to water supply development the birth of the hydraulic mission, embodied in a central government agency consisting of engineers. Whereas before water was controlled locally, after the first transition its development and management becomes highly centralised. During this phase river-basin development is important and one would typically expect to find river-basin authorities.

The supply-oriented phase runs up against a barrier when river basins close, i.e. when water demand continues to outstrip supply even though all available water sources have been developed or are prohibitively expensive to develop. This induces increased competition between water use sectors and calls for a different approach to managing water. However, making the second water transition, from supply-oriented development to water demand management, requires substantial changes in institutional arrangements for water management, possibly including the creation of river basin councils. Under favourable socio-economic and political conditions this transition can be made, resulting in a stabilisation of water demand and the birth of sustainable water management. However, this transition is not automatic and whether and how well it occurs is a function of the adaptive capacity of a society.

The need to make the water transition in the Lerma-Chapala basin is urgent. This basin in central Mexico has reached a crisis point, with total water depletion exceeding supply by 10 percent on average. Unchecked groundwater pumping has produced declines in aquifer levels of 2.1 m/year (Scott and Garcés-Restrepo 2000), while surface water depletion exceeds supply in all but the wettest years, as a result of which Lake Chapala, the receiving water body of the basin, is drying up. In addition, water is being transferred from the agricultural to the urban and industrial sectors, without due compensation to farmers. Lastly, water pollution is serious with significant wastewater reuse for irrigation within the basin (Scott et al. 2000).

In response to the deterioration in the basin's water resource base, several institutional innovations have occurred in the basin since 1989, including the signing of a river basin co-ordination agreement (1989), the creation of a river basin council (1993) and the establishment of aquifer management councils (1995–onwards). Water reforms at the national level, such as the creation of a national water agency in 1989, the transfer of government irrigation districts to users (1991–present) and the promulgation of a new water law in 1992, have also significantly altered

institutional arrangements for water management in the basin. These reforms are strongly interrelated and constitute Mexico's attempt to manage the water transition.

This paper partially assesses the effectiveness of these changes in dealing with basin closure in the Lerma-Chapala basin. The rationale of this assessment is to explore the types of institutional arrangements needed to manage the water transition at the basin level. The next section presents a basin water balance and introduces the water management stakeholders in the basin. This brief basin profile provides the backdrop for the description of the institutional arrangements in the basin in the third section, which also assesses stakeholder participation and the representation of interests in the river basin council. The key challenges facing the basin, namely surface and groundwater allocation mechanisms and the representation of interests are reviewed in the final section, followed by conclusions.

2. The Lerma-Chapala basin: water balance and stakeholders

2.1 Water balance

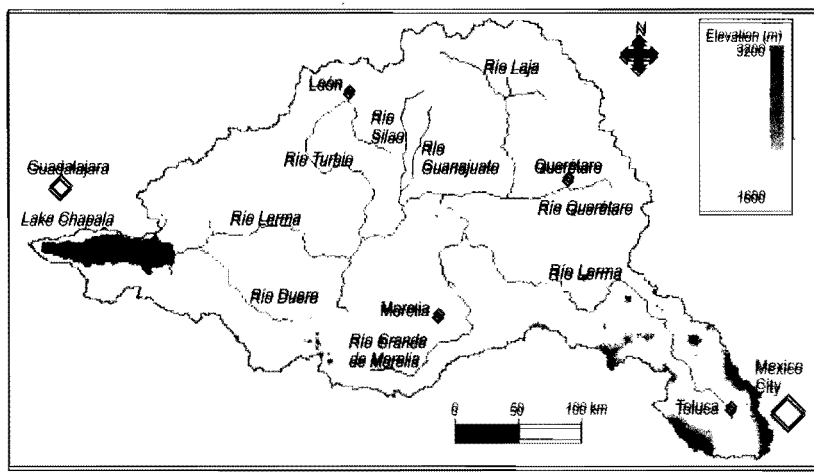
The Lerma-Chapala basin covers some 54,300 km^2 and crosses five states: Querétaro (5%), Guanajuato (44%), Michoacán (28%), Mexico (10%) and Jalisco (13%). The basin is home to a dynamic agricultural sector and a rapidly growing industrial sector, and accounts for 9 percent of Mexico's GNP. It is the source of water for around 15 million people (11 million in the basin and 2 million each in Guadalajara and Mexico City) and contains 13 percent of the irrigated area in the country. The average annual runoff in the basin from 1940 to 1995 was 5,757 million cubic meters (MCM), a little over one percent of Mexico's total runoff (CNA 1999a).

The headwaters of the Río Lerma rise in the east of the basin near the city of Toluca at an elevation of 2600 m above sea level to discharge into Lake Chapala in the west at an elevation of 1,500 m.a.s.l. The total length of the Río Lerma is 750 km and eight major tributaries discharge into it. Lake Chapala, with a length of 77 km and a width of 23 km, is Mexico's largest natural lake and at full capacity stores 8,125 MCM and covers 111,000 ha. The shallow depth of the lake (7.2 m) results in the loss of a large percentage of its storage to evaporation each year[2]. At times of high water levels Lake Chapala discharges into the Santiago River, which flows in a north-westerly direction and then drops to the Pacific Ocean after 524 km. The topography and stream network of the basin are shown in Figure 1, which was derived from the DEM at 30-sec resolution issued by the United States Geological Survey (USGS).

The climate in the basin is semi-arid to sub-humid, with 90 percent of the rains falling between May and October. Rainfall is highly variable, with an average annual rainfall over the 1945–1997 period of 712 mm, and a minimum of 494 mm in 1999 and a maximum of 1,022 mm in 1958 (CNA 1999e). Average monthly temperatures vary

[2]On a scale of 1:10,000 the dimensions of the lake are 7.7 m by 2.3 m and less than 1 mm deep.

Figure 1: Topography and stream network of the Lerma-Chapala basin



from 14.6°C in January to 21.3°C in May, thus a range of crops can be grown throughout the year. The potential evapotranspiration mirrors the temperature variation, with a peak in April/May, and an annual total of some 1,900 mm. In every month except July and August there is a net deficit between rainfall and evapotranspiration, indicating the importance of irrigation for agricultural production in the basin.

A total of 40 aquifers, largely interconnected, have been identified in the basin (CNA/MW 1999). Up to depths of over a hundred meters from the surface, the aquifers are composed of alluvial and lacustrine materials while the lower layers, several hundred meters in depth, are composed primarily of basaltic rocks and rhyolite tuff (Chávez 1998). The aquifers are recharged through rainfall infiltration, surface run-off, and importantly deep percolation from surface irrigation. Various sources report wildly different data on annual extraction and recharge rates, making it hard to portray with any precision the groundwater situation in the basin. What is clear is that 30 of the 40 aquifers are in deficit and falling fast, at 2.1 m/year on average (Scott and Garcés-Restrepo 2000). The most recent data from CAN (National Water Commission) indicate that average annual recharge is 3,980 MCM, while average annual extractions are placed at 4,621 MCM giving a deficit of 641 MCM per year (CNA 1999a).

Table 1 presents current average consumptive water use for different sectors in the basin compared to average annual renewable water, showing a deficit of 900 MCM. The percentage of available water that is developed and put to use in the

Table 1: Water balance of the Lerma-Chapala basin

	Surface Water		Groundwater		Total	
	MCM	%	MCM	%	MCM	%
Agriculture	3,424	57	3,160	68	6,584	62
Urban	40	>1	751	16	791	7
Out-of-Basin Transfer	237	4	323	7	560	5
Industry	39	>1	239	5	278	3
Other	6	>1	148	3	154	2
Total Consumptive Use	3,746	62	4,621	100	8,367	79
Lake Evaporation	2,270	38	-	-	2,270	21
Total Depletion	6,016	100	4,621	100	10,637	100
Runoff / Recharge	5,757	96	3,980	86	9,737	91
Balance	-259	-4	-641	- 14	-900	- 9

Source: CNA 1999a

basin is 110 percent[3], showing its degree of over-commitment. The out-of-basin transfers are to Guadalajara (surface water) and Mexico City (groundwater) for urban water supply.

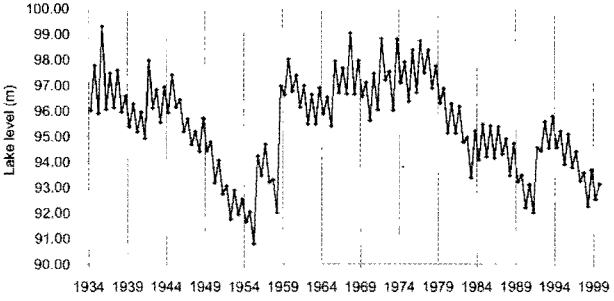
To portray basin closure in the Lerma-Chapala basin it is instructive to analyse fluctuations in the water levels of Lake Chapala. Figure 2 shows these fluctuations from 1934 to 1999 and relates them to developments in the basin. Starting in 1945, water levels in the lake declined sharply, from around 97 m[4] on average to 90.8 m in 1954, due to a drought combined with significant abstractions from the lake. At this time around 250,000 ha were irrigated, mainly with surface water, and the constructed storage capacity in the basin was 1,817 MCM. This period was the first time the basin headed towards closure as far as surface water is concerned. However, thanks to good rains towards the end of the 1950s, the lake recuperated, and levels fluctuated between 95.5 m and 98.5 m from 1960 to 1979.

In 1979 a second period of decline set in leading to basin closure in the mid-1980s. Constructed storage capacity in the basin had increased to 4,499 MCM and the average irrigated area had grown to around 650,000 ha, with a significant increase in groundwater irrigation. Even though abstractions from the lake for hydroelectricity had ceased, the combination of these factors resulted in declines of the lake level, from around 95 m at the start of 1980 to 92 m in 1990. After a modest recuperation in the early 1990s, lake levels in October 2000 are at their lowest since 1954, due to continued over-exploitation of surface and groundwater. It is unlikely that the lake will recover without exceptional runoff as generated through a major hurricane.

[3]This basin water exploitation indicator is arrived at by dividing total depletion (process and non-process) by annual renewable water (see Seckler et al. 1998 and Molden 1997).

[4]A locally defined benchmark where 100 m is defined as the high shoreline. (de Anda et al. 1998)

Figure 2: Lake Chapala water levels and basin developments



Rainfall (mm)[1]	670	648	685	757	740	668	720
Population (millions)[2]	2.5	3.0	3.6	4.5	5.9	8.7	11.0
Storage Capacity Dams (MCM)[3]	747	1,628	1,817	3,269	3,840	4,499	4,499
Irrigation (ha)[4]	n.a.	175,843	250,500	408,746	681,668	657,734	689,743
Lake Inflow from Lerma (MCM)[5]	2,864	1,652	1,692	1,773	1,931	590	n.a.
Lake Extractions (MCM)[5]	2,638	1,049	674	1,350	1,817	309	293

Sources for lake levels: de P. Sandoval (1994) and CNA (1991–1999b)

(1) Decade average from de P. Sandoval (1994) for 1934-1949 and CNA/MW (1999) for 1950–1999.

(2) Population data for the end of the decade. Sources: de P. Sandoval (1994) for estimates for 1939, 1949, 1959, 1969 and 1979 and CNA/MW (1999) for actual figures for 1989 and 1999.

(3) Constructed storage capacity at end of decade. Source: de P. Sandoval (1994) and CNA (1999e).

(4) Average actual irrigated area over the decade. Source: CNA (1999e).

(5) Decade average, excluding evaporation from de P. Sandoval (1994) and CNA (1991, 1992, 1993a, 1994, 1995, 1996, 1997, 1998, 1999b).

2.2 Major users of water

2.2.1 Irrigated agriculture

The main water user in the basin is irrigated agriculture, causing 57 percent of the total depletion of surface water and 68 percent of the total depletion of groundwater (see Table 1). Eleven large-scale canal irrigation systems (termed irrigation districts in Mexico) command around 285,000 ha and some 16,000 farmer-managed and private irrigation systems (termed *unidades de riego* in Mexico) cover 510,000 ha. Twenty-seven reservoirs with a storage capacity of 2,500 MCM provide 235,000 ha in the irrigation districts with surface water while around 1,500 smaller reservoirs serve 180,000 ha in the *unidades*. An estimated 17,500 deep tubewells provide around 380,000 ha in the basin with groundwater, of which 47,000 ha is located in irrigation districts (CNA 1993b; CNA/MW 1999).

There are an estimated 88,000 water users (70,000 *ejidatarios*[5] and 18,000 *pequeños propietarios*[6]) in the irrigation districts, and 100,000 water users (84,000 *ejidatarios* and 16,000 *pequeños propietarios*) in the *unidades* (CNA/MW 1999). Data on cropping patterns and productivity for the whole basin are not available, although studies on parts of the basin or selected irrigation systems are available (e.g. Flores-López and Scott 2000; Kloezen and Garcés Restrepo 1998; Silva-Ochao 2000).

In the early 1990s the Mexican government transferred the government-managed irrigation districts to Water Users' Associations (WUAs) to reduce public expenditure on irrigation (Espinosa-de León and Trava 1992; Trava 1994; Gorriz et al. 1995; Johnson 1997a). In the Lerma-Chapala basin 10 irrigation districts were transferred, after a comprehensive social mobilisation campaign, to WUAs, who now manage secondary canal units varying in size from 1,500 to 30,000 ha. The WUAs were formed as legally recognised non-profit associations to whom CNA granted concessions for the use of water and the irrigation infrastructure, for periods ranging from 5 to 50 years.

In all the districts CNA continues to manage the dams, headworks and main canals and delivers water in bulk to the WUAs, except in the Alto Río Lerma irrigation district where a federation of WUAs has been formed to manage the main system (Kloezen 2000). Although user involvement in irrigation management has increased, at the same time the state's control over water was reasserted through IMT. This is apparent from the new water law, which reaffirms federal control over the nation's waters as well as the irrigation infrastructure and makes CNA ultimately responsible for the management of the irrigation districts.

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[5] *Ejidatarios* are members of *ejidos*, land reform communities created after the Mexican Revolution of 1910. Land holdings per *ejidatario* are typically less than 5 ha.

[6] *Pequeños propietarios* are private farmers with a limit on land ownership of 100 ha; however, holdings may be managed in much larger blocks, with nominal ownership in the hands of family members, friends and others.

The management structures in the *unidades* are much more diverse, and may consist of informal WUAs, government recognised WUAs, water judges, pump groups or commercial management. As state intervention in the *unidades* has been piecemeal in comparison to the districts and has usually only consisted of assistance in construction and the granting of water rights, their representation in formal decision-making forums is weak. In the case of groundwater *unidades* this is changing, with the recent creation of *Consejos Técnicos de Aguas* (COTAS; aquifer management councils) in 17 aquifers. These COTAS are to serve as forums for reaching agreement on aquifer management, taking into consideration the needs of the different sectors using groundwater.

2.2.2 Urban water supply

Domestic water supply in the basin depends mainly on groundwater (95%), with total consumptive use standing at 791 MCM. In addition, water is transferred out of the basin to provide Guadalajara (237 MCM surface water) and Mexico City (323 MCM groundwater) with urban water. The population in the basin has increased significantly, doubling from 2.1 million inhabitants in 1930 to 4.5 million in 1970 and then more then doubling in the next 30 years to 11 million in 2000 (CNA/MW 1999). During this period Mexico's population grew from 16.6 million to 100.6 million. The population's annual growth rate in the basin between 1990 and 1995 was 2.16 percent, implying that the basin's population will double in around 30 years if this rate remains the same (CNA/MW 1999). Besides a five-fold increase in the population in the past 70 years, the basin's population has become strongly urbanised. Population in the seven largest cities in the basin increased from 267,197 in 1930 to 4,500,643 in 2000 (CNA/MW 1999). Understandably, population growth has led to increasing pressures on the basin's water resources. Scott et al. (forthcoming) project that urban water demand in the medium term will increase by some 4.1 percent per year.

Starting in 1983 domestic water supply, wastewater collection and more recently wastewater treatment were decentralised to the municipalities. The creation of water utilities has been promoted, to separate these activities from other municipal responsibilities. However, according to CNA (1999d: 8) "most of the water utilities have a poor performance and need to be greatly improved to achieve technical and economical sufficiency."

2.2.3 Industry

Although industry only uses a small amount of the basin's water (278 MCM or 3 percent of consumptive use) it generates 35 percent of Mexico's industrial GNP and pays around $42 million in water taxes to the federal government (CNA/MW 1999). The 6,400 registered industrial firms in the basin are still a major source of water pollution (figures are not available), although officially they must have a permit from CNA indicating effluent standards to discharge wastewater.

3. Institutional arrangements for water management in the Lerma-Chapala basin

A watershed year for water management in Mexico was 1989. Whereas the previous 100 years were characterised by increasing federal control over water, since 1989 decentralisation has been the norm. Currently states, municipalities and water users have a much larger say in water management decision-making. These changes are all part of the transition from supply to demand management in the Mexican water sector and the reconfiguration of the relationships between water users and the three levels of government (federal, state and municipal). In this regard, two aspects of how Mexico is structured as a country are important, namely that it is a highly centralised federation[7] and that surface water is defined in the Constitution as national property, placed in the trust of the federal government.

3.1 Water rights

In Mexico the federal government, as the holder of water property rights, has the right to grant surface water-use rights as concessions to users (Kloezen 1998). The concession titles set out the quantity of surface water a user is entitled to, although in practice the actual quantity a user receives may be adjusted annually to reflect water availability, with priority accorded to domestic water use (CNA, 1999c). Thus, for allocating surface water Mexico follows the proportional appropriation doctrine and in theory all concession holders share proportionally in any shortages or surpluses of water.[8]

The situation surrounding groundwater is more complex, as the Constitution does not define it as national property, but rather states that overlying landowners may bring groundwater to the surface as long as this does not affect other users. In 1946 the Constitution was amended to the effect that the federal government can intervene in aquifers in overdraft, by issuing pump permits or declaring that new pumps may not be installed. Based on a ruling of the Supreme Court in 1983 groundwater is now considered national property, although this is not reflected in the Constitution or the 1992 water law (Palacios-Vélez and Martínez 1999). Groundwater concessions in Mexico are granted on a volumetric basis with a maximum extraction or pumping rate specified (and limited by electrical power transformer capacity).

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[7]Mexico is a federation composed of 31 states and a Federal District. Each state is subdivided into municipalities, has its own constitution and laws as well as a governor who serves as the highest executive authority. The co-ordination of federal and state affairs is achieved through federal legislation and by compacts. Concerning water, the federal government may enter into co-ordination agreements with the states in order for them to take on specific responsibilities.

[8]This contrasts with the prior appropriation system, where first rights have seniority implying that water rights issued later are the first to be curtailed in times of shortage.

Once issued, water concessions need to be registered in the *Registro Publico de Derechos de Agua* (REPDA; Public Registry of Water Rights), maintained by CNA. After registration the concessions become fully tradable within river basins, although the CNA needs to be notified of the trade and needs to approve it (Kloezen, 1998).

3.2 Water management organisations and stakeholders

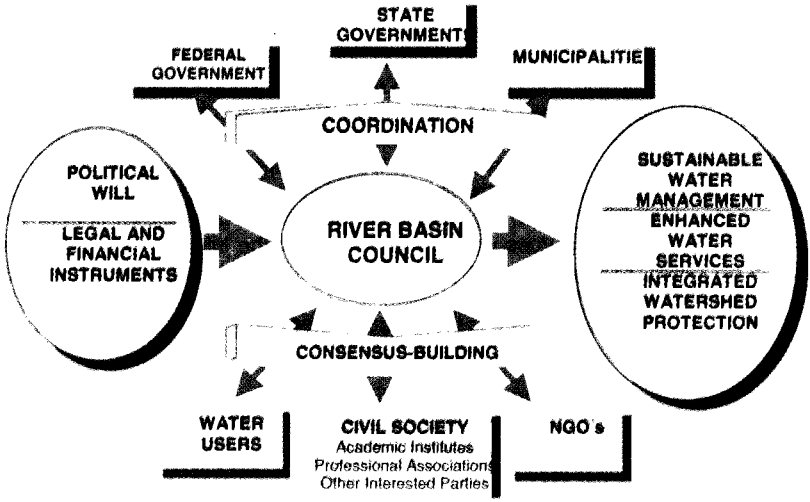
In the Lerma-Chapala basin a wide array of organisations and stakeholders are involved in water management, of which the major ones are described below. The government agency responsible for water management in the basin is the CNA. Created in January 1989 the CNA is a semi-autonomous federal agency charged with defining water policy, granting water concessions and wastewater discharge permits, establishing norms for water use and water quality and integrating regional and national water management plans.

The role of states in the water sector has been limited to regulating the municipal water utilities and supporting those utilities which show poor technical and economic performance. State legislation regulates the domestic water industry, establishes the basis for the creation of water utilities and sets the rules for determining water tariffs. As part of the "new federalism" policy during the Zedillo administration (1995–2000), the federal government promoted the delegation of water sector responsibilities and programmes to the states, but notably not financial resources. Although the federal government has encouraged the modification of state laws to promote the participation of state governments in all water sector activities through the creation of State Water Commissions, the response has been lukewarm. This is not the case in the state of Guanajuato, where CEAG (*Comisión Estatal del Agua de Guanajuato*; Guanajuato State Water Commission) has taken on its new role with vigour.

The official aim of unifying all government responsibilities related to water in the CNA was to create the necessary conditions for moving towards sustainable water management (CNA, 1999d). To complement this move a modern and comprehensive water law was promulgated in 1992. This law defines an integral approach for managing surface and groundwater in the context of river basins, which it considers as the ideal geographical unit for the planning, development and management of water. It also promotes decentralisation, stakeholder participation, better control over water withdrawals and wastewater discharges, and full-cost pricing.

A key provision of the 1992 water law is the stipulation that stakeholder participation is mandatory in water management at the river basin level. To this end river basin councils, which are forums where federal, state and municipal governments as well as water user representatives share the responsibility for allocating water resources and fostering integral water management at the basin level, have been established in 26 river basins. The government's philosophy behind the river basin councils, detailed in the 1992 water law, is that they are to be co-ordination and consensus-building bodies, as shown in Figure 3. In addition, the CNA has divided the country into 13 hydrologic regions and established an office in each region to improve river basin planning and the interaction with stakeholders.

Figure 3: The philosophy behind river basin councils in Mexico



Mexico's first river basin council was established in the Lerma-Chapala basin, in response to the drying up of Lake Chapala in the 1980s, combined with the severe contamination of the Lerma River. It was clear that something had to be done to preserve Lake Chapala, which generates significant tourism revenues and supplies two million inhabitants of Guadalajara with domestic water. In addition, its symbolic value as Mexico's largest natural lake is high. According to Mestre (1997:144):

> *"A wide-ranging water diagnosis existing by mid 1989 clearly presented four capital problems in the Lerma River basin: scarcity, as well as unsuitable water allocation, pollution, inefficiency of water use, and environmental depredation. To turn the tide, it became clear that it would be insufficient and imprudent to maintain that the federal government was solely responsible for this chaos and for its solution or mitigation."*

Hence, the federal government and the governments of the five states falling in the river basin signed an agreement in Chapala on 13 April 1989, adopting four main objectives to improve water management in the basin:

- Allocate surface and groundwater fairly among users and regulate its use;
- Improve water quality by treating municipal and industrial effluents;

- Increase water-use efficiency; and
- Conserve the river basin ecosystem and protect watersheds.

On 1 September 1989 a formal Consultative Council was formed to follow up on these objectives. Based on the 1992 water law the Consultative Council became the Lerma-Chapala River Basin Council on 28 January 1993. A challenge for the River Basin Council has been ensuring effective user representation—critical in the consensus building and co-ordination role envisioned in the law. Until the end of 1998, the Council was very top heavy: its president was the federal minister of agriculture until 1995 and the federal minister of the environment from 1995 to 1998, while its members were the governors of the five states making up the basin, the federal ministers of five key ministries and the Directors General of CFE, PEMEX and CNA. It is evident from this choice of institutional design that control over water and financial resources was a driving force in the inter-agency alignments within the basin. In 1998 this changed, with user representatives from six different sectors (agriculture, fisheries, services, industry, livestock and urban) being appointed to the Council. Also, the Director General of the CNA became the president of the Council, while the remaining members are the five state governors.

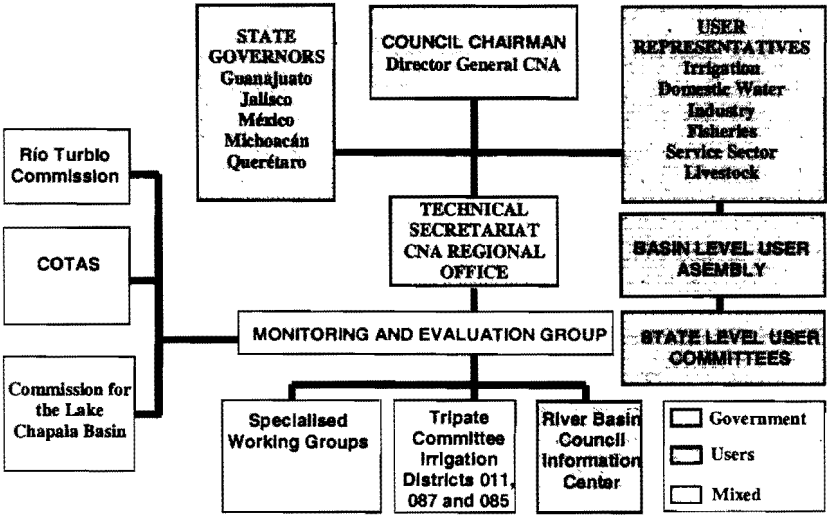
This change was based on a modification in 1997 of the water law and its regulations, to allow for larger representation of users. However, the users on the Council have been nominated by CNA, and do not necessarily reflect the interests of the water use sector they represent. To rectify this, CNA is currently working to establish a stepped form of user representation consisting of user committees in each state of the basin for each of the six water use sectors represented on the Council, giving a total of 36 user committees. These committees will each vote for a representative to sit in the user assembly at the basin level, which in turn will elect the six user representatives on the Council. In addition, forums at the sub-basin level, such as Commissions and COTAS complement the Council (see Figure 4).

As part of the process of strengthening stakeholder participation in the River Basin Council a participatory planning process was started in the Lerma-Chapala basin in 1998, based on the hypothesis that local stakeholders have a better understanding of the problems within the region and will play a decisive role in plan implementation. To mobilise stakeholders and build consensus, the CNA organised 15 workshops in the Lerma-Chapala basin, attended by 160 user representatives and 33 representatives of civil society (NGOs, research institutes, etc).

4. Over-arching issues

Through the Lerma-Chapala River Basin Council, promising progress has been made towards improved water management in the basin. This progress is remarkable, in light of the complicated transition from highly centralised water management to one in which states, municipalities and water users have a larger say. Nonetheless, from a water perspective the Lerma-Chapala basin is still in crisis and time is running out. The efforts of the council in the past 10 years need to be redoubled to tackle the significant challenges lying ahead of it. Three challenges stand out, namely surface and groundwater allocation and the representation of interests in the council.

Figure 4: Structure of the Lerma-Chapala River Basin Council



4.1 Surface water allocation

To allocate surface water fairly among users in the basin, the governors of the five states in the basin and the federal government signed a treaty in August 1991 (CCCLC, 1991). An important objective of the treaty is to maintain adequate water levels in Lake Chapala and to ensure Guadalajara's domestic water supply. To preserve Lake Chapala the treaty sets out three allocation policies, namely critical, average and abundant, based on the volume of water in the lake (less than 3,300 MCM, from 3,300 to 6,000 MCM and more than 6,000 MCM, respectively). Each year the council verifies the volume stored in Lake Chapala to determine the allocation policy to be followed for the next year. For each allocation policy, formulas have been drawn up to calculate allocations to the irrigation systems in the basin, based on the surface runoff generated in each of the five states in the previous year. Table 2 indicates how this works for the Alto Río Lerma irrigation district. Based on extensive modelling of these formulas it was concluded that the resulting water allocation would not impinge on the 1,440 MCM needed by Lake Chapala for evaporation.

Table 2: Water allocation principles for the Alto Río Lerma Irrigation District

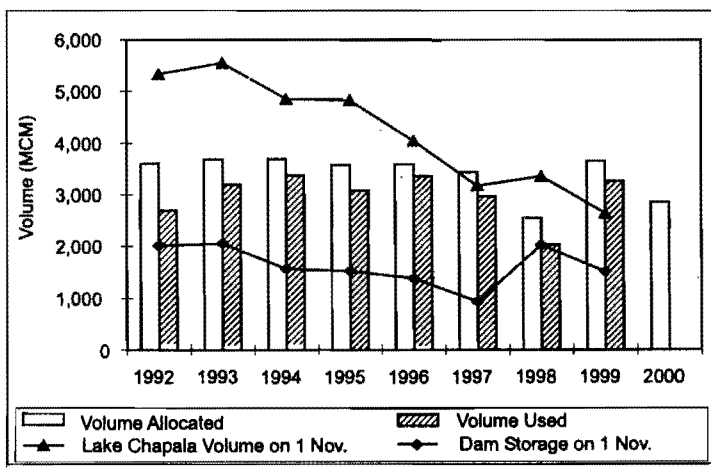
Lake Chapala Volume	Surface Runoff Generated (SRG) in the State of Guanajuato (MCM)	Volume Allocated (VA) to Irrigation District (MCM)
Critical	if SRG between 280 and 1,260	then VA = 94.2% of SRG –262.8
	if SRG > 1,260	then VA = 924
Average	if SRG between 144 and 1,125	then VA = 94.2% of SRG –135.6
	if SRG between 1,125 and 1,400	then VA = 924
	if SRG > 1,400	then VA = 955
Abundant	if SRG between 19 and 1,000	then VA = 94.2% of SRG –17.9
	if SRG between 1,000 and 1,200	then VA = 924
	if SRG > 1,200	then VA = 955

Source: CCCLC (1991)

Since 1991, the Monitoring and Evaluation Group of the Council has met each year and has applied the water allocation rules set out in the treaty. Figure 5 sets out the volumes of water allocated and used from 1992 to 2000 as well as the volume of water stored in Lake Chapala. This shows that the 1991 treaty has been enforced, as actual use has never been higher than the allocated values. A caveat here is that only the extractions by irrigation districts are accurately measured, thus actual withdrawals may have been higher as the amount of water going to the *unidades de riego* is unknown.

Sources: CNA (1991, 1992, 1993a, 1994, 1995, 1996, 1997, 1998, 1999b)

Figure 5: Surface water allocated and used in the Lerma-Chapala basin



Despite the apparently good performance of the surface water allocation mechanisms at the basin level through the application of the 1991 treaty, Lake Chapala's volume has halved in the past eight years. This is so because the surface water treaty takes the surface runoff generated in the previous year to determine water allocations. In 1997 rainfall was 645 mm and dam storage (used here as a proxy of surface runoff) was consequently low. Combined with a lake volume below 3,300 MCM the critical allocation policy was followed for 1998, leading to the lowest allocations since the treaty was signed. However, rainfall in 1998 was exceptionally good, at 810 mm some 100 mm above average, leading to a recuperation of the volume of water stored behind dams and a slight increase in the volume of Lake Chapala to 3,361 MCM. As a result, the average allocation policy was followed for 1999 and 3,664 MCM were allocated to water users, the highest level since the signing of the treaty. Unfortunately, rainfall in 1999 was a historic low of 494 mm. These two factors resulted in Lake Chapala dropping to its lowest level since the signing of the treaty.

Although the signing of the surface water treaty in 1991 was historic, the members of the council have recognised and discussed its shortcomings candidly. In 1999 the council decided to revise the treaty as it was clear that it was not rescuing Lake Chapala. In 1999 and 2000 detailed hydrological studies were carried out using data from the 1945 to 1997 period (an improvement over the 1950 to 1979 data used for the previous treaty) to develop a new model for calculating surface runoff (CNA, 1999e). The council signed the amendment of the 1991 surface treaty on 24 August 2000 (Consejo de Cuenca Lerma-Chapala, 2000). However, various states feel that they did not have sufficient input in the design of the surface runoff model and that the federal government forced the treaty on them, thereby negating the co-ordinating role of the council. In addition, consultation with water users concerning the new treaty has been minimal, although the user representatives voted in favour of it. Although the signing of the new treaty shows the adaptability of the council and the commitment of its members to construct a water allocation policy that meets urban and agricultural needs while safeguarding the environment, the process by which it was arrived at needs improvement.

An issue that the council has not yet started to consider is how to compensate farmers for water transferred out of agriculture for urban and environmental demands. In closed basins inter-sectoral transfers are inevitable and it will invariably be the irrigation sector that will need to cede water. A key institutional challenge in closed river basins is how to deal with these transfers in a just and equitable manner. Scott et al. (forthcoming) calculate that the benefits forgone for farmers in the Alto Río Lerma irrigation district as a result of the reduced allocation to the district for 2000 amounted to US$ 14 million. Although sufficient water was available in its main dam to cover its full allocation (955 MCM) the district was allocated only 648.2 MCM under the treaty, due to the critically low volume of water in Lake Chapala and the minimal surface runoff generated in Guanajuato in 1999. To shore up water levels in Lake Chapala the council decided to release the additional storage in the Solis Dam, the first time that surface water was physically transferred from the agricultural sector to the urban and environmental sector under the 1991 treaty. The Lerma-Chapala River Basin Council provides a good forum for drawing up and enforcing compensation mechanisms and for safeguarding the water rights of farmers.

4.2 The allocation of groundwater

Another serious challenge that the council and other water management stakeholders in the basin need to deal with urgently is the serious overdraft of the basin's aquifers. Although the council signed a co-ordination agreement to regulate the groundwater extraction in the basin in 1993, progress on the ground has been much slower (CCCLC, 1993). A key problem is that the council, through the CNA, does not physically control the water extraction infrastructure (the wells), as it does in the case of surface water (the dams). Although the constitution mandates the federal government to intervene in aquifers in overdraft by placing them under *veda*, entailing that it is prohibited to sink new wells without permission from the federal government, the experience with *vedas* has been mixed (Arreguín, 1998). The reality of groundwater extraction in Guanajuato clearly shows how groundwater regulation by the federal government has run aground. According to Vázquez (1999) ten *vedas* were issued in Guanajuato between 1948 and 1964, prohibiting the drilling of new wells in large parts of the state while in 1983 the remainder of the state was placed under *veda*. Notwithstanding these legal restrictions, the number of wells increased from approximately 2,000 in 1958 to 16,500 in 1997 (Guerrero, 1998).

Based on the recognition that *vedas* have not worked, and to counter the continued depletion of groundwater in the Lerma-Chapala basin, the CNA started promoting the formation of COTAS in selected aquifers in 1995, as an outflow of the 1993 agreement. Through the establishment of COTAS, which fall under the River Basin Council, the CNA is seeking to stimulate the organised participation of aquifer users with the aim of establishing mutual agreements for reversing groundwater depletion, in keeping with Article 76 of the water law regulations (CNA, 1999d). Based on recent developments in the State of Guanajuato, where CEAG enthusiastically promoted the creation of COTAS (Wester et al. 1999), the structure of the COTAS has been defined at the national level in the rules and regulations for river basin councils (CNA, 2000). In these rules the COTAS are defined as full-fledged user organisations, whose membership consists of all the water users of an aquifer. They are to serve as mechanisms for reaching agreement on aquifer management taking into consideration the needs of the various sectors using groundwater (CNA, 2000).

To date, 17 COTAS have been formed in the basin. However, none of them has yet started to devise ways to reduce groundwater extraction. Considering that some 350,000 ha in the basin are irrigated with groundwater and that industrial and domestic uses depend nearly entirely on groundwater, it is fair to say that groundwater is the strategic resource in the basin. The long-term consequences of its continued depletion easily overshadow those of Lake Chapala drying up. Although the COTAS are a timely institutional response to the pressing need for innovative approaches to managing aquifers in the basin, it is unclear whether they will succeed in reducing aquifer over-exploitation.

4.3 Representation of interests

The institutional arrangements for water management in the Lerma-Chapala basin revolve around who controls water. With basin closure, the competition for access

to water is becoming more severe and poor people are losing their access to water, due to reductions in surface irrigation and increased costs for groundwater irrigation. Unfortunately, meeting the water needs of poor people and including poor women and men at all levels of water management decision-making is not a priority of the council, nor of the larger set of institutional arrangements for water management in Mexico. The council needs to start considering seriously how to safeguard and improve the access of the poor to water, and how to combat the current *de facto* concentration of water rights in the hands of the few.

5. Conclusions

The paper has presented a classic scenario of change management, with crises occurring over time, each being met with a different response. The drought and water shortages between 1945 to 1954 resulted in a doubling of the reservoir capacity within the basin. However pressure on available resources continued to increase, with the irrigated area increasing almost four-fold up to 1989, and population increasing almost three-fold. With no opportunity available for further increases in stored water, dramatic institutional reforms have been introduced from 1989, devolving responsibility for water management in irrigation systems to water users, and initiating participatory water management bodies at the basin level for high-level decision-making on water allocation.

A central component in this reform has been the 1992 water law, though of equal importance has been the institutional capability to put the law into practice, and to adapt to a dynamic situation with further measures for controlling and managing available surface and ground water resources. An essential component of this decision-making process, both in relation to overall strategy and to day-to-day management, has been professional data collection, processing and analysis.

Though the institutional measures have had a significant impact in restructuring the way in which water resources are managed, the basin is still in crisis, with the level of Lake Chapala still in decline. It is anticipated that further radical measures will need to be taken in the near future, especially in the irrigated agriculture sector, as this is the major consumptive user of available water resources. At the heart of this change will be the need to protect the livelihoods of those most at risk, farmers with small landholdings who are already close to the poverty line.

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Governing Closing Basins: The Case of the Gediz River in Turkey

Mark Svendsen
Consultant, Philomath, Oregon, USA
D. Hammond Murray-Rust
International Water Management Institute, Colombo, Sri Lanka
Nilgün Harmancıoğlu
and Necdet Alpaslan
Dokuz Eylul University, Faculty of Engineering, Tinaztepe Campus, Buca, Izmir, Turkey

Abstract

The Gediz is a closing basin with little new water available for allocation. It is not, however, a mature basin, in the sense that the institutional set-up is not yet fully developed. Both surface and groundwater use are largely unregulated, and groundwater extraction is growing rapidly in response to urban and, particularly, industrial demand. There is no functional system of allocating rights to either surface or ground water. The most serious current problem, however, is deteriorating water quality in the Gediz and its tributaries resulting from urban and industrial wastewater discharges and, to a lesser extent, agricultural return flows.

Two public agencies are responsible for in-stream and wastewater quality monitoring, but neither has enforcement powers. These are concentrated in a third party in each province—the provincial governor. Governors are subject to competing pressures and are generally unable to mount effective enforcement programmes. Responsibilities for basin planning and monitoring are compartmentalised, broken out into dimensions of ground and surface water on one hand, and quantity and quality on the other. Co-ordination among the responsible units is limited.

Ultimately the roots of the water quality problem are political in nature, as there is presently a severe imbalance in power among the various involved parties—industry, municipalities, agriculture, and the environment. The environment, in particular, is underrepresented and an internationally-recognised bird sanctuary at the mouth of the Gediz currently receives only extremely limited quantities of poor quality water during the summer months.

Solutions to these problems involve systematising water rights, developing co-ordinating mechanisms among managers, involving the private sector in wastewater treatment, and the emergence of an effective NGO-based advocacy for environmental concerns in the basin.

1. Introduction

The Gediz basin in western Turkey (Figure 1) has changed considerably in the past decade, moving from being a comparatively water-rich basin to one that is

Figure 1: Location of Gediz basin

now closing[1]. This change has been in part a result of a severe drought that affected the basin from 1989 to 1994, in part due to an above average increase in urban and industrial demand, and in part due to a rapidly growing concern for issues of water quality and environmental protection. Paralleling these hydrologic changes has been a much slower institutional response that has not kept up with the requirements for changes in the way water is allocated and managed.

The basin is currently caught up in a very dynamic period of reassessment and change which began with the onset of drought in 1989. Before the drought, there was little competition for water, and the established mechanism for allocating water to different users through a set of bilateral agreements worked well. The only serious conflicts were internal to irrigation systems where there were disagreements between the state Hydraulics Works Organisation (DSI) and water users.

When the drought struck, water issues for irrigation in the peak summer season were reduced sharply, return flows diminished, and, as a consequence, water quality in the lower third of the basin deteriorated. Rural residents began to complain that water was unsuitable for irrigation. At the same time there was widespread desiccation of the important wetland areas in the Gediz delta, leading to large reductions in bird populations and, possibly, loss of species diversity.

Although the drought has now passed, the legacy is seen in a number of important issues that continue to lie at the core of the debates surrounding the management of water in the Gediz basin. Several of these are highlighted below and discussed in more detail in the remainder of the paper.

[1]A closed basin is one in which there is no unused water left to be allocated.

- The increasingly apparent need for a unified co-ordinating mechanism for allocating water among irrigation, urban demand, industrial requirements and environmental protection to replace existing bilateral processes.

- The continuing struggle between older long-established institutions dealing with water resource development and water allocation, and emerging institutions concerned primarily with water quality and environmental issues.

- The need to represent and protect the interests of certain water users, such as the Gediz delta ecology and the Irrigation Associations established during the past five years to assume responsibility of operation and maintenance for 110,000 hectares of large-scale irrigation systems, within the wider debate on water resources allocation and management.

- The need for clear rules assigning responsibility for setting water quality and quantity standards and monitoring actual conditions, and for sufficient political power and will to sanction violators of the standards.

In the remainder of the paper we deal first with the hydrology and water use patterns within the basin and then turn to the legal, policy, and institutional conditions which influence how the basin is governed and managed. Finally, we combine the two assessments to summarise the problems facing the basin and the challenges it must meet to overcome them. The economic and social context of Turkey is described briefly in Annex 1.

2. Basin water use

The Gediz basin contains a typical range of water users, although the balance among them has been changing during the past couple of decades. Each user category is described briefly hereunder.

2.1 Irrigated agriculture

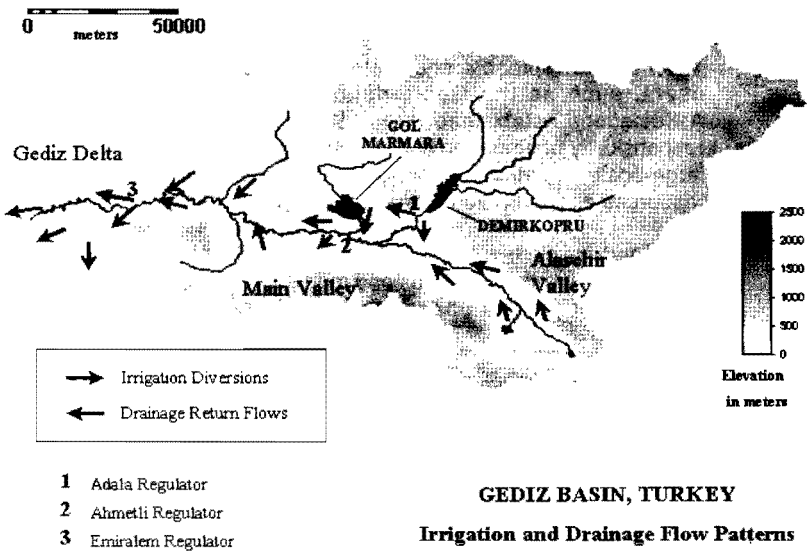
Traditionally the largest user of water has been irrigated agriculture, originally deriving from small run-of-the-river diversions from the Gediz and its tributaries dating back some three thousand years. Since 1945 the development of large-scale systems and groundwater exploitation have transformed irrigated agriculture.

2.1.1 Large scale surface irrigation

The first investments in modern irrigated agriculture began in 1945 with the construction of two large regulators to tap the flow of the Gediz River. Adala regulator serves some 20,000 hectares of land in the middle portion of the basin while Emiralem regulator commands 22,000 hectares in the Gediz delta (Figure 2). In the 1960s, a second set of investments were made that included the construction of Demirkopru

Reservoir a few kilometres upstream of Adala, a third regulator at Ahmetli, and the regulation and raising of the natural lake of Gol Marmara. Ahmetli Regulator commands some 45,000 hectares of land. The final surface water developments took place in the Alasehir valley with the construction of two small reservoirs.

Figure 2: Irrigation and drainage flow patterns, Gediz basin



The total command area of the large-scale surface systems is approximately 110,000 ha. The predominant crops are cotton (50%), grapes (35%), maize, fruit orchards, and vegetables. At present surface water issues from Demirkopru are limited to the interval between mid-June and mid-September which is focused on the cotton growing season. Natural stream flows from tributaries can be used for land preparation for cotton or for early irrigation of grapes and fruit trees, but there are no releases made into the Gediz River from Demirkopru outside this period.

Water use in the 90,000 hectares of the central and delta zones is limited to 75 m^3/sec from Demirkopru and 15 m^3/sec from Gol Marmara for a release period of approximately 60 days, or a total of some 550 million cubic metres during the year. This is equivalent to some 450 mm of irrigation water for the growing season.

In the Alasehir Valley in the east of the basin, irrigation is almost exclusively for grapes. Application rates are approximately 350 mm/season and during the summer there is no significant net outflow into the main part of the basin. It is estimated that, through a combination of surface application and some pumping of the shallow aquifer, approximately 60 million m^3 are consumed during the summer season.

2.1.2 Small-scale surface irrigation

In many tributary valleys into the Gediz there are small-scale surface water diversions that take advantage of winter run-off and spring snowmelt. Typical crops are fruit trees, winter wheat, and vegetables because these require water only in spring and early summer before the streams dry up.

There are no accurate records of the total area involved, but it almost certainly is more than 25,000 hectares since almost every village situated on the valley fringe has some irrigated area (Kayam and Svendsen, 1999). Because the number of irrigations is low, normally 2–4 irrigations of about 50 mm each for the entire season, total water use is also low and is estimated at 50 million m^3.

2.1.3 Groundwater irrigation

There are two different categories of groundwater users: those who are members of village or pump co-operatives and those who make private investments.

Groundwater user groups

Starting in the 1960s, but increasingly in the 1970s, the government has fostered community-based irrigation based around deep tubewells. Most deep tubewells have discharges in the range of 50-150 l/sec and are often tapping groundwater at least 100 m below the surface. The majority of wells are outside the boundaries of the surface irrigation systems and are concentrated in the Akhisar and Nif valleys. Typically crops are high value and include tobacco, vegetables, and fruit trees. Total water extractions are estimated at 30 million m^3/year on the basis of 100 wells having a typical discharge of 75 l/sec and operated for 40-50 days per year.

Private groundwater users

Private groundwater exploitation started during the drought of 1989–1994. Many individuals purchased centrifugal pumps to exploit shallow groundwater within the boundaries of surface irrigation systems, and in some cases neighbours formed informal pump groups to purchase a pump and well, and share operating costs at the end of the season. Farmers have kept using these pumps and there has been a recent small increase as some farmers adopt trickle irrigation systems for high-value fruits and vegetables.

The vast majority of private pump owners are within the boundaries of the surface irrigation systems. As such they rely on the seepage and management losses from the surface irrigation system. While there is some evidence that the shallow groundwater table dropped during the drought, it has since recovered and it is assumed that they do not mine groundwater but merely re-use surface water. Their net water use is therefore included in the total surface irrigation volumes. However, official records of surface irrigation shows that only about 70 percent of farmers use surface water and some of those also pump. It is estimated that some 40,000 hectares of land in the command areas of the surface irrigation systems are actually pump-based with only 70,000 hectares relying primarily on canal water.

A few private pump owners are situated on the fringes of the surface irrigation system or in the area between the Alasehir valley and the main Gediz valley. These are estimated to use some 5 million m^3/year that is not direct recharge from surface irrigation systems.

2.2 Municipal water supply

The Gediz basin has two separate classes of urban and municipal water users: the towns and villages within the basin itself, and a substantial trans-basin diversion of drinking water to Izmir.

2.2.1 Within-basin use

There are no accurate records of total water extractions for urban and municipal water consumption in the Gediz basin. All municipal extractions are from groundwater. Based on estimates provided by the different municipalities, it appears that extractions are in the order of 130 million m^3/year. However, much of this returns in the form of wastewater, either percolation into the groundwater or discharge in surface water. Allowing for 20 percent actual consumption, the net municipal extraction within the basin is estimated to be 26 million m^3/year.

Some municipalities also have shown interest in using good-quality spring water for their water supply. In a few cases municipalities have arranged with villages to use a portion of their spring water and agree to compensate them by improving village irrigation systems.

2.2.2 Izmir use of Gediz water

The city of Izmir has had a long-standing claim on groundwater within the Gediz basin. There are two main well fields, at Sarikiz in the north of the basin and Goksu near Manisa. Actual consumption data are not available, but Izmir has extracted as much as 108 million m^3/year from these well fields. Because the water is transferred out of the basin, there is no return flow[2]. An important potential source of additional water for in-basin use is the estimated 50 percent of the water entering the Izmir municipal system which is lost to underground leakage. Since Izmir is on the sea, no reuse of these losses is possible. If the conveyance efficiency of the Izmir piped system were improved, up to 50 million m^3 of high-quality groundwater could be left in the Gediz basin annually and used for other purposes.

[2]There is a proposal for Izmir to supply irrigators in lower portions of the Gediz basin with treated wastewater. Irrigators are enthusiastic about this because of the very poor quality of the surface water they currently receive. There are concerns, however, about possible high salinity in the treated effluent. At design output, the treatment plant would produce about 880 million m^3/year, roughly equivalent to the entire current use in the basin.

2.3 Industry

There are two important industrial areas in the basin. The largest is in the Nif Valley immediately east of Izmir in Kemalpasa municipality. There is also a growing industrial estate in the western edge of Manisa. Industries included ceramics, leather, food processing, metal works and assembly plants.

In both areas groundwater is used for the industries, and each industry must obtain a permit from DSI. However, there are no records of how much water is consumed and it is difficult to make an estimate of total water use.

2.4 Hydropower

Between 1970 and 1988, Demirkopru Reservoir was used for hydropower generation throughout the year. Since the drought, however, power generation has been restricted to periods when water is released for irrigation or for flood control and no special releases for hydropower are made.

2.5 Environmental consumption

The seaward fringe of the Gediz delta is an important nature reserve and has recently been designated as a Ramsar site to protect rare bird species. Originally the area received excess water from the Gediz River for much of the year, but since 1990, with restrictions on irrigation releases, the reserve suffers from water shortages. The summer months are the critical time for providing water specifically for the nature reserve, since during the winter water is available from the Gediz River before flowing to the sea.

In response to demands to preserve bird habitat, one small channel with a capacity of 0.7 m^3/sec does now extend from the irrigation system into the nature reserve. However, the channel does not always flow at the maximum rate during the 60 day irrigation season, and so the potential volume of about 4 million m^3 per day is not normally provided. One preliminary estimate suggests that to maintain appropriate conditions for freshwater bird habitat, as much as 1.5 m^3/sec is required during the 120 days of the summer season, or a total of about 15 million cubic meters. Enlargement of an existing irrigation channel to carry an additional 1 m^3/sec flow is proposed.

A second component of environmental demand is the water needed for waste conveyance from points of origin within the basin to the sea. In transporting wastes, the flow must provide sufficient velocity to prevent organic compounds and heavy metals, adsorbed on to soil particles, from settling out before reaching the sea, and sufficient dilution to avoid in-stream environmental harm. Obviously, reducing the pollutant loads which must be carried will reduce the quantity of water needed for this purpose.

2.6 Use patterns

The total estimated water extraction by the different users is shown in Table 1.

Table 1: Estimated water use by sector

Water User	Estimated consumption [million m³]	Share	Notes
Surface Water			
Large-scale irrigation	550	62%	From Demirkopru and Gol Marmara
	60	7%	Alasehir valley
Small-scale irrigation	50	6%	
Hydropower	0	-	No priority for hydropower
Bird Reserve	4	-	Current releases only; needs more
Groundwater			
Pump irrigation	30	3%	Only those outside surface irrigation
Groups	5	1%	area
Private irrigators	26	2%	
Urban within the	108	12%	18% of extraction, remainder is return
Basin	50	6%	flow
Transfer to Izmir City			Trans-basin transfer, no return flow
Industry			Estimated by DSI
Totals			
Annual	833	100%	
Summer (4 months)	760		

3. Water resources of the Gediz basin

3.1 Hydrology

3.1.1 Surface water

The hydrology of the Gediz basin is typically Mediterranean. Precipitation falls between November and April, and peak river flows occur in February or March. Annual precipitation varies from 800 mm in higher inland areas to about 450 mm near the cost, with about 80 percent falling in the winter months. Under natural conditions there is a steady decline in stream discharge until May when many of the smaller streams dry up. Summer flows are only present in the Gediz River and its largest tributaries, and even they may be negligible in the peak summer months. Following the irrigation season, the only flows in the Gediz River are from the few larger tributaries plus residual return flows from irrigated areas and industrial and municipal wastewater discharges to the river.

Following the construction of Demirkopru Dam and before the drought, net annual surface water availability in the main basin and the delta is estimated to have been approximately 1,900 million m³/year. Since 1990, however, there has been a persistent decline in surface water flows into Demirkopru and water availability has averaged only some 940 million m³ during this period. As some of this flow occurs in winter and is derived from tributaries where there is no storage, there is little difference between annual surface water availability and current demand of about 660 million m³.

3.1.2 Groundwater

Groundwater resources are able to make up some of the potential shortfall in overall water availability. The central part of the basin is an alluvial plain whose groundwater reserve is replenished in most years. Only during the peak of the drought, from 1991 to 1993, were there reports of declining year-to-year water tables, and they have since recovered.

In the alluvial fan areas on either side of the main valley and in the Nif Valley the situation is more critical. Tubewell-based farmers in the Akhisar area complain of a steady and long-term decline in water tables, and in the Nif Valley the water table is reported to have dropped by 5–8 meters in the past 10 years as industrial extractions have burgeoned. Springs in the limestone areas are also reported to have declined in the past decade.

The estimated safe annual yield for groundwater in the main part of the valley is estimated to be 160 million m^3/year which is about one-third considerably less than the 219 million cubic meters estimated as being extracted from the main and Nif valleys. Despite the absence of definitive figures, it appears that groundwater use presently exceeds, by a sizeable margin, the sustainable limit.

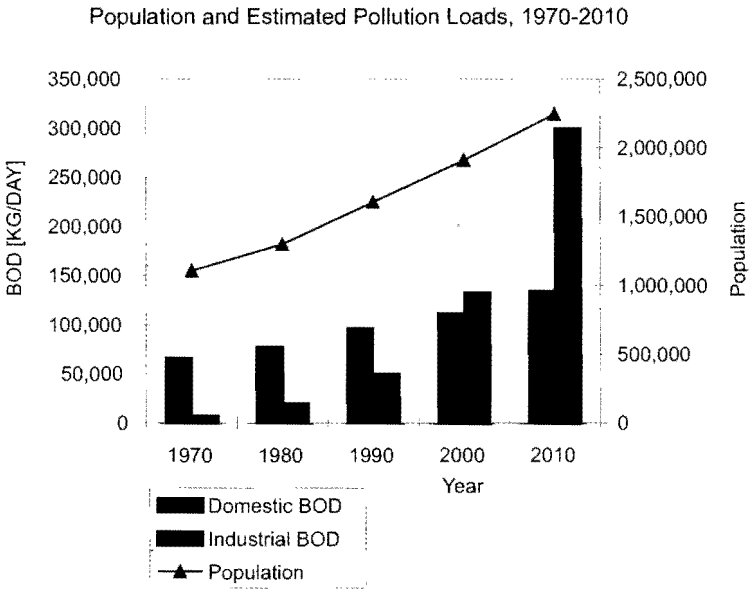
In the Gediz delta there is little groundwater utilisation, and extraction near the coast is prohibited to prevent salt water intrusion. The groundwater is deep and therefore there are no shallow tubewells.

3.2 Changing patterns of demand

The drought had an impact not only on the releases made from Demirkopru but also on changing demand. Rice used to be grown in poorly drained central parts of the basin but has been replaced by cotton, while there has been a steady increase in grape and fruit tree areas as agro-industrial enterprises have grown up to support cash crop agriculture. The trend toward grape cultivation, although partly a response to the growing market for raisins, resulted in decreased demand for irrigation water, and total irrigation deliveries are now only about 70 percent of the pre-drought situation. With a recent surge in interest in drip irrigation by fruit, vegetable and seed corn growers, demand is likely to continue to decline.

In contrast, non-agricultural demand is growing rapidly. The area has a higher than average growth rate because of in-migration from poorer parts of Turkey, and Izmir has promoted industrial development to complement agricultural production. Domestic demand for water has been growing by approximately 2-3 percent a year, industrial demand by as much as 10 percent per year. Given that most non-agricultural consumption of water is from groundwater rather than surface water, aquifer management requires closer attention than surface water with respect to available volumes.

Figure 3: Estimated population and organic waste load generation, Gediz basin, 1970–2010



However, an additional demand is arising which is associated with growing concern over water quality, particularly during the peak of the summer season when surface water supplies are limited (see Annex 1). Figure 3 shows actual and estimated growth of basin population between 1970 and 2010, along with estimated organic load from both domestic and industrial sources. As seen, although domestic load increases modestly along with population growth, industrial load grows exponentially. Note that the chart shows only potential loads and does not take into account the effect of treatment facilities which may or may not exist as of a particular date.

3.3 Summary

3.3.1 Surface water

Irrigation currently uses a large share of the surface water resources of the basin. Withdrawals total about 660 million m^3, with 83 percent of that going to large-scale irrigation systems. Current surface water allocation practices are primarily aimed at providing reliable water deliveries to the Irrigation Associations in the large irrigation systems, and this has been achieved with considerable success. Hydropower generation has no priority of its own and uses only water which is to be released for irrigation. A small and probably inadequate allocation of poor quality surface water is currently made for the wetlands in the Gediz delta.

Heavily-polluted wastewater discharged from urban areas and industries within the basin seriously degrades the quality of surface water in natural channels, particularly in the low-flow summer months. Since water use for these purposes is growing at an estimated rate of six to eight percent per year, this degradation can be expected to worsen unless major efforts at control are made successfully.

3.3.2 Groundwater

Groundwater supplies roughly a quarter of basin water use, of which about 16 percent is for irrigation, and the remainder for urban and industrial use. Groundwater supplies nearly all of the water used for these two latter purposes. Irrigation use of groundwater is largely static or declining as less-water intensive crops replace cotton and improved water application technology gains a foothold. Municipal and, particularly, industrial uses are expanding rapidly, however. At present as much as one-quarter of groundwater withdrawal in the basin may be unsustainable overdrafting, and pressure on these aquifers is expected to increase as industrial demand continues to grow.

Much of the water withdrawn for municipal and industrial use within the basin is returned to surface waterways, but in seriously degraded condition. This, in turn, gives rise to a need for additional allocations of surface water for waste load transport and dilution, water which is simply not available at present. The alternative is to improve quality of wastewater discharges significantly at their sources.

4. Legal, policy, and institutional environment

4.1 Water rights

All natural water resources, except some small privately-owned springs, are vested in the state by the Turkish constitution (Yavuz and Cakmak, 1996). The basic principle governing surface water use rights in Turkey provides that water is a public good which everyone is entitled to use, subject to the rights of prior users. Surface water use is normally free of any obligation to obtain prior authorisation. Conflicts are resolved by first referring to local customary rules and regulations. If the dispute cannot be resolved in this way, rights are settled by court decision. There is no registration system for surface water rights or water use. In large basins where impacts of new diversions are diffuse, this system is generally unable to prevent or resolve conflicts between new and existing claims, and this is leading to serious problems of over-allocation in some basins (Svendsen and Nott, 1997).

Groundwater also is state property. Its management is governed by a 1960 law giving sole authority over the use and protection of groundwater to the General Directorate of State Hydraulic Works (DSI). Drilling a well deeper than 10 meters requires prior approval from DSI, while constructing shallower wells requires only that DSI be notified. Shallow groundwater is thus an open access resource, while deeper aquifers are subject to some controls.

According to the groundwater law, when abstractions "approach the safe output level" of the aquifer, a committee of representatives of "relevant ministries" is to be

formed to decide on pending and future applications for groundwater utilisation. Frederiksen and Vissia (1998) conclude that enforcement of the groundwater law is weak, which by extension implies that, in practice, the system of groundwater rights created by the current groundwater law is not as effective as it could be.

Rights to both ground and surface water use are thus not formalised. Although they follow roughly the appropriative doctrine of allocation, there are no guarantees of continued access. The principles of the system of water rights outlined above apply in the Gediz basin.

4.2 Actors

In an earlier section, five categories of water users in the Gediz basin were identified and their respective water uses outlined. Some of these water users are able to represent their own interests (industries and municipalities), while others may be either many and unorganised (small-system irrigators) or unable for other reasons to represent themselves (ecosystems). In addition there are other State actors such as DSI involved in Gediz basin water management which, while not water users, are important players. The range of basin stakeholders is thus different, and broader, than the group of actual water users. The major ones of these are described below.

4.2.1 Public agencies

DSI

The General Directorate of State Hydraulic Works (DSI) is the main executive agency of the Government of Turkey for the country's overall water resources planning, execution and operation. It was established in 1954 and is currently a part of the Ministry of Energy and Natural Resources. The mandate of the DSI is "to develop water and land resources in Turkey" (DSI, 1995). It is responsible for major irrigation, flood control, drainage, hydropower development, and supplying water to cities with populations over 100,000. DSI centralises most of the state functions involved in planning and developing large-scale water resources.

Until recently, DSI's policy has been to manage the irrigation schemes it designs and constructs. Current policy and practice is to transfer schemes to locally-based Irrigation Associations (IAs) to manage. DSI also transfers hydropower and municipal water supply schemes that it designs and constructs to other agencies to operate.

DSI is also responsible for managing and allocating groundwater to prospective users. It does this through the permitting system described in the previous section. Its responsibilities for groundwater quality are limited to monitoring.

DSI maintains 26 regional offices across the country, organised along watershed lines. The Gediz basin lies entirely within one of these regions and is serviced by the regional office in Izmir.

Ministry of Environment

The Ministry of Environment (MoE) is the public agency with overall responsible for surface water quality. In spite of this general status, however, its mandate and capacities extend to cover only some of the functions that implementing this responsibility entail. Its major responsibilities include co-ordinating plans among the various public and private agencies involved with protecting the environment, commissioning environmental impact assessments of major water resources projects, and setting standards for and monitoring surface water quality. Actual monitoring and reporting of water quality and wastewater discharges are carried out by provincial offices of MoE. The explicit mandate of the MoE does not extend to groundwater quality. Neither the national nor the provincial offices of MoE possess direct enforcement powers.

Municipalities and villages

Towns and villages play three important roles in the water resource arena. First they are water users and dischargers of wastewater. There are 19 settlements in the basin with a combined population of 1.35 million. All draw their domestic water supplies from groundwater. Of the 19, only 3 have completed wastewater sewage systems and treatment plants. The remainder discharge untreated wastewater into the Gediz and tributaries.

The second important role played by towns and villages is that of representing irrigation water users in their areas. They do this (a) through their statutory dominance of the boards of large-scale Irrigation Associations, (b) as owners and operators of municipal irrigation wellfields, and (c) as representatives of the interests of otherwise unorganised farmers irrigating from private wells or small surface water sources who make up parts of their constituencies.

The third role is that of environmental regulation. Municipal and village administrations are responsible for operating water and wastewater treatment plants within their jurisdictions and monitoring the quality of domestic water supplies[3]. They also have some authority to monitor industrial wastewater discharges, although most are not active in this area.

Provinces and districts

Provincial and district governors, appointed by the Ministry of the Interior in Ankara, are the only authorities with the power to assess fines or issue and enforce prohibitions against violators of water quality regulations. All other actors, including MoE, MoH, DSI, and municipalities, may only report cases that contradict laws for which they are responsible to the provincial or district governor. District governors must secure approval from the provincial governor before taking action. Provincial governors are thus singularly responsible for water quality enforcement proceeding.

[3]The Ministry of Health (MoH) may monitor the quality of drinking water in piped distribution systems at the request of a municipality or village.

State Planning Organisation

The state Planning Organisation is an arm of the Prime Ministry which prepares a rolling five-year investment plan for the nation. It is responsible for planning all public capital investment in the country, including investments for water resource development, wastewater treatment, and environmental problem mitigation.

General Directorate of Rural Services

The General Directorate of Rural Services (GDRS), a part of the Prime Ministry, is responsible for developing small-scale groundwater resources for irrigation, developing surface water sources with flows of less than 500 litres per second for irrigation, on-farm irrigation development, and the construction of rural roads and village water supply systems. GDRS's minor irrigation schemes are transferred to farmers' co-operatives or local governments upon completion. GDRS does not have an operation and maintenance capacity.

4.2.2 Semi-public or private groups

Irrigation Associations

Thirteen Irrigation Associations (IAs) were established in the seven large canal irrigation commands in the basin in 1995 under the accelerated irrigation management transfer programme of DSI and have assumed operational control of canal irrigation in those areas. DSI continues to operate the main reservoir and river diversion structures, but operational management below that level is now in the hands of the IAs.

The legal basis for forming IAs is a law allowing the establishment of associations of local governments, and the present governance structure of the IAs is dominated by elected village heads, town mayors, and elected members of local municipal councils. Irrigation Associations are public bodies that enjoy tax exemptions and are non-profit, but are not bound by standard government civil service regulations and financial procedures. Although this system has drawbacks, it does provide valuable links with local government structures. IAs operate the canal systems within their areas, employing hired staff and financing operations and maintenance through fees collected from water users. The 13 IAs collaborate extensively on an informal basis and have discussed the possibility of forming a more permanent association to represent their common interests. They are the most important water users in the basin and retain a strong functional tie to DSI, which provides their bulk water supply and serves as the basin water allocation authority in the absence of a more explicit system of water right allocation.

Other irrigators

Other irrigation water suppliers and users not encompassed by IAs include towns and villages which have developed well-fields for irrigation supply in their areas, individual farmers and groups of farmers who have invested in irrigation wells, and farmers who employ small surface water diversions in upper parts of the Gediz

catchment to irrigate crops. There is no formal organisation tying these water users together, though their number is significant. To some extent, local village heads and town mayors are able and generally willing to represent the interests of these irrigators when a need arises. Such representation is not co-ordinated among villages, however, and in general would not be expected to be particularly potent in competition with larger better-organised interests.

Environmental NGOs

There are many NGOs active in the field environmental conservation in Turkey. A 1995 directory lists 98 of them, and there are others which are not included in the directory. With respect to water-related issues in general, and the Gediz in particular, the following are among the most important.

- Turkish Erosion Control, Reforestation, and Environment Foundation (TEMA). TEMA was established in 1992 with strong business community support. It currently has about 50,000 members and in 1997 operated on a budget of US$ 2 million. TEMA publishes a monthly bulletin on environmental issues and every two-years publishes an Environmental Profile of Turkey, which is now also available in English. It enjoys good contacts with the Ministry of Environment and has been instrumental in shaping the new national environmental laws and regulations[4]. It is the most influential of the national environmental NGOs.

- Gediz basin Erosion Control Reforestation and Environment Foundation (GEMA). This NGO has interests similar to those of TEMA but is concerned specifically with the Gediz basin

- Society for the Protection of Wildlife. This society was established in 1975 and works to raise awareness of shrinking populations of various wildlife species, with a special focus on birds. The society works extensively with elementary school children, publishing a newsletter and guidebooks for schools and others. It collaborates with the World Wildlife Fund and other international organisations.

Although concerned with water, none of these organisations place a priority focus on it. Most of NGO activities to date have been concerned with education, awareness raising, and lobbying, with little independent scientific or information collection effort evidenced so far.

Industries

Although industrial plants are scattered throughout the Gediz basin, the largest concentration is in two Organised Industrial Districts, one in Kemalpasa in Izmir

[4]DSI has an agreement with TEMA for reforestation of certain catchment areas above DSI reservoirs.

Province with abut 180 enterprises, and the second near Manisa in Manisa Province with about 50 enterprises. The owners of these industries are organised into several associations which wield considerable political power. These include the Aegean Chamber of Industry, the Businessmen's Association, and the Young Businessmen's Association.

Environmental assemblies

Local environmental assemblies (Mahalli Cevre Kurulu) have recently been formed in several basin areas. Authorised under the Environmental Law, assemblies are broadly constituted, comprising mayors, DSI, the Chamber of Industry, and so on, and are typically chaired by the provincial governor. They meet monthly and are authorised to make fairly influential decisions on issues relating to urban environmental quality. Such an authority, chaired by the district governor, exists also for the Kemalpasa Organised Industrial District.

Water and the Poor

As always, the poor, particularly those living in makeshift and illegal housing on the urban fringe, have the worst access to safe drinking water and sanitation services. Because of more limited mobility, they are also the ones most affected by pollution of the Gediz which they are more likely to use for recreational purposes. Access to irrigation water is determined by access to land, which in turn is also related to wealth, both as a cause and as an effect. Many smallholders do practise very productive agriculture, however, often growing high-value horticultural crops.

4.3 Essential functions: gaps and overlap

Burton (1999) has identified 11 essential functions of basin management. A somewhat modified listing of these functions, as they apply in the Gediz basin, crossed with the key actors identified in the previous section is shown in Table 2. These functions are replicated, as appropriate, across four broad categories—surface water, ground water, wastewater disposal, and agricultural return flows. Cells are marked to indicate an actor which is active in a particular functional area. Information is drawn largely from richly-detailed reports prepared by *Harmancioğlu* et al. (1999, 2000a, 2000b)[5].

Several terms require definition. Allocation refers to basin or sub-basin-level division of water among users, including practices relating to the granting of rights to use water. It also includes the supply of bulk quantities of water to major distribution

[5]Note that the activity indications contained in the table refer to actual activity in practice, and not nominal responsibility as assigned in statutes. Open circles indicate limited activity, while filled circles indicate more extensive activity. Situations where there is only minor activity might not be indicated in the table. The indications are the collective judgements of the study authors and do not represent formal or official judgements by any of the collaborating organisations.

Table 2: Key actors and essential basin management functions

Key Actors	Surface Water									Groundwater							Wastewater						Ag Returns			
	Plan (basin-level)	Allocate Water	Construct Facilities	Distribute Water	Maintain Facilities	Monitor Quality	Ensure Quality	Protect Against Flooding	Protect Ecology	Plan (basin-level)	Allocate Water	Construct Facilities	Withdraw/Distribute Water	Maintain Facilities	Monitor Quality	Ensure Quality	Plan (basin-level)	Construct Facilities	Operate Facilities	Maintain Facilities	Monitor Quality	Enforce Quality	Construct Facilities	Maintain Facilities	Monitor Quality	Enforce Quality
DSI	o	•	•		•	•		•	o	o	•	•			•								•	o		
Irrigation Associations			o	•	•																			o		
Other Irrigators		o	o	•	•						o	•	•	•												
GDRS			•									o											o			
MoE						o			o												o					
Local Governments												•	•	•				o	•	•						
Industries											o	•	•	•				•	•	•						
Provinces (MoI)																						o				
NGOs																										
Bank of the Provinces (IB)																		•								

Note: • indicates activity; o indicates limited activity.

Note: DSI = State Hydraulics Works Organisation, GDRS = General Directorate for Rural Services, MoE = Ministry of Environment, Local Governments = Locally-elected urban governments (municipalities and villages), MoI = Ministry of Interior, NGO = (environmental) non-governmental organisations.

Note: Surface water is used only for irrigation and environmental purposes.

points. Water distribution refers to the more routine practices associated with the regular delivery of water to multiple users. It might also be thought of as provision of a water-related service to users. Monitoring water quality refers to taking measurements, taking and analysing samples, and storing the resulting data. Ensuring water quality is a more active process of investigating deviations from quality standards based on monitoring information, identifying causes, and taking remedial action. Enforcing water quality refers to the process of securing compliance with wastewater quality standards on the part of the discharging municipalities, industries, or agriculturalists.

A number of interesting points emerge from an examination of Table 2, supplemented with background observations.

- There has been very limited planning at the basin level with respect to surface water and virtually none for groundwater and waste disposal[6]. There is no integrated plan which considers both groundwater and surface water availability, nor does existing planning consider water quality, wastewater disposal, current and projected land use, anticipated future demand and return flows, or projected future quantity and quality of water resources.

- Water is allocated, in practice, by a variety of agencies and users operating independently of each other. These include DSI, private surface and groundwater irrigators, and industries. There is no national legal framework for surface water rights and only a rudimentary system of allocating access to groundwater, and both are largely open access resources at present. Although nominal control is stronger for groundwater than for surface water, groundwater is presently the most stressed of the two resources resource. It is also the more desirable of the two, in part because of the poor quality of Gediz surface water, but also because of the relative ease of access provided by groundwater. The current system of registering groundwater withdrawals does not appear to be effective at present at limiting overdrafting which is occurring in certain sub-basins.

- Water quality monitoring takes place, but information is often not available in useful forms to interested parties. DSI operates 14 water quality sampling locations within the Gediz basin, sampling about 35 parameters on a monthly or bi-monthly basis. The information collected remains as pure data in DSI files and is not generally used as a basis for policymaking or decision-making for basin management.

[6]DSI is currently anticipating a new Gediz basin planning exercise. The previous plan was prepared 35 years ago and updated in 1982, but covered only surface water. The groundwater section of the DSI regional office is also planning a new groundwater survey in the near future.

- A single actor, the provincial governor's office, is empowered to authorise enforcement of breaches of wastewater discharge regulations by banning offending practices or imposing fines. In practice, attempts to process fines or prohibit industrial activities often leads to confrontation between industrialists and public administrators, with the administrators generally lacking the political will and power to make penalties stick. It is very common for files of violation reports to remain unprocessed in the offices of district and provincial governors.

- Ensuring surface water and groundwater quality is not actively practised in the Gediz basin. Ensuring water quality involves conducting follow-up investigations of observed sub-standard water quality to identify its sources and proposing remedies.

- No attention is currently paid to the quality of agricultural return flows. It is sometimes presumed that these flows contribute nitrates to groundwater and nitrates, phosphorus, and organic chemical residues, e.g. from pesticides, to surface water, but there is little hard information on this, nor is any responsible party actively monitoring or assessing the quality and impact of agricultural return flows.

- Agricultural drainage infrastructure is inadequately maintained at present. Drain maintenance receives a lower priority from IAs compared with delivery channel maintenance and DSI has inadequate budget and equipment to fully maintain larger drains. In addition, responsibility for maintaining main drains which serve more than one IA is under dispute by DSI and IAs.

- NGOs have no role in performing essential management functions, but clearly have an important role to play in overall basin governance. This suggests that cataloguing essential functions, while useful, does not constitute, by itself, a sufficient analytic methodology for understanding and diagnosing problems affecting basin governance[7].

4.4 Enabling conditions: where problems lie

The essential functions and actors' roles depicted in Table 2 provide a static view of responsibilities. Additional attributes of well-functioning basin governance systems relate to its dynamics. We term these attributes *enabling conditions.*

[7]The term *governance* is used in a somewhat different sense here than in Burton's list of essential attributes, of which it is one. Here the term refers to the rules providing the context for multi-actor basin management and the processes and activities engaged in by those actors operating within this set of rules.

Enabling Conditions
Political Attributes
Representation of interests
Balanced power
Informational Attributes
Process transparency
Information availability
Information accessibility
Legal Authority
Appropriate institutions
Adequate powers
Resources
Human
Financial
Institutional
Infrastructural

Enabling conditions are features of the institutional environment at the basin level that must be present, in some measure, to achieve good governance and management of the basin. These attributes are not specific to any one actor, but apply to all actors and their interactions and comprise necessary (but not sufficient) normative conditions for success. Basic enabling conditions are shown in the box below. A full analysis of these factors is well beyond the scope of this paper. A brief sketch of each in the context of the Gediz basin will be attempted to illustrate the concepts and indicate broad strengths and weaknesses.

4.4.1 Political attributes

This is perhaps the most important gap in the current set of enabling conditions. Although some water users are well represented, others are not, and in the arena of political give and take those without representation become losers. *Industrialists,* for example, have ample financial resources, are well organised, and have ready access to political decision makers. *Other irrigators,* on the other hand, are unorganised and enjoy representation only through their local village heads. Their interests are rather fragile. *Irrigation Associations* are intermediate. They enjoy multiple connections to the local political establishment by virtue of having a number of village heads and town mayors on their managing committees. In addition they collaborate informally, sharing information and co-ordinating activities. *Irrigation Associations* would benefit by establishing more formal linkages among themselves to allow a single spokesperson to represent them collectively in discussions over basin water allocation, water quality standards, potential irrigation return flow

restrictions, and so on. *Other irrigators* could affiliate with such an association and, contributing financially to it, participate in its representational benefits.

The most serious failure of representation at the moment relates to the environment. Although it is nominally represented by the Ministry of Environment, the Ministry is still relatively young and has yet to establish presence and capacity in many areas. For example, it currently has provincial offices in only two of the four provinces covered by the Gediz basin. It also lacks sufficient budget to perform its many duties fully. Moreover, as a government agency, it will always be subject to political pressures and pulls that encourage or inhibit vigorous pursuit of particular water quality issues. Experience from other countries has shown that strong non-governmental organisations (NGOs) rooted in civil society are essential components of the political system surrounding environmental issues. These NGOs serve as advocates for environmental values and for unrepresented future generations. There are several groups with potential to fulfil this role, but at present they provide an ineffective counterweight to other interests.

Just as important as the existence of representational bodies is the need for a rough balance of political power and influence among various interests. When power is one-sided, issues are not aired adequately, and decisions are also one-sided. A key to the evolution of a suitable and balanced governance regime for the Gediz basin is further maturation of non-government organisations and associations based in civil society which can advocate for environmental interests.

4.4.2 Informational attributes

Another essential enabling condition is the presence in the public domain of accurate and up-to-date descriptive information on water-related issues in the basin, along with open public transaction of decision making processes related to plans, regulations, violations, and sanctions. The first of these stipulations require that information on basin water allocations, reservoir positions, groundwater elevations, water quality conditions, available resources, and so on be a part of the public record. Information collected with public funds should be available to the general public at little or no charge in the interest of sound and democratic public decision making. This disclosure condition applies to intra- and inter-departmental information relationships as well as to those with the general public. The second stipulation, transparency of public proceedings, is likewise essential to fair democratic processes. Rent-seeking behaviour requires darkness and privacy to thrive, and conducting regulatory processes in full view of the public is an effective antidote to such practices.

4.4.3 Legal authority

Establishing appropriate institutions requires suitable legal authority. This does not appear to the most serious current problem constraining the emergence of an effective governance regime in the Gediz basin. Although improvements can be made, and a number of legislative changes are proposed in the Eighth Five Year Plan, the most important short-term constraints appear to lie in other areas, such

as balanced political power and providing adequate resources. Over the longer run, however, the legislation of a new legal basis for an effective system of water rights allocation, protection, and transfer will be essential.

4.4.4 Resources

Clearly, all four types of resources listed in the box are needed for effective implementation of basin management activities. In a number of the responsible public organisations they are inadequate. In some this constraint may be relaxed by reassigning staff positions from functions which have lost importance to those which are increasingly so. Another potential problem is scattering of resources among a variety of institutions, where each lacks a critical mass to be effective. In a context of co-operation, it is not necessary that resources be consolidated under a single administrative structure for effective implementation. However co-operation and co-ordination must be effective if a decentralised strategy is to be effective.

5. Toward solutions

5.1 Problem summary

In this section the hydrologic, policy, and institutional problems identified in earlier sections are brought together and summarised.

5.1.1 Poor surface water quality

The most pressing water-related problem facing the Gediz basin presently is the poor and deteriorating quality of its surface water. The deterioration results primarily from the basin's recent rapid growth in population and the even more rapid growth in local industry, coupled with the widespread use of agricultural chemicals in a highly productive agriculture. Failure to control this growing problem at its several sources leads to large requirements for in-stream flows for dilution-flows which are then unavailable for other uses. The problem stems from several sources.

- **Weak enforcement.** First and foremost, it is the inability of the provincial and district governors, appointed by the Ministry of Interior, to apply and enforce sanctions and penalties on violators of wastewater discharge standards that is responsible for the growing pollution problem. Although monitoring could be improved and standards tightened, the failure to enforce existing standards effectively, on the basis of existing information, sends a powerful signal to polluters that compliance is unnecessary.

- **Weak co-ordination.** A second cause of deteriorating surfaced water quality is poor co-ordination and co-operation among the three separate agencies responsible for (a) surface water quality monitoring, (b) wastewater discharge monitoring, and (c) enforcement of standards. To some extent this is driven by bureaucratic tussling over turf. In

addition, the failure of any of the three parties to come forward with effective, inclusive, and forward-looking leadership is a cause.

- **Limited availability of data.** Because of restricted access, the debate on water quality is poorly informed and emotional rather than scientific, making development of acceptable remedial measures difficult and contentious.

- **Haphazard monitoring of wastewater discharges.** The most readily identifiable and correctable causes of Gediz pollution are untreated or inadequately treated wastewater discharges from industries, cities, and towns. It is the responsibility of the Ministry of Environment to monitor these discharges and report breaches of standards to the provincial governor. Limited staff, laboratory facilities, and funds currently forestall an adequate monitoring programme.

- **Inadequate funding for wastewater treatment plants.** Inadequate funding has two components – capital and operating expenses. Several funding windows are available to industries and municipalities for investment capital but a shortage remains. For municipalities, there is little private sector involvement in constructing and operating treatment facilities, in contrast to the case in many other countries. A considerable amount of the funds made available by the state for municipal treatment plant construction have come through the bank of the provinces, but with little expectation of repayment. This makes the discipline of mobilising private capital for such investment difficult or impossible. Inadequate investment in wastewater treatment by the industrial sector relates, in part, to the weak enforcement record of provincial governors. As long as the costs of compliance exceed the costs of non-compliance, this situation is likely to continue.

- **Limited public awareness of the problem.** Negative effects of surface water pollution include harm to public health, increased costs to other water users, and negative environmental effects, particularly in the Gediz delta. Limited public awareness of the problem and its impacts results in limited public pressure and support for reforms, which in turn affects every single one of the factors outlined above. Causes of limited public awareness include restricted public access to water quality data collected by government agencies, inadequate MoE efforts to publicise water quality problems, and the long gestation period for non-governmental environmental organisations to become effective advocates and spokespersons.

5.1.2 Unknown groundwater quality

The extent of possible groundwater contamination, particularly in the Nef Creek watershed, is unknown. Due to coarse alluvial soils and the extensive use of in-ground holding pits, some wastewater from both urban and industrial sources may

go into groundwater rather than being disposed of as surface water effluent. The primary cause of this uncertainty is the following.

- Groundwater quality monitoring is not widespread and the results not publicly available, making it difficult to know if significant degradation of groundwater quality is occurring.

This is a significant gap because aquifer pollution is often more difficult and expensive to mitigate than pollution of surface waters. The possibility of contamination gains added significance as a result of the almost total dependence of the basin's population on groundwater for domestic supplies.

5.1.3 Loosely-controlled allocation among users

Shallow groundwater is an open-access resource in the Gediz basin, meaning that anyone with physical access to such water can withdraw and use it. Unregulated use of shallow groundwater creates difficulties where there are clear hydrologic linkages between surface water flows, shallow groundwater availability, and deep aquifer conditions. Deep groundwater and surface water, once released from the Demirkopru Reservoir, share this open access characteristic, in part, as well. The result is that some legitimate needs, especially environmental needs, are inadequately met, access of existing users is insecure, and it is difficult to transfer water allocations among users in a rational way. Among the causes are the following.

- **Inadequate representation.** Interests of some users are not well represented in allocational planning and decision-making. The most salient example is the environment, and, in particular, the needs of the Gediz delta and its rich complement of wildlife.

- **Inadequate specification.** While water needs in the basin for large-scale irrigation and urban use are generally known at present, present use and future requirements for small scale irrigation, the burgeoning industrial sector, and the environment are not well specified in terms of quantity, timing, and quality requirements. This makes allocation decision making difficult.

- **Ineffective reporting and record-keeping.** While municipal extractions are reasonably well-documented, industrial extractions from groundwater remain largely a matter of conjecture. This makes evaluation of new requests for withdrawal permits difficult. There is likewise no cumulative inventory of the total number of permits issued, the agreed extraction rates, and the depth from which water is extracted, rendering this process even less rigorous and reliable.

5.1.4 Over-arching future problems

In addition to the current problems affecting water allocation and basin governance, there are longer-term problems which will require more fundamental changes in laws, policies, institutions, and practices. Two of the most significant are the following:

- **Rudimentary water rights system.** The current national system of recording and harmonising rights to use water dates from an earlier simpler day and is not well adapted to a water short environment. It does not provide security for present users, does not allow for or adequately protect environmental uses of water, and does not provide incentives for economy of use or for orderly transfers among sectors.

- **Lack of integrated planning.** Assessment of basin water resources is currently separated into ground and surface water components. Because these interact in practice, there is a need to understand the basin as an integrated water resource system. Also, because water quality influences the uses to which water can be put, and gives rise to its own quantitative demands for dilution flows, quantity and quality must also receive joint consideration.

5.2 Recent strides

The current situation in the Gediz basin, and at the national level, is dynamic and somewhat fluid. Locally a number of steps have been or are being taken to improve the enforcement of water quality standards and protect the natural environment. Many of these steps began with a Franco-Turkish basin study of the Gediz in the mid-1990s. Although this study was intended to lead to various action programmes, the latter failed to materialise because of lack of co-operation among the different institutions involved[8]. The study did raise awareness of problems and stimulate other initiatives, however.

In 1996, the provincial MoE office conducted a study of polluting industries in Izmir province which resulted in sanctions on 14 firms. In that same year, MoE offices in Izmir and Manisa began a two-year surface water quality sampling exercise in the lower Gediz.

In early 1998, three provincial governors from the Gediz basin, together with MoE and other parties, convened a "co-ordination meeting" for the basin, which led to the establishment of a co-ordinating committee consisting of the directors of the three provincial MoE offices. More recently, this co-ordinating committee was transformed into a permanent body named the *Environmental Protection Service Association of Gediz Basin Provinces*. This Association was officially authorised by the cabinet of the national government in December 1999 giving it a legal persona. This association has a broader base than earlier initiatives, and, in principle, has

[8]The study was never formally "accepted" by DSI or MoE.

considerable power. Since its creation, however, it has lain largely dormant due to lack of resources and the ongoing bottleneck in the enforcement of existing standards and regulations.

At the national level, sentiment for change is reflected in the recently published Eighth Five Year Plan covering the period 2001–2005. The Plan recognises the need for change in the way water is allocated and managed. There is a commitment to introduce new water legislation that will cover such issues as water rights, responsibilities for water allocation, setting and enforcing environmental standards, and consolidating the position of the Irrigation Associations. However, the Plan does not specifically mention basin level water management nor is there any provision for establishing basin level entities that could implement or co-ordination various basin-level activities. Reduction in support for utilisation of fertilisers and agricultural chemicals is a preliminary step toward addressing non-point source pollution problems. Revising water and wastewater standards to comply with EU standards will raise the bar for existing polluters and those in compliance alike.

The Plan does indicate that the private sector will become more involved in various aspects of water, adding an additional set of regulatory challenges to the existing situation and raising the question of the security of rights to water use by less well-represented groups. Until these new initiatives are defined and brought into place, however, current institutional arrangements will continue within the context of rapid growth in demand for water and increasing pressure on water resources from wastewater disposal from urban, industrial and agricultural users.

5.3 Strengths to build on

Although the problems faced are formidable, Turkey and the Gediz basin have a number of strengths on which to build an effective basin governance regime. These include the following.

- The premier water resource agency in the country, DSI, is responsible for both ground and surface water, providing a strong base for integrated treatment in the future. This is not the case in many other countries where separate organisations are responsible. Moreover, handing over irrigation management responsibilities to IAs positions it well to take on the role of basin planner and water quality monitor for both ground and surface waters.

- Water quality is squarely identified as an important problem in the Gediz basin. Moreover, while serious, it has not yet reached catastrophic proportions, offering a grace period in which action can be taken. Actors in the basin appear to be responding to the warning signals.

- There is recognition that a number of different actors must be involved in solving water quality problems in the Gediz. It is important to transform this recognition into effective ways of working together, rather than squandering energy and resources in intra-governmental squabbles over bureaucratic turf.

- Likewise, there is recognition that there are multiple dimensions to water resource management problems—different disciplines, different interests, different uses, ground and surface water, quantity and quality, and so on. Recognising this provides opportunity to develop an integrated approach to basin water resource planning and management.

- A new water law is under consideration, offering an opportunity to lay legal groundwork for effective basin management and protection for the Gediz and other water-short basins in the country.

- There is a strong university-based scientific community, e.g. CEVMER and others, providing capability for applied problem-solving research and, where needed, independent scientific assessment.

- There are linkages with international institutions such as IWMI which provide access to international experience of basin governance problems. Moreover, there is a healthy willingness to look outside the country to the experiences of others and a strong interest in harmonising standards, practices, and procedures with those of the European Union.

5.4 Challenges

A number of immediate solutions to problems affecting governance and management of water resources in the Gediz basin are self-evident from the listing of problems in section 5.1. In this concluding section, we indicate four important longer-range challenges facing the basin. Addressing these challenges effectively would go a long way toward putting into place a strong, dynamic, and flexible system of basin governance.

5.4.1 Systematise water rights

The current rudimentary rights system cannot continue to provide security and flexibility in an era of growing water scarcity. A new system which is fair, flexible, and effective needs to be designed, based on both Turkish and international experience.

5.4.2 Build representational presence and political muscle

Some basin water users, such as the natural environment, are not well represented in water-related discussions at present, and there are severe imbalances of political power among the various water users. Fair and equitable governance of basin water resources requires that users and interests be represented in discussion and decision-making fora in a balanced way. NGOs rooted in civil society provide an important voice and advocacy presence for the environment, supplementing the efforts of the MoE, and their emergence as a political force will add balance to

decision-making and pressure for effective enforcement of sanctions for water quality violations.

5.4.3 Develop Co-ordinating Mechanisms

Alternative models for water basin governance exist. At one pole is a *comprehensive basin authority,* which concentrates power, responsibility, and capacity to implement directly many basin management tasks. At the other pole is a *co-ordinating committee* which simply provides a forum for discussion and voluntary co-ordination. Between these poles many variations are possible. One thing that is clear is that the present system of compartmentalising water quantity and quality, ground and surface water, and fresh water and wastewater is not an effective base for the future. Mechanisms have to be developed for bringing these components together in a functional integrated system for planning, governance, and management[9].

A useful first step would be the completion of an integrated assessment of basin water resources of all types and of the present and predicted demands on those resources. High-level political commitment to such an undertaking and strong leadership would be essential. It is equally important that this exercise not be carried out by a single organisation, but that it involves the various agencies, and the different departments within agencies, which have mandates to address water-related issues in the basin. The report produced is only half of the desired output of such a process. The other half is the experience of joint action among agencies and groups to implement the study and the creation of "ownership" of the result by the various stakeholders.

5.4.4 Involve the private sector

In many countries, the private sector plays important roles in water resource management. Turkey is well embarked on the devolution of responsibility for managing previously state-operated irrigation systems to locally-based associations. The private sector can also play a major role in providing safe drinking water and effective sanitation services to urban areas. Private sector involvement has a number of advantages, including operational efficiency, ability to mobilise private capital, and access to new technology. To attract such involvement without state guarantees of repayment, firms must have confidence that the principle of payment-for-service will be honoured and supported by the involved governmental entities. Bringing in such private participation would provide needed capital for wastewater collection and treatment systems and provide wider access to these essential services.

[9]Turkey is not pursuing the concept of basin-wide authorities at present because of the difficult issues posed by important trans-national river basins shared by Turkey and several of its neighbours. The next five-year plan may address this option.

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Annex 1. Economic and social context of Turkey

Turkey is a parliamentary democracy of approximately 65 million people. As of 1997, its population was growing at a rate of 1.5 percent. There is extensive internal migration and rapid urbanisation. At present, 65 percent of the population lives in urban areas, and, while the rural population is shrinking at an annual rate of 0.7 percent, urban population is growing at 2.8 percent per year. At the sub-national level, the country is governed by a mixed system employing both local elections and central government appointments. Population centres (cities, towns, and villages) are governed by locally-elected assemblies or councils with administrations headed by locally-elected mayors. Provinces and districts, while having locally-elected assemblies, are headed by senior civil servants appointed by the Ministry of the Interior. National level policy guidance and instruction is important at all levels and centralised revenue collection makes revenue transfers from national to local levels important and enhances the power of the centre.

Turkey has a strong mixed economy, larger than that of Russia. The present one-year-old government is taking strong steps to privatise publicly-owned enterprises and introduce other economic reforms under an IMF-backed programme (WSJ, 2000). Economic growth averaged 6.1 percent per year in 1997–98, but shrank at a rate of 6.4 percent for 1999 as a result of the earthquake and the economic restructuring programme. Inflation, however, which has been chronically high for more than two decades, has declined sharply. Turkey hopes to join the European Union, providing a powerful motive across all sectors for harmonising Turkish policies, practices, and standards with those of the EU.

In 1999, agriculture provided just 15 percent of GDP and provided 45 percent of national employment as a result. Agricultural incomes are just one-fifth to one-quarter of those in other sectors. Industry makes up 23 percent of the economy and services 62 percent.

Annex 2. Estimation of future organic loads in Gediz River water

Based on the data in Table 3 and assuming that in a typical year since the end of the drought, the only surface flows are 75 m^3/sec released from Demirkopru, 15 m^3/sec released from Gol Marmara, 5 m^3/sec as urban wastewater return flows, and a further 5 m^3/sec from industrial return flows, then the estimated biological oxygen demand (BOD) concentration on a basin-wide basis can be estimated.

Table 3.2 shows these estimates (which are not spatially distributed within different parts of the basin). Irrigation water extractions at different regulators will show different concentrations because of the concentration of BOD generation in urban and industrial areas.

The drought year of 1990 shows a marked increase in potential BOD concentration because irrigation water was only released for 32 days out of a possible 60 days in July and August. In 1992 it would have been higher, on the order of 40-45 g/ m^3 released, because irrigation water was only released for 27 days during July and August. By 1997 the potential concentration has dropped despite urban and industrial growth because water is issued for the full 60 days. However, if there are no releases from

Table 3 : Population, domestic and industrial BOD loads (kg/day), Gediz basin, 1970–2010

	1970	1980	1990	1997	2010
Population (1)					
Upper	477,449	552,767	646,467	704,844	819,945
Middle	386,617	447,446	538,095	551,583	727,322
Lower	242,264	298,599	421,184	512,198	696,840
Total Basin	1,106,330	1,298,812	1,605,746	1,768,625	2,244,107
Domestic BOD (2)					
Upper	28,646	33,166	38,788	42,290	49,196
Middle	23,197	26,846	32,286	33,095	43,639
Lower	14,536	17,916	25,271	30,731	41,810
Total Basin	66,380	77,929	96,345	106,116	134,646
Industrial BOD (3)	8,000	20,000	50,000	100,000	300,000
Total Estimated BOD	75,000	100,000	150,000	206,000	435,000

Notes: 1. Population data based on State Statistical Office data
2. Domestic BOD at 60 g/person/day
3. Industrial BOD in 1997 is estimated to equal urban BOD generation. Past and future industrial BOD values are calculated on a basis on +10 percent industrial growth rate per annum.

Table 4: Estimated dry season potential BOD loads, Gediz basin, 1970–2010

	1970	1980	1990	1997	2010
Daily surface water release (m^3/sec)	80	80	100	100	100
Number of days	60	60	32	60	60
BOD (kg/day)	75,000	100,000	150,000	206,000	435,000
Concentration per unit of water released (g/m^3)	10.8	14.5	32.6	23.8	50.3

Demirkopru to dilute wastewater return flows, the situation in 2010 will be at least 20 percent higher than in the peak of the drought of 1992.

These data only refer to BOD. With no reliable estimates of chemical oxygen demand (COD) releases from industry, it is not possible to generate similar estimates, but they will surely show the same growth trends.

In the Menemen portion of the delta, where there is extensive cultivation of soft fruits and vegetables, most farmers rely on groundwater pumping, because the surface water is considered too polluted to use on edible crops. Even the cotton farmers complain of "water that burns". In the tail-end areas downstream of a large tannery complex, water quality is appalling and directly affects the nature reserve.

Although winter floods, and particularly the near record flood of February 1999, flush out some of the waste that accumulates in periods of low flows, the lack of any regulated minimum flow in the river for non-agricultural purposes means that water quality returns to sub-standard conditions very rapidly.

Water Management in the Upper Sub-Basin of the Inderagiri River Basin in Indonesia: Issues and Implications Related to Integrated Water Resources Management

Helmi
Lecturer, Centre for Irrigation, Land and Water Resources Development Studies Andalas University, Padang, Indonesia

Abstract

Integrated water resources management (IWRM) is an important development agenda for addressing institutional problems and capacity building for the use, control, preservation and sustainability of water systems. Pursuing this requires understanding of related issues and their implications for development of effective water management institutions.

Indonesia is in the process of reforming its water resources management policy, which will give emphasis to putting IWRM principles into action. One of the elements of the new policy is related to the improvement of river-basin management. Although experience on river-basin management has been developed in one basin (Brantas river basin in East Java), this was not the case for other regions of the country until lately.

This paper discusses the dynamics of water use and management in the upper sub-basin of the Inderagiri river basin, in West Sumatra, Indonesia. Issues and implications related to IWRM are identified. The topics covered are:

- *the policy and institutional context of river-basin management, with an overview of the water management policy reforms and related aspects of policy relevant to improvement of river-basin management in West Sumatra Province;*
- *a more specific discussion on the setting and hydrology of the upper sub-basin;*
- *a special case illustrating water use competition and water allocation in a river (Ombilin River) within the upper sub-basin. This includes stakeholder identification; river water accounting; the changing pattern of water use; impacts on the poor and other downstream users; and the lack of a framework for river-basin management.*

The conclusion is that this problem of water-use competition and the impacts it causes have raised the need for improved water management in the Ombilin River. Frameworks for this are not yet developed. The on-going water management policy reform provides a basis for management improvement. It is suggested that measures be taken to review existing provincial water management regulations and to develop a framework for river-basin management. Capacity building for river-basin

management can be initiated from efforts to solve the Ombilin River problems, and lessons from the experience can be used for other river basins in West Sumatra.

1. Introduction

West Sumatra Province is one of the priority areas for improvement of water resources management, as part of the on-going implementation of policy reform. One item of the reform agenda is the improvement of river-basin management. River-basin management and water allocation from the source have increasingly become issues in West Sumatra in the last decade. The development of electric power plants and the growth of urban settlement areas in West Sumatra have increased demand for water, which in turn increased competition for water use between irrigated agriculture and other sectors of the economy.

Despite the increasing demand for better and more organised water management in West Sumatra, the framework and experience for river-basin management and water allocation from the source is not yet developed. This paper attempts to present issues related to river-basin management and to identify implications for efforts to adopt integrated water resource management principles as the basis for future development of effective institutions.

The paper first discusses the direction of water resource management reform in Indonesia. This is followed by a discussion of the upper Inderagiri sub-basin and its changing pattern of water uses. Two prominent issues related to water allocation and basin management are discussed, illustrating the nature and dynamics of water uses and management in the basin. In the last part implications related to integrated water resource management are identified.

2. The policy and institutional context of river-basin management in Indonesia

2.1 Water resources management policy reform

The Indonesian government is reforming its water resources and irrigation management policy. This section presents the reform principles, which are closely related to the improvement of river basin management, especially for the West Sumatra context. The reforms have four objectives (BAPPENAS, 2000):

1. Improving national institutional frameworks for water resources development and management.

2. Improving organisational and financial frameworks for river-basin management.

3. Improving regional water quality management, regulatory institutions and implementation.

4. Improving irrigation management policy, institutions and regulations.

Among those objectives, the first and the second are closely related to the improvement of water allocation from the source and river basin management. One of five sub-objectives[1] of the first objective mentions the involvement of stakeholders (including private sector) in river-basin management and decision-making. The proposed reforms in this sub-objective cover three areas:

- issuing government regulations emphasising the participation of stakeholders (public agency institutions, community, and private) in water resources development and management.
- amending ministerial regulations to: (1) include stakeholders' representatives in provincial and basin water management co-ordination committees (in Indonesian language called: PTPA and PPTPA); and (2) merging provincial water management committees (PTPA) with provincial irrigation committees.
- establishing functional PTPA and basin water management committees (PPTPA) with stakeholders' representation in key river basins in 12 provinces.

The second objective contains three sub-objectives, one of which is the improvement of the provincial regulatory framework for river basin and aquifers management. This will be the basis for development of effective water management institutions at province and basin levels.

2.2 River-basin management in Indonesia

River basins and their management authority. The Government of Indonesia (GOI) started to recognise the river basin as the unit of water management in 1982, through the enactment of Government Regulation (GR) No. 22/1982[2]. In 1989 Public Works Ministerial Regulation No. 39/PRT/1989 was issued to specify the 90 river basins in Indonesia[3]. The objective of this ministerial regulation is to ensure that conservation and use of water in the basins are conducted in a holistic and integrated manner. In 1990, the Public Works Ministerial Regulation (No. 48/PRT/

[1](1) Establishment a national water resources management co-ordination framework; (2) adoption of a national policy for water resources management; (3) involvement of stakeholders (including private sector) in river-basin management and decision-making; (4) improvement of national water resources information and decision support systems; (5) improvement of national hydrological and water-quality data collection and management systems.

[2]Article 4, Chapter III stressed the use of river basins as the basis for water resources management.

[3]The Public Works Ministry has been abolished this year and its function has been merged into the Ministry of Settlements and Regional Development (MSRD). This involved reorganisation of MSRD, whose name is changed to Ministry of Settlements and Regional Infrastructure Development. Adjustment of laws and regulations related to water management is underway within the framework of policy reform.

1990) was enacted, specifying the authority for the management of water and river basins. Out of the 90 river basins, 73 are managed by provincial governments, 15 fall under the management of Ministry of Public Works, and 2 basins[4] are under the management of public corporations. Incorporation of the idea of river-basin management into policy and action are thus relatively new to Indonesia and the management framework—other than in those two basins under public corporations—is not yet developed.

River basins of West Sumatra and the Inderagiri sub-basin. The area of West Sumatra province is divided into six river basins. These are named: Inderagiri; Silaut; Anai-Sialang; Rokan; Kampar; and Batang Hari. Two (Silaut and Anai-Sialang) are entirely in West Sumatra province, the rivers flowing down to the West Coast of West Sumatra. The other four are upstream parts of river basins, which flow to the East Coast of Sumatra in the provinces of Riau and Jambi. According to the Public Works Ministerial decision on the division of river basins, the Inderagiri river basin falls under the authority of the Ministry of Public Works because it is located in two provinces. The upper part is in West Sumatra and the lower part in Riau.

3. The upper sub-basin of Inderagiri river basin and its hydrology

3.1 Demographic and employment features

The population of the sub-basin in 1997 was 662,425, and the average population density was 408 persons per km^2. The urban-rural population ratio was 0.28. This implies that water supply for urban needs will be an important issue in the near future. In terms of households, the population data show that in 1997 there were 150,466 households in the basin. The average household size was 4.59 persons. It is estimated that only about 12.56 percent (or some 18,898) households were served by pipe-borne water. These data reflect there are still a large number of households that need piped water in the future. There were also some industries, offices, and other social facilities that were served by piped water.

About 67.6 percent were categorised as farm households[5], indicating that the majority of households in the basin engaged in the agricultural sector as their main occupation. It is reasonable to expect water demand for agricultural-related activities to be a major issue in the basin.

[4]Brantas River in East Java under the Jasa Tirta Public Corporation, and Citarum River in West Java under Otorita Jatiluhur Public Corporation.

[5]Data taken from agricultural census conducted in 1993. No recent data available on the number of households by type of livelihood or occupation. Data from 1993 agricultural census were used to estimate the number of households in agricultural and non-agricultural sectors. Assuming that the percentages of people in both sectors are as before, the number of farm households in the basin in 1997 would be 97,742.

3.2 The sub-basin

The sub-basin consists of three major rivers, Lembang/Sumani, Sumpur, and Ombilin, and two lakes, Danau Dibawah and Singkarak. Water from the Lembang/Sumani and Sumpur rivers flows into Singkarak Lake, while the Ombilin River originates from Singkarak Lake and flows eastward to the Inderagiri. The altitude varies from 164 m above sea level at the lowest point (near confluence of Ombilin River and Sinamar River) to 1,200 m at the highest point where the Lembang River originates from the Dibawah Lake. Thus, water supply in the Ombilin River depends largely on the outflow from Singkarak Lake, while Singkarak water supply is influenced by inflow from Lembang/Sumani and Sumpur rivers. Moreover, water supply in Lembang/Sumani River is largely determined by the outflow from Danau Dibawah Lake. These three main rivers (and their tributaries) and two lakes constitute a sub-basin.

The total area of the upper Inderagiri sub-basin is estimated at 3,059.7 km^2. The Lembang/Sumani watershed constitutes 48 percent of this, the Ombilin 30 percent, and the Sumpur 13 percent. The sub-basin includes 400 villages, within three districts and three municipalities. Around 87 percent of the villages are rural.

3.3 Climate and rainfall

The sub-basin generally has the typical humid tropic climate that covers almost all of Sumatra. However, differences exist among regions of the basin. An agro-climatic map of West Sumatra (Oldemann[6] et al 1978) shows five climatic zones—on the basis of consecutive wet and dry months[7]—in the basin. Based on these zones, a large part of area of the sub-basin under Lembang/Sumani and Sumpur Rivers belongs to the wettest zone, while most of the Ombilin watershed is in the driest zone, constituting around one-third of the sub-basin. Consequently, changes in the outflows from Singkarak Lake would affect water availability for the part of the sub-basin in the Ombilin watershed.

Rainfall in the basin tends to follow the agro-climatic zones. Average annual rainfall in the sub-basin is 2,025.9 mm. There are differences in rainfall pattern between the watersheds. The data show that the watershed of the Sumpur River is wettest, with average rainfall of 2,484 mm per year. This is slightly higher than the Lembang/Sumani watershed (2,200.6 mm). The Ombilin watershed is driest (1,789.3 mm).

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[6]Climatic zone Type A has 9 consecutive wet months and less than 2 consecutive dry months; Type B1 7–9 consecutive wet months and less than 2 consecutive dry months; Type C1 5 –6 consecutive wet months and less than 2 consecutive dry months; Type D2 3 –4 consecutive wet months and 2–3 consecutive dry months; Type E2 less than 3 consecutive wet months and 2–3 consecutive dry months.

[7]Oldemann et.al. (1978) defined a wet month as having monthly average rainfall of 200 mm or more, and a dry month as having 100 mm and less.

4. The sub-basin under stress: construction of hydroelectric power plant at Singkarak Lake and impacts on the poor and other water users on Ombilin River

4.1 Stakeholder identification and water accounting[8] along Ombilin River

Stakeholder identification. Four major groups[9] from various sectors have direct interests in the water of the Ombilin River. These are farmers/irrigators who use waterwheels to lift water from the river; a coal-mining company which uses water for washing coal; domestic water suppliers who provide water for Sawah Lunto town and their consumers; and an electricity company which uses water from Singkarak Lake for hydro-power generation (for which the outflows from the lake to Ombilin River need to be reduced) and for two thermal power plants located along the river[10].

The hydrological setting. (See Figure 1 for schematic presentation). Seven major rivers flow into the Ombilin River and influence its discharge. They are (from upstream to downstream): Bengkawas, Katialo, Silaki, Selo, Malakutan, Lunto, and Lasi. Among these, the Selo has the biggest inflow to the Ombilin, and Silaki the lowest (see Figure 2).

Zoning of the sub-basin and water uses. Based on types of water uses, the Ombilin River can be divided into three zones: A (upstream), B (midstream), and C (downstream).

Zone A is from the Singkarak outlet to the confluence with Selo River. In this zone the use of water is mainly for irrigation. Water is lifted by waterwheels. Three rivers, Bengkawas, Katialo, and Silaki, flow into the Ombilin in this zone. 58 waterwheels were found, of which only 30 were functioning.

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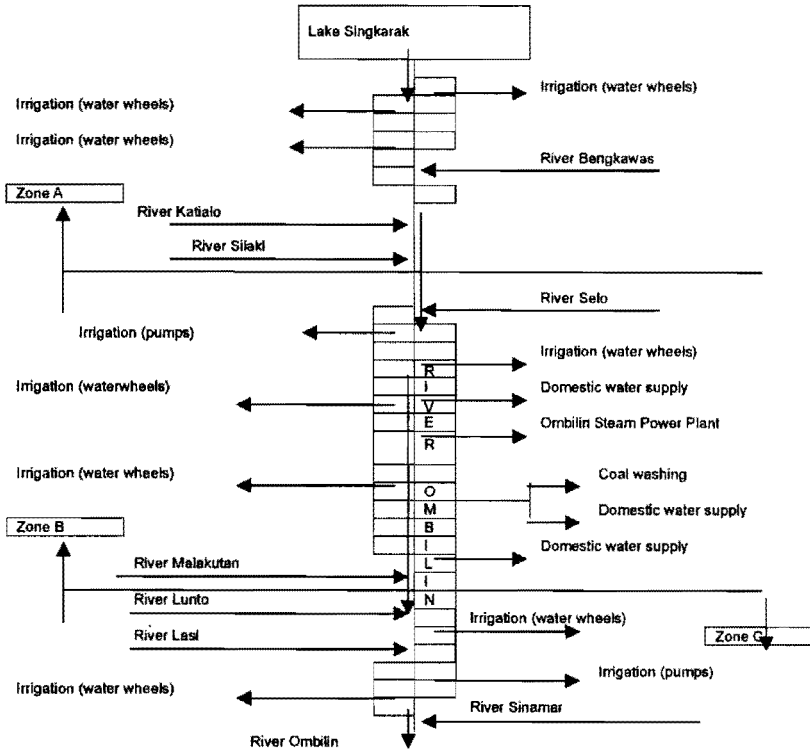
[8]Water accounting is an art and procedure "to classify water-balance components into water use categories that reflect the consequences of human intervention in the hydrologic cycle" (Molden, 1997). This classification enables analysis of water uses, depletion, and productivity in a water basin context. There are three main components: inflow (consisting of gross inflow and net inflow), available water (the difference between net inflow and committed water), and committed water (the part of outflow reserved for other uses). The depletive use consists of two components: process and non-process depletion.

Increasing competition for water from the river source creates conflicts among users. Efforts to improve water management at a particular river require understanding of how much water is available, being used, and depleted for various uses, and for this water accounting is a tool to generate understanding, which will help in formulating policy and developing effective institutions.

[9]Other groups do not consume water but use the river for various activities. They include fisherfolk; users of river for bathing, washing, and other personal needs; people collecting building materials such as sand, gravel, and stone.

[10]For more details of impacts on the poor and other users see section 4.3.

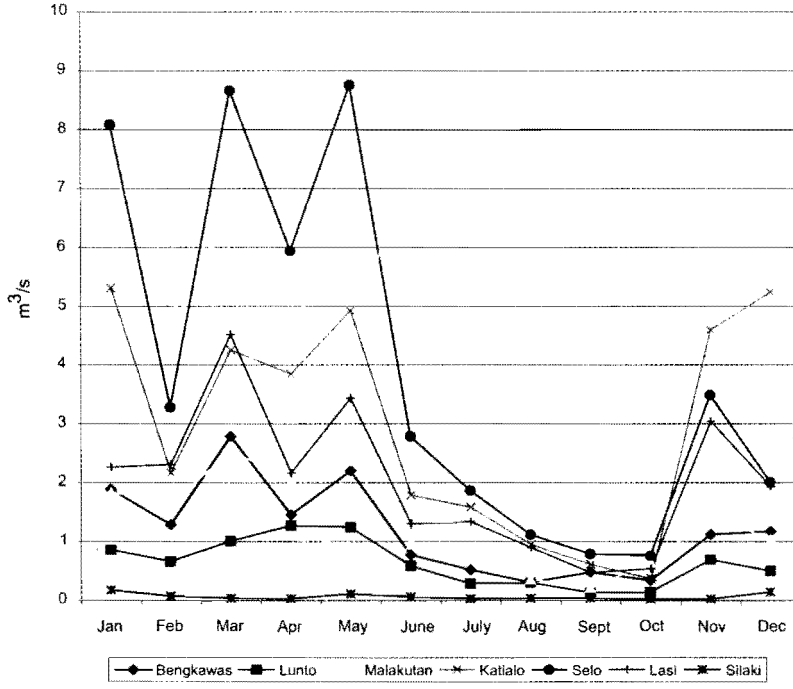
Figure 1: Inflows, water uses, and zoning of part of the Ombilin River (under study)



Zone B is between the confluences with the Selo and Malakutan rivers. There are three types of water use in this zone: irrigation, domestic, and industrial. From the inventory, 77 waterwheels for irrigation are found only 38 of them functional. In addition to the waterwheels, five pumping stations for irrigation are also in this zone. There are two pumping stations for drinking water and one for washing coal.

Zone C is between the confluences with the Lunto and Sinamar rivers. In this zone water use is mainly for irrigation, using waterwheels to lift water from the river. In this zone there are 231 waterwheels for irrigation, of which only 116 are functioning. In addition, there are nine pumping stations for irrigation.

Figure 2: Dependable flows of seven tributaries flowing into the Ombilin River



4.2 Water Balance

Water balance computations for each zone showed that discharges are higher than the outflows for water uses for different purposes (Table 1). In Zones A, B and C, respectively only about 5.4 percent, 30.6 percent and 12.7 percent of the water is being used. The data suggest that pressure on water resources is highest in Zone B, followed by Zone C, and Zone A.

Water Accounting. Further classification of the water balance components into use categories (river water accounting) indicated that the depleted fraction of gross and net inflow for the part of the Ombilin River under study is 0.34 (in this case gross inflow is equal to net inflow). The process fraction of depleted water is 1 (because total depletion is assumed to be equal to process depletion), and the process fraction of available water is 0.43. (Table 2).

Table 1: Water balance computation for the Ombilin River

Items	Zone A		Zone B		Zone C		
	Inflow m^3/s	Outflow m^3/s	Inflow m^3/s	Outflow m^3/s	Inflow m^3/s	Outflow m^3/s	
Singkarak Lake	3.333	-					
Bengkawas River	1.19	-					
Katialo River	2.97	-					
Silaki River	0.07	-					
Irrigation (Agric.)	-	0.41					
Water Balance	7.563	0.41	7.153				
Selo River			3.96				
Irrigation (Agric.)			-	0.92			water flowing down-stream
Talawi Domestic WS Company			-	0.04			
PLN Thermal Power Plant			-	0.005			
TBO Thermal Power Plant			-	1.9			
Coal washing			-	0.14			
Rantih Pump Station (Domestic WS)			-	0.4			
Water Balance			11.113	3.405	7.708		
Malakutan River					1.32	-	
Lunto River					0.64	-	
Lasi River					2.02	-	
Irrigation (Agric.)					-	1.489	
Water Balance					11.688	1.489	10.199

4.3 Issue 1: Impacts of construction of a hydro-electric power plant at Singkarak Lake on the poor and other water users.

The development of Singkarak Hydro-electric Power Plant has caused a drastic reduction in the discharge of the Ombilin River because a large amount of water from Singkarak Lake is now drained out to another river, flowing to the west coast, whereas the Ombilin River flows to the east coast. A permanent weir has been built at the outlet from Singkarak Lake to the Ombilin River, and the outflow to the river has been reduced and kept in the range of 2–6 m^3/s instead of the former average of about 40 m^3/s. The development of Singkarak HEPP has thus increased the scarcity of water, and competition over water use in the river.

Changing the amount of water supply has brought about a number of changes in the water use pattern of the basin. It has also brought several problems to water users along the river.

Table 2: Water accounting for part of the Ombilin River under study (normal year)

No	Items		Note	Amount	Total
	Inflow				
1	Gross inflow		2+3+4+5+6+7+8+9		15.503
2		Singkarak Outlet	m^3/s	3.33	
	Zone A	Inflow from rivers			
3		a. Bengkawas River	m^3/s	1.19	
4		b. Katialo River	m^3/s	2.97	
5		c. Silaki River	m^3/s	0.07	
	Zone B	Inflow from rivers			
6		Selo River	m^3/s	3.96	
	Zone C	Inflow from rivers			
7		a. Malakutan River	m^3/s	1.32	
8		b. Lunto River	m^3/s	0.64	
9		c. Lasi River	m^3/s	2.02	
10	Storage Change		11 + 12		0
11	Surface			0	
12	Subsurface			0	
13	Net inflow		1 – 10		15.503
14	Depletive use				
15	Process depletion		17+18+19+21+22+23+24+25		5.304
16	Evapotranspiration				
17	Zone A	Irrigation (Agric.)	m^3/s	0.410	
18	Zone B	Irrigation (Agric.)	m^3/s	0.920	
19	Zone C	Irrigation (Agric.)	m^3/s	1.489	
20	Municipal, Industry, and Energy.		21+22+23+24+25		2.485
21	Talawi Domestic WS Company		m^3/s	0.040	
22	Coal Washing		m^3/s	0.140	
23	Rantih Pump Station (Domestic WS)		m^3/s	0.400	
24	PLN Thermal Power Plant		m^3/s	0.005	
25	TBO Thermal Power Plant		m^3/s	1.9	
26	Non-Process depletion				0
27	Flows to sinks		m^3/s	na	
28	Other evaporation		m^3/s	na	
29	Total Depletion		15		5.304
	Outflow				
30	Total Outflow		13 – 29		10.199
31	Surface outflow from rivers		30	10.199	
32	Surface outflow from drains			na	
33	Subsurface outflow			na	
34	Committed Water		35+36		3.1
35	Navigation (assumed)		m^3/s	0.775	
36	Environment maintenance (assumed)		m^3/s	2.325	
37	Uncommitted water		30 – 34	7.099	
38	Available water		13 – 34	12.403	
39	Available for irrigation		38 – 20	9.918	
	Indicators				
40	Depleted fraction (gross and net)		37 / 13 x 100 %	34 %	
41	Process fraction (depleted)		15 / 29	1	
42	Process fraction (available)		29 / 38 x 100 %	43 %	

(1) Reduction in the number of waterwheels and irrigated area

Irrigation systems along the Ombilin River are supplied by traditional waterwheels and pumps. No surface system was found. This method of irrigation is felt by the farmers to be the most suitable system under the physical conditions. The limited rice fields available; their locations scattered over a narrow flat area along the river; and the average river width of around 50 meters would make the construction of weirs for surface irrigation very costly. In addition, the porosity of the soil requires continuous flows of irrigation.

A field inventory found some 184 waterwheels serving a command area of 333 hectares and 463 farmers. This indicates that, on average, a waterwheel serves 1.8 hectare with 2.5 farmers involved. However, the exact capacity of waterwheels as well as serviced area and number of farmers involved vary depending on the size of waterwheel which is determined by the length, number, and diameter of its water tubes.[11] In general, the capacity of a waterwheel increases as the length, number, and diameter of water tubes increase. In reality, there are waterwheels that could irrigate up to 15 hectares, involving some 30 farmers.

Pump irrigation technology has begun to be used in the last few years, especially by those whose land can no longer be served by waterwheels. When the field inventory was conducted 14 pump irrigation units were found along the Ombilin River, with a command area of 138.5 ha, involving some 200 farmers. Most of these were provided by either government or non-government agencies. Pumps are usually given to farmers who group themselves into an organisation. In that case, pump irrigation is owned by a group and not by a farmer personally. There has thus been a change in the institutional form of irrigation ownership, following change in the irrigation technology from traditional waterwheel to pump irrigation system.

Some farmers whose land was served by pump irrigation complained about the cost of operation and maintenance of a pump compared to a waterwheel. Another problem is the soil type, which is mostly porous and needs continuous inflow of water to maintain soil moisture and fulfil the crop water requirement. This is a weakness of pump irrigation whose technology often is not mastered by the farmers and whose operating time is limited. A waterwheel on the other hand has a comparative advantage, as it can be operated continuously without significant additional cost.

Irrigation has been severely affected by reduction in the river discharge. The numbers of waterwheels, command area, and farm families serviced have declined markedly after the Singkarak HEPP development. The number of currently existing waterwheels is only around 50 percent of that in 1996 (before the operation of the Singkarak HEPP started), and current irrigated area is approximately 61 percent of that in 1996. Table 3 shows changes in these numbers during the last five years.

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[11]A water tube is part of the waterwheel, extracting water from the river. Normally, the larger the waterwheel the higher the number of tubes it has. However, under some conditions— for example, when river discharge is low— the operator may reduce the number of tubes to allow it to continue operating.

Table 3: Number of waterwheels, service area, and farmers in the Ombilin River from 1996–2000

Year	Number of waterwheels	Irrigation service area (ha)	Number of farmers
1996	366	549	729
1997	296	470	621
1998	237	405	556
1999	195	343	478
2000	184	333	463

(2) Increased operation and maintenance costs of waterwheel irrigation systems

For owners and operators of waterwheels, reduction in the river discharge has caused several problems in system operation and maintenance (O&M). Firstly, the current discharge, especially in the dry season, often cannot rotate the waterwheels or if it can the rotation rate is very low. Consequently, operators have to lengthen the traditional weir to increase water depth and direct water towards the wheel so as to increase its rotation speed. Another way of making a waterwheel continue operating under such conditions is by reducing the number of water tubes, making it lighter and easier to move. The consequence of both choices is increase in the workload and cost of operating and maintaining the system, and reduction in the capacity of the wheel to supply water which means decrease in the area of land irrigated and reliability of irrigation water.

Secondly, increased intensity of damage on traditional weirs and waterwheels results from drastic increases of river discharge due to sudden opening of the gate at the Singkarak outlet. According to farmers, the gatekeeper usually opens it during the rainy season to avoid flooding on the settlement and irrigated area, which are located in low land surrounding Singkarak Lake. Consequently, Ombilin River discharge increased during the rainy season because of additional inflow coming from Singkarak Lake.

To the owners and operators of waterwheel irrigation systems, increased damage intensity means more labour, capital and costs if the system is to be repaired. The socio-economic survey shows that on average the intensity of waterwheel damage increased from 1 to 2.5 per season since the operation of Singkarak HEPP (Table 4)

(3) Unreliability of irrigation water and decline of rice yield.

The higher intensity of damage to waterwheels has resulted in some problems in irrigation water supply. Most farmers reported that irrigation water supply has been unreliable since development of Singkarak HEPP, due to the above-mentioned problems of operation and maintenance. As a result, the growth and yield of rice on land irrigated by waterwheels declined markedly. Some farmers reported a lighter effect while others noted a considerable decline. The socio-economic survey showed that the average yield of rice dropped from 4.2 ton per hectare before the development of Singkarak HEPP to 3.1 t/ha in 1999.

Table 4: Damage intensity, and average rehabilitation costs of waterwhseels and weirs, before and after development of Singkarak HEPP

Items	Average intensity/cost (per season)		Percentage increase
	Before HEPP Rp.	After HEPP Rp.	
Waterwheel damage	1	2.5	150
Weir damage	1	4.5	350
Rehabilitation costs of waterwheel	150,000	1,100,000	633
Rehabilitation costs of weir	50,000	425,000	750

(4) Impact on domestic water supply and industry

The reduction of discharge in Ombilin River has also affected the water supply of the pump station for coal washing and the water quality of domestic water supply. However, the coal washing company experienced it only initially. The PLN (the company operating the Singkarak HEPP) has built a weir to improve water level so that problem is solved.

Reduced water quality has brought some problems to domestic water suppliers and consumers. The main problems facing the domestic water suppliers (in this case was PDAM) is increased operation and maintenance costs. The domestic water company manager estimated that water treatment cost increased by almost 100 percent. However, at times when raw water quality was very low, the domestic water suppliers did not perform water treatment since it would not bear any improvement in the quality of water. At such times, the domestic water company would distribute raw water directly to the customers without treating it. So far, no health-related problems caused by low water quality have been reported by the domestic water consumers.

The latest data show that in 1999 the company served approximately around 27 percent (or 15,042) people of Sawahlunto municipality. This indicates that a low percentage of people have access to pipe-borne water in the town. Therefore, it is reasonable enough to expect a growing demand for piped water in the near future, and a greater amount of water from Ombilin river to be taken by PDAM since there are no other water sources in the area.

4.4 Issue 2: Non-existence of organisation for river-basin management and framework for water rights licensing.

As has been mentioned earlier, the incorporation of the idea of river-basin management into policy and action are relatively new to Indonesia. The management framework is not yet developed except in two basins in Java, which are managed by publicly owned corporations. In other provinces, the idea of river-basin management is newly introduced. As the responsibility for water management is

fragmented among a number of government agencies a provincial water management committee (PTPA) is supposed to be set up in each province[12]. In West Sumatra the PTPA was set up in 1994. The characteristics of this committee are:

- Its main function is to assist the governor in co-ordinating water management at the provincial level.
- The specific tasks are: (1) data collection, processing, and preparing materials to be used to formulate provincial policy on water management co-ordination; and (2) providing consideration and/or advice to the governor on matters related to water supply, waste water drainage, and flood control.
- The members of the committee are staff from agencies related to water management (other stakeholders are not considered as members of the committee).

No specific budget was allocated for this committee, so its activity was on an ad hoc basis. When there were problems related to water supply, drainage or flood a meeting of provincial staff would be held but it was not clear whether the meeting was a PTPA meeting or just a meeting related to the performance of general government tasks.

The government regulation related to the provincial PTPA has an article, which states that the governor can set up basin water management committees (PPTPA) to assist the PTPA in performing its tasks. Until now no such committee has been set up in any of the six river basins in West Sumatra. As conflicts over water allocation and use tended to increase in West Sumatra, as illustrated with the case of Ombilin River, there is clearly a need to develop a framework for river-basin management in the province. The case of Ombilin River can be used as the pilot activity to develop the framework and capacity for integrated water resource management at the basin level.

In terms of priority of water use, GR No. 22/1982 underlines that water for drinking is the highest priority because drinking water is a very basic human need for survival. This essential need of water for human life seems to be the basis for prioritisation so that the order of priority can be seen, as one source said, as water for life, water for livelihood, and water for amenity. Environmental need for water is not included in the list. Since there are inter-regional differences in water use and in the capacity to provide water, the order of priority below drinking water may be arranged differently in different regions of Indonesia. The PTPA is the co-ordinating body tasked with making such prioritisation.

The prioritisation still leaves questions, such as how it would be applied in decision making in times of short- or long-term water shortage. What about the

[12]Based on Public Works Ministerial Decision No. 67/PRT/1993

irrigation systems, if higher priority users exert their right over water from the same source? Clarification of such points remains desirable.

Water rights are to be given in the form of use rights, allocated by the government through a licensing mechanism. Since water and source of water are considered to embody social functions, there are uses of water that require licence, and others do not. Tapping sources for non-commercial drinking water and other individual domestic uses is allowed without licence as long as these do not harm the water source or other water users' interests. According to MR No. 48/PRT/ 1990, a government licence is required for uses like domestic water supply, municipality and real estate, irrigation, animal husbandry, plantation, fishery, industry, mining, energy, navigation, disposing of waste, etc.

The Minister of Public Works or the governor is authorised to issue licences for water use within their respective basins. Licences for groundwater use are issued by the Minister of Mining and Energy. Licences for water use may be given to individuals, groups of individuals or any legal entity. A group having a licence is authorised to arrange water distribution among its members based on government regulations. Those granted a licence must pay a fee to the ministry or to the governor, depending on who issues the licence. According to MR 48/PRT/1990, the fee is to be used for financing operation and maintenance of water structures and maintaining of the water source. Every licence on water use has a time frame depending on the kind of use. There is no general reference for this yet, but the fee is supposed to be set every five years.

Transfer of water licences is prohibited. Article 18 of MR 48/PRT/1990 states that giving up a water licence or selling it to other parties may be allowed if the licensing agency gives its permission. The MR, however, is not explicit on this exception.

This formal system for allocating water use rights is hardly implemented, except perhaps to some extent in the two basins managed by publicly owned company. The problems are not only the existence of gaps and inconsistencies in the formal regulations, policies and organisations. The lack of consensus on some key concepts (Pusposutardjo 1996) and the lack of hydrological data in most of the basins (Hehanusa et al. 1994) make it impossible for the government to make basin-level plans or even to make the right decisions on whether or not new uses of river water are justifiable.

Regulations provide that licences for water uses that potentially affect water balance must be based on general basin-level plans for development, protection, and utilisation of the basin water. In cases where such plans have not been made, the issuing of licences must be based on consensus in the co-ordinating body, PTPA. But what would be the basis for such a consensus?

In most basins, water allocation is governed by whatever local communities accept as rules. In predominantly agricultural basins, traditional adat may govern water allocation. Where non-agricultural sectors have exerted their interests, claims over water may be based on political or economic power leading to transfer of water from the agricultural sector (Kurnia et al 1996). Nevertheless, government is capable of exercising the authority in water allocation, including inter-basin water transfers.

Transferring water from Ombilin River to Anai-Sialang basin is an example. The decisions about this transfer, it seems, were made on the basis of studies done by the government. The original water users must adjust to the new situation.

One of the impacts of the government action, for farmers in Ombilin River, is that it has affected the operation of their waterwheels supplying water to their paddy fields, due to lower river discharge. The lower flow has also caused domestic pollution more felt in the downstream Ombilin River. This underlines the importance of formalisation of irrigation water rights in order to protect the interests of the poor and small farmers. Also, it is important to assess the technologies used by the existing water users in order to predict the impact of river water reallocation and consequent reduced water supply to them.

5. Conclusions and implications for Integrated Water Resources Management

Preceding sections have indicated the need to develop effective water management institutions. Improving water management in Inderagiri sub-basin (especially in the under watershed) will take more effort and longer time because the organisation for river-basin management and frameworks for water rights are not yet developed.

The construction of a hydroelectric power plant at Singkarak Lake has significantly reduced the outflow from this lake to the Ombilin River, which in turn has affected water users along the river. Among the impacts were:

- the cost of operating waterwheels has increased and the number of waterwheels for irrigation has gone down by around 20 percent;
- reported productivity of irrigated rice has decreased; and
- water quality for domestic water supply has declined and the cost of water purification has increased.

A number of options can be considered in order to solve the problems in the short term, while starting longer-term efforts to develop effective water management institutions. The proposed options are:

- In the short-term, problems faced by the users need to be solved by reviewing water allocation rules, especially by releasing more water from Singkarak Lake to Ombilin River.
- The handling of water allocation needs to be done systematically. A water board consisting of all stakeholders should be set up and given authority to regulate water allocation, especially from Singkarak Lake.
- The technology for lifting water for irrigation both with waterwheels and diesel pumps needs to be adjusted to meet the need of local environment. Soil porosity is high and there is need for 24 hours of water supply. The waterwheel is well suited for this environment but the water level in the river is not sufficient to continue operating it

efficiently with the current technology. Farmers indicated that they have difficulties with the cost of pump operation and maintenance and are thinking about using electric pumps to lift water from the river.

- It is also proposed that the electricity company provide a special discount for the domestic water supply company and farmers who will use electric pumps for irrigation, as a "good neighbourhood policy."

- In the long-term, the government should take the initiative to set up a co-ordinating body (water board) which can effectively enforce water allocation rules, for which the national water resources policy has provided a legal basis.

Steps required to implement these options would include:

- Reviewing all water-related laws and provincial regulations and adjusting these in accordance with the direction of the new national water policy.

- Drafting and issuing a Governor Decision for setting up a working group to review water-related laws and regulations, and a co-ordinating and/or operating body for river (sub-)basin management, using the Ombilin sub-basin as the pilot site.

- Reviewing the possibility of charging a surface water use tax, and using this income to finance the co-ordinating body and river and watershed maintenance.

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Water Management for Irrigation and Environment in a Water-Stressed Basin in South-West France: Charging is an Important Tool, but is it Sufficient?

Henri Tardieu
General Manager, Compagnie d'Aménagement des Coteaux de Gascogne (CACG)
Tarbes, France

Abstract

In France, the water management issue is no longer a question of developing stakeholders' participation or transferring State competence to user associations. As for the other countries with a complete and complex institutional framework, the point is to define clearly the role of each water management stakeholder and to answer both remaining questions:

1. *How to ensure sustainability of the investments by raising the price of water without discouraging economic development?*
2. *How to share water among users when resources are scarce?*

The general answer given to these questions relies on the two basic principles of a good water management leading to sustainable development:

1. *as it consumes more than 70 percent of the available water of low flow periods, irrigated agriculture must respect the other uses by limiting its demand to the allocated volume;*
2. *as it involves large and long-term public investments, irrigated agriculture must at least bear the "sustainability cost" of the upstream water resources.*

Such a general answer is of course largely case-specific and should be adjusted to each institutional framework.

France, like other Euro-Mediterranean countries, has a long history of water development, born from water scarcity and a constant search for the best agricultural use and the fairest sharing. A complex institutional structure has progressively been set up to develop private initiatives within a public service framework.

During the last century, Authorised User Associations (ASA) were developed. They were public establishments constituted by landowners for sharing the construction and management of irrigation systems.

In the 1950s, the State created, within more ambitious land use planning, the Regional Development Companies (SARs), public corporations with a "concession" from the State, to develop water resources and manage irrigation schemes in the southern regions of France. Well subsidised by the State at the beginning, the SARs now

cover their costs with the contributions of their customers. This management is now financially sustainable as it includes the provisions necessary to maintain the investments under concession. It nevertheless keeps the basic characteristics of a French public service: continuity, equity, sustainability, and transparency.

Finally, Basin Organisations were set up more recently, with a widened approach to include management and protection of the environment, to seek a global consensus on water management by using dialogue and financial incentives, while the State keeps the role of regulation.

After a short discussion about the stakeholders in French irrigation and water management, this paper addresses both socio-economic questions stated above, with a specific discussion of the case of the Neste system, a water-stressed basin in the south-west of France.

1. The key stakeholders in irrigation and water management in France

1.1 At the individual level: farmers

Farmers aim to satisfy the objectives they select for their household (to ensure a minimum revenue), their enterprise (to maximise profits, to minimise risks, and to improve the quality of the products) and their land (to be sustainable).

Each one freely chooses the crops to grow on the basis of advice from his profession with due consideration given to the market. He consequently optimises the management of the production factors, particularly the on-farm irrigation system.

The valorisation of water through irrigated agriculture varies, largely due to the heterogeneity of the production systems. The cost of irrigation water is generally relatively high in the Mediterranean regions, and implies high performances with high value-added crops.

The constraints of agricultural competitiveness make the irrigator very sensitive to the reliability of water supply and of course to its cost.

For each culture in a given cropping pattern, water value can be assessed; so the water demand is represented by the graph of water values per water volume. Such a graph shows how an irrigator reacts when the water price varies.

1.2 At the level of small systems: Authorised User Associations (ASA)

Gathering irrigators through an association which owns and/or manages common assets is the first and the oldest way to manage collective irrigation [Lesbats et al 1996]. These associations bring together the land-owners concerned with the irrigation system. They are self-managed structures, based on a legal framework developed since the 19th century, and have all the authority needed to carry out and to manage their irrigation system.

The statutes of Authorised User Associations (ASAs) are public; they confer on them the capacity to act for the public good, particularly in the matter of cost recovery, where they follow the rules of public accounting. Costs are shared in proportion to the involvement of each owner in the project area, generally as a function of his irrigated area.

These associations have a very long lifetime, since the properties are irrevocably engaged in the association. This long experience provides valuable references.

Initially, the collective participation of members is exemplary. They define their projects according to their needs and their means of fulfilling them. They personally ensure operation and minor maintenance. The apparent cost, corresponding only to monetary expenditure, is thus largely below the comprehensive cost of water.

But it sometimes happens that the necessary solidarity decreases and the ASA goes wrong by lack of involvement and lack of professionalism. Members are then concerned about the immediate balance of the accounts, and cut down the maintenance expenditure. This entails serious consequences in terms of quality and continuity of service.

To be assisted in all these approaches, and to preserve or re-establish the durability of their system, at the conception as well as at the management stage, ASAs have currently been calling for the help of the Administration. The ASA statutes indeed foresee that in case of bankruptcy of the ASA, the State representative has to replace the ASA President. Considering the State's other involvements, ASAs are now looking for professional advice, particularly on the part of the SARs (see below).

Such a complementary relationship between ASAs and a technically competent body can be organised at the start of the project so as to guarantee sustainable management. This is the case with the design and/or maintenance contracts offered by CACG, one of the SARs. These contracts can also evolve towards Public Service Delegation.

1.3 At the level of large systems: Regional Development Companies (SARs)

Created about 40 years ago, in the southern regions of France where water was proved to be a limiting factor to development, the SARs are characterised by the originality of their mission and statutes (Plantey et al.1996).

Their mission, defined by the concession contract with the State, deals with the implementation and operation of hydraulic projects necessary for the development of their region. Managing the conceded water resources, they ensure their conveyance to the centres of urban and industrial consumption, and the distribution in rural irrigated areas. For this purpose, they have all the rights and obligations of the owner of the works, but without the right to sell them.

Their statutes are those of private companies, implying rules of sound management and economic efficiency. The majority of the shareholders are public, and so is the

governance: the local authorities (Départements[1] and Regions) have therefore control of the strategic resources in the name of the public good for all water users. The agricultural users are especially represented in the Board and participate therefore in governance as the SARs' private shareholders.

In accordance with the specifications of their concession contract, the action of the SARs is guided by the principles of sustainable management of a public service:

- Quality, continuity of water service;
- Equity when water is to be shared between users;
- Sustainability with adequate provisions for long term maintenance;
- Transparency of the management and accountability to the Board.

The SARs' continuous effort, with regard to innovation and professionalism, bears fruit: the system performances ensure, for a controlled cost, the best adequacy between resources and needs on the basis of integrated water management. Despite the relative scarcity of the resource in the French Mediterranean regions, water shortages or conflicts between users are no longer a major concern in the systems managed by the SARs (Tardieu and Plantey 1999).

When an exceptional crisis situation arises, high-tech equipment and well-tried methods in water sharing allow equitable management of the resource. This is typically the case of the Neste system managed by CACG.

1.4 At the level of large catchment basins

The Basin Committee, a sort of water parliament where users, local authorities and government are represented, is in charge of conservation of the water environment and of water management policy in one of the six French large catchment basins. It develops, in collaboration with the State Administration, the long-term water policy plan (SDAGE).

The Water Agencies are their executive body: taxes, collected in accordance with voted decisions of the Basin Committee, discourage polluters and consumers from polluting and consuming. This incentive to behave in a more responsible manner is coupled with a financial policy since the product of the taxes is allocated to financial aids for pollution abatement and for conservation/development of water resources. For irrigation particularly Water Agencies contribute to investments in modernisation and regulation, which are very important sources of water savings.

After 30 years the system based on the principles of solidarity and equity (the polluter pays and the consumer pays) is well accepted by public opinion. But the French Water Agencies are not to be misunderstood: they do not have direct responsibilities in water system management unlike the bodies described above.

[1]A Département is a local government unit.

1.5 At the State level

According to the terms of the 1992 Water Law, it is not the State's responsibility to ensure directly the operational management of water resources, except for very large rivers. Its authority should guarantee the respect of the necessary regulations of water uses, which are subject to previous authorisation. Elaboration and updating of the rules should be carried out in consensus with the members of the water community, so as to minimise the number of rule-breaker users.

Finally the State is the owner of large hydraulic works for irrigation purposes, precisely those which are delegated to the SARs by a concession contract. As a consequence, it supervises both the maintenance and the best use of the assets in order to meet all water demands.

Although this presentation of the French institutional framework in water management may be too simplified, we can nevertheless see an attempt to clarify the respective roles of different stakeholders:

- basin planning and financial policy: the Basin Committee seeks a consensus to reconcile all users, both among themselves and with the environment, in a global approach to water management using financial incentives.
- operational management: the SARs manage water resources by contracting with users, and ensure the sustainability of the assets; the ASAs have almost the same objectives but only for smaller irrigation systems.
- regulation and law enforcement: the State sets up regulation measures, keeping in mind both the necessary consensus and its own possibilities for applying them to all users.

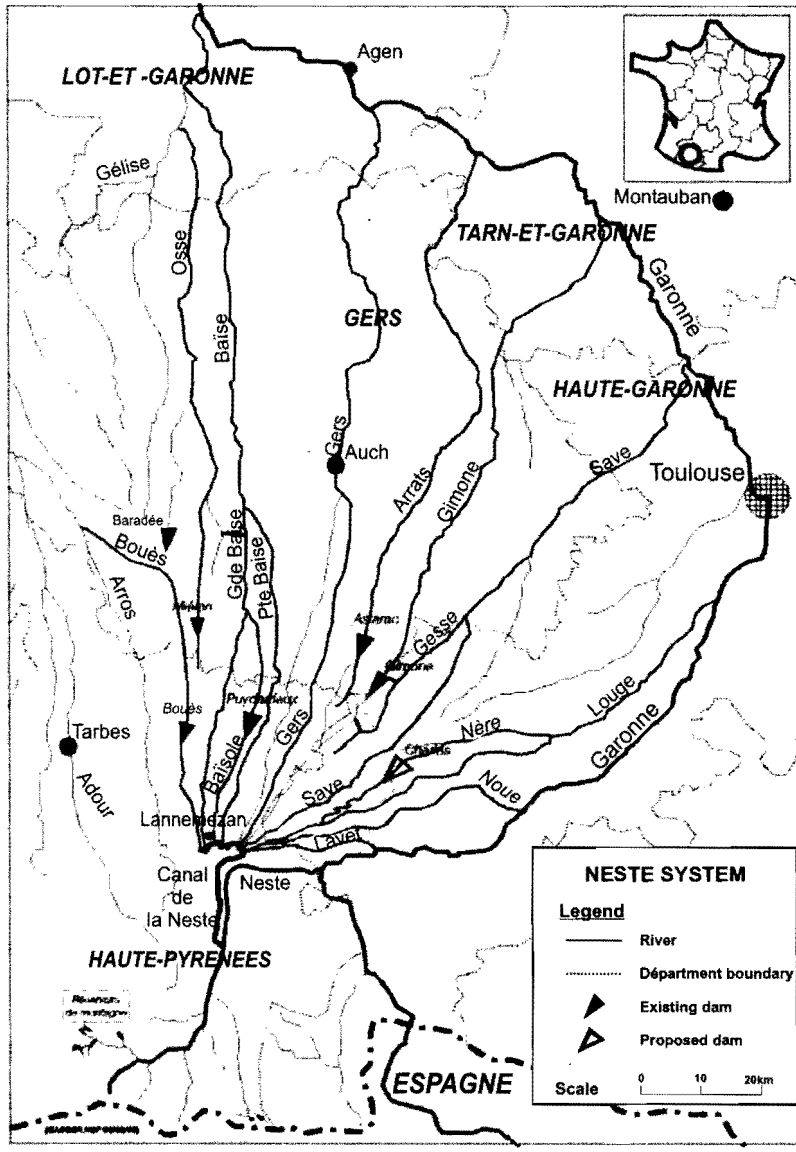
It is worth noting that the French water organisation is also characterised by a "public/private" mix. The freedom of the private initiative is balanced by the research of the public good. The economic efficiency of private management is associated with the sustainability of the public service.

2. The Neste system: an example of "controlled water management"

In the south-west of France, water management concerns several uses, among which, particularly for surface water, there are three important competing uses: irrigation, hydropower and minimum flow in the rivers.

As an example, water management in the Neste system is here described not only as a successful set of rules, consultation methods and high-tech controls, but also as a system facing a regulation problem due to a water supply below the water demand. The specific features of the water management agency—the Compagnie

Figure 1: Map of the Neste basin



d'Aménagement des Coteaux de Gascogne (CACG), one of the SARs—are described as preconditions of the success of "controlled water management": the institutional originality of the SARs with public missions and private management, their joint experience in regional development and water management, their capacity in maintenance and asset conservation, and finally the good practices they follow in pricing water as an economic tool together with a quota system.

Economic analysis of the water value in each use, particularly for irrigation in the specific context of irrigated agriculture and land development, may clarify the allocation of water and validate the regulation tools used in "controlled water management."

2.1 Presentation of the Neste system

In 1990, after a deep crisis, with conflicts between users due to a water-scarce situation, a new management method was set up (Tardieu 1991). In operation for 10 years, it can be described as follows with its successes and limitations:

Location: A 10,000 km^2 basin located in the south-west of France with 650 mm of rainfall, where irrigation is necessary for most kinds of agricultural production, and surface water is the only resource for urban and industrial uses because of lack of groundwater: recharged rivers (1,300 km) are the common resource for every user.

Water users:

- fish, wildlife and tourism need 250 Mm^3/year to strengthen low flows[2];
- 200,000 inhabitants consume 13 Mm^3/year;
- 51,000 irrigated hectares (28,000 l/s subscribed by 3,000 irrigators) consume 70 (average) to 95 Mm^3/year (dry years);
- a 10,000 hectares waiting list without irrigation contract (equivalent to 6,000 l/s).

Water resources:

- the Neste Canal (a State concession to CACG) which diverts 250 Mm^3 of the natural flow of the river Neste;
- stored resources: 100 Mm^3, of which 48 Mm^3 are stored in hydroelectric mountain reservoirs and 52 Mm^3 in CACG lakes (also State concessions).

[2]Mm^3 = million (10^6) cubic meters.

Types of withdrawal:

- individual withdrawals (14,500 l/s subscribed through "conventions de restitution", or "pour-back contracts";
- collective withdrawals by ASAs or CACG (State-conceded) irrigation networks (13,500 l/s).

Monitoring and remote control:

- resources: 200 river flow meters, 40 dam and canal gates, and 150 pumping stations under remote control;
- demand: 1,500 individual water meters (checked 3 to 4 times a year), 6,000 meters on collective networks, 150 pumping stations under continuous monitoring

Resource-demand balancing:

- The balance is ensured with a failure rate of 1 in 4 (years). For a more comfortable balance, the additional resource needed is 43 Mm^3 for the waiting list, and 7 Mm^3 to reduce the failure rate.

2.2 Management rules: the contract, individual and collective

Each user signs with CACG a water contract called "convention de restitution" guaranteeing that his/her withdrawal is balanced out by an equivalent upstream recharge. The contract states a maximum diversion flow and a subscribed volume (the "quota") with a 2-tier price (2-step): the first price is a function of the subscribed flow (Francs 320 per l/s)[3], the second price is a function of the volume consumed over and above the quota. (F 0.63 per m^3 above the 4,000 m^3/l/s quota).

Thus there are two limits on the abstraction of water by the user: a rate limit, and a volume limit. If the authorised flow rate is Q litres per second, the volume quota for the year is 4,000 m^3. (This means in effect that the user may abstract water for 1,110 hours before the quota is exceeded.) The extra payment required by those who exceed their volume quota is F 0.63 per m^3. The price step is thus large. By paying F 320 the user becomes entitled to take up to 4,000 m^3, so if the full quota is taken its average price per m^3 is F 0.08. If the quota is exceeded by the user, the marginal price for taking more water rises immediately to F 0.63.

In reality, the user will often take less than the quota, particularly during rainy years. In that case the payment of F 320 remains, so in effect the average price paid per m^3 is more than F 0.08, which is the minimum possible. Over a long period, the average price actually paid is close to F 0.12 per m^3.

[3] 1 Franc = about 12.6 US cents (October 2000).

The contract also fixes penalties for the user (in case of withdrawing above the subscribed flow, or lack of water meter) and for CACG (in case of quota reduction).

As demand exceeds resources even when dams are full, the Neste Commission, which brings together all water stakeholders from the five Départements involved, decided to start a "waiting list" of applicants. All rejected applications are registered in a withdrawal file freely accessible (6,000 l/s to date). Newly created resources and contract resignations allow a few new applications to be met annually, according to priority rules (young farmers) or to seniority on the waiting list. All the yearly contracts get a collective withdrawal authorisation in each of the five Départements.

When dams are not full or when it is anticipated that the Neste river flow will decrease, the Neste Commission meets before the irrigation season to decide on a quota reduction. The choice of the meeting date is the result of a compromise between the possibility of making a sound hydrological forecast and the possibility for farmers to adjust cropping patterns or inputs.

During the irrigation period, water meters are checked; if the quota seems likely to be entirely used, a warning letter is sent by CACG to the irrigator. Quota overrides are billed at the end of the season. Besides, CACG which is also in charge of the resource management activates its computerised remote control (RIO software): tactical water management in order to save water transferred from the remote-controlled dams (checked every three hours); strategic water management in order to optimise water allocation between irrigation and river wildlife with the objective of emptying the reservoirs by the end of the low flow period with a failure rate of 1 in 10 (weekly check).

After the irrigation season, water management performance is assessed in terms of respect or improvement of minimum wildlife flows, respect of volumes subscribed by irrigators and water savings throughout the system:

- Since 1990, when the system was first put in operation, failures to maintain wildlife minimum flows have been rare: One to two days per year over a few kilometres, as compared to the drying up of several dozens of kilometres over several weeks in 1989.

- However, irrigators' quotas have been reduced in 4 years out of 10 (although one of these reductions was later cancelled). The ultimate solution, when a crisis cannot be solved by quotas—imposition of the authority of the state, through intervention by the Prefect of the Department—has not been applied, except for substituting (in 3 years out of 10) a simple interdiction instead of the economic incentive for staying within the allocated quota.

- As to water savings throughout the system, it can be said, after using the RIO software for 10 years, that these amount to over 20 percent of the managed volume.

2.3 Successes and problems of the system: can a limited supply be regulated?

In the Neste system both principles of good water management are respected:

- Water is shared in such a way that fish and wildlife are preserved all along the 1,300 km of recharged rivers and that irrigators are delivered their contracted volumes;

- CACG, on behalf of the "conceding" State which bills the cost of the service, gets the financial means to cover at least the "sustainability cost" and guarantee the maintenance of the invested assets (F 3,000 million in current prices).

This is an obvious progress in comparison with the two "wrong practices" of the previous period: daily interdictions by the Prefect, which irrigators were circumventing by over-investing in pumping capacities, thus worsening subsequent crises; and the inability to charge for the "resource" part of the water service, thus leading to asset jeopardy.

One direct positive consequence is that irrigators are driven to saving water and optimising their cropping patterns, through a sound and sustainable incentive far more valuable than any media campaign. It also induces a renewed interest on the part of advice and research networks towards quota optimisation, in terms of cropping patterns or input selection (Balas 1993).

But a fundamental question remains which concerns "spatial development"[3]: what about the waiting list's demand, if water resource creation is hampered by procedure problems as well as limitations of public funds? One solution is sometimes envisaged: to reduce definitively all quotas of current irrigators, in order to let in the new applicants. This bad solution, which addresses issues of equity, economic efficiency, social acceptance and technical and agricultural management, has been discussed in a special paper (Tardieu 1999) and is summarised in section 4.

3. How to charge for balancing the irrigation costs without threatening economic development?

Whichever institutional framework one chooses, irrigation's main challenge is to cover the full cost of water used, by raising the water price.

The point is, for most irrigation systems being managed by government agencies, that public subsidies are now limited by Budget constraints. Such subsidies may consist in financing the operating personnel, heavy maintenance or rehabilitation costs, or in under-pricing the energy, etc. For us Europeans, the commitment "user pays for water" will be the basis of the new European Water Directive. Some targeted and transparent subsidies will still be acceptable, on the condition that they will be gradually phased out. This objective of an irrigation system breaking even thanks to adapted water charges is not impossible to reach: it is already the case in several regions of France.

However, the economic and social consequences of water price rises can be serious, as shown by the following examples of likely risks:

- Overall reduction in the country's agricultural production, making it impossible to reach the goal frequently assigned to irrigation, i.e. to secure food self-sufficiency. This consequence may be accepted if the country can maintain its "food sovereignty" [FAO-NGO 1996]. A regular increase in the price of water has recently been started in Tunisia, except for cereals, for which water charges have been kept constant.

- Higher food prices for urban consumers, which induces larger food imports and some losses of internal market shares for irrigating farmers. This has already been verified in various African countries.

- Lower agricultural income, hence increased rural poverty and population migration towards towns. Even if the irrigating farmers are not the most vulnerable in economic terms—since they can use a wider range of crops—the economic development of rural populations must remain irrigation's fundamental objective.

On the other hand, the "true prices" process can also entail some benefits:

- a new respect for water, which improves management efficiency;

- an incentive to choose the most profitable crops and to maximise comparative advantages;

- a means to know which assets have to be maintained, and which investments have to be done.

So, this price adjustment process has to be conducted with great care, taking into account the economic consequences on production: this is done by analysing the "water value" of irrigation for the farmer, i.e. the additional added value per water unit (m^3) offered by irrigated crops as compared with rain-fed.

3.1 Full cost and "sustainability cost"

Before tackling this issue, it is worth restating the definition of the full cost of water from the point of view of the agency responsible for water resource acquisition and distribution.

The full cost of water includes:

- operating costs: staff, energy, daily upkeep;

- investment-linked costs: depreciation and/or maintenance/renewal, financial costs of the initial investment.

A water price set at this level secures a balanced budget for the managing agency without any subsidies. In France, this price is about 1 F/m^3 for the large irrigation schemes, where water charges are based on the full cost of water with the first investment partially subsidised.

However, the cost of major headworks (reservoirs, transfer canals) is generally not included. The rationale for such under-charging is based on the consideration that these works are both strategic and multi-purpose and that they were created for the sake of regional development at a time when economies were more state-backed and more protected. Today, countries where such infrastructure is paid for by water users instead of taxpayers are rare. Nevertheless, it is the objective that has been set for irrigation, notably in France, with a transition period allowing a smooth evolution of production systems.

During that phase, water charges are meant to cover what will be called the sustainability cost of water, something that, in the case of heavy, long-life investments, is very different from the full cost:

- *sustainability cost = operating cost* + maintenance and sustainable renewal cost; or
- *sustainability cost = full cost* – financial cost of initial investment

With a water price set at the sustainability cost level, no new investment is possible; but budget constraints are met, and sustainable operation and maintenance ensured without having to resort to public funding.

As a very simplified example, here are the different costs, added to the water distribution cost, generated by the water resource infrastructure. This is the case of the Neste system: actual annual costs of a reservoir dam feeding a river (investment cost 10 F/m^3 with a quasi-infinite life duration).

Table 1: Calculation of sustainability cost and full cost, in the Neste system

Units: F/m^3

Operation and daily upkeep	0.05	
Maintenance / Renewal (0.5% x investment cost)	0.05	
Sustainability cost		0.10
Financial cost (Long-term interest rate : 5%)	0.50	
Full cost		0.60

A water price covering the sustainability cost of 0.10 F/m^3 is socially acceptable and, after the necessary public funding of the initial investment, prevents the need for further subsidies.

This transition phase, in the pricing policy is adopted in France: irrigation distribution costs are charged usually around 1 F/ m^3, i.e. at full cost pricing whereas the irrigator's share of the water resource costs is charged more around 0.10 F/m^3, i.e. at sustainability cost pricing.

3.2 Water Strategic Value

On the basis of the existing farming infrastructure, the strategic value (*Vs*) corresponds to the optimum combination between irrigated and non-irrigated crops, with a given cropping pattern:

$$\text{Strategic Value:} \quad Vs = \frac{VAI - VANI}{VI}$$

where

VAI = Value Added from Irrigated crops (before deducting the cost of water);

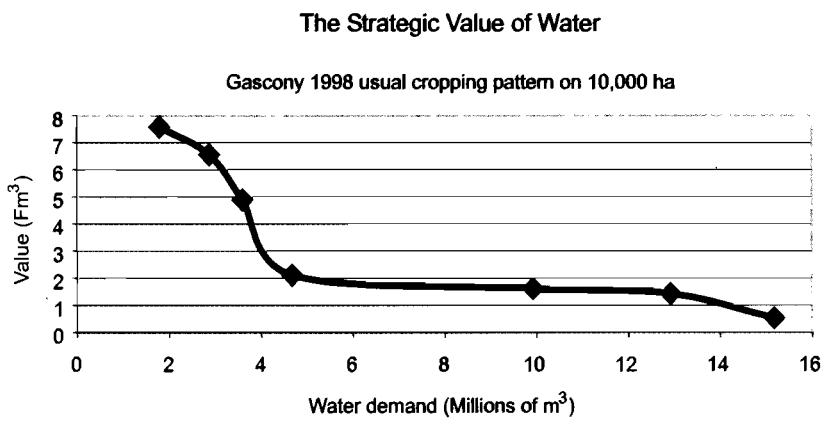
VANI = Value Added from Non-Irrigated crops (rain-fed crops) which could be cultivated instead of Irrigated crops

VI = Volume of water allocated to Irrigation

This value[5] reflects strategic choices made by the farmer at a point in time when he can still modify his cropping pattern, and adjust his irrigation practice to a variable allocated water volume. It is the result of a decision taken once or twice a year and it should at least cover the cost of irrigation (not included in *VAI*) for it to be profitable.

The strategic values of irrigated crops in any region can then be related to the areas of those crops and hence to their water consumption. By arranging these various crops in decreasing order of their strategic values, we can obtain a graphical relationship between crop value and water demand, as shown in figure 2.

Figure 2: Effect of water quantity on water value



[5]See also Molden et al. 1998.

The following remarks can be made on the Vs formula presented above:

- Variations in the crop price (domestic or world price) can lead to a change in value that rules out irrigation, or on the contrary to a stronger water demand; this is particularly the case for cereals, whose water valuation is relatively feeble but which call for large volumes of water.

- Changes in the yield or added value of a given rainfed crop can paradoxically entail changes in irrigation water demand. For instance, a specific subsidy to rainfed durum ("hard" wheat) makes it an alternative to irrigated maize in the driest parts of southern France. On the other hand, the probable diminishing profitability of cattle breeding (because of the coming reform of the Common Agricultural Policy of the European Union) will increase water demand for irrigated cereals; the improvement of rainfed crops in Sahelian Africa may lead to reserving irrigation for high added-value crops, such as vegetables or fruits.

- Improving irrigation effectiveness, thus diminishing the formula's denominator, increases water value and may make irrigation profitable; this is often the case with the flood irrigation of meadows, economically unthinkable in water-scarce areas but quite sound, if carefully conducted, in a mixed farming system.

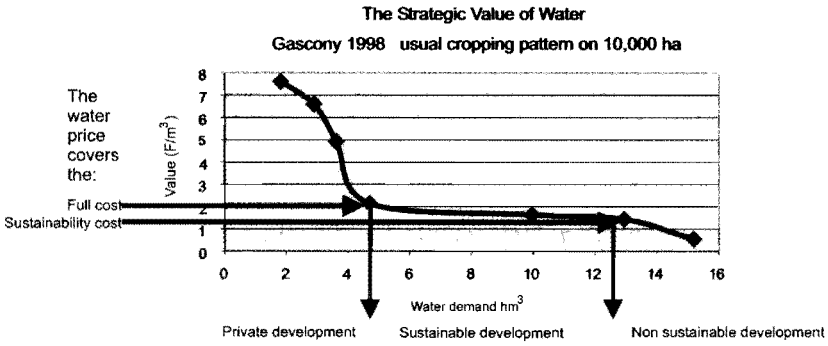
3.3 Water's Strategic Value, price and budget constraints

By comparing the *strategic values* of water for the farmer and its *comprehensive cost,* it is easy to know the average price that will balance the irrigation manager's budget.

The problem for the irrigation agency, and for the State which is often backing it, is the following: water price rises, which help to balance its budget, have a negative effect on water sales and, hence, a tendency to raise the costs of each m^3 sold since irrigation costs are mostly fixed ones (depreciation, financial, and maintenance costs). This is a vicious circle leading inevitably to the collapse of the system. That is why, in a now-transparent management environment, the State may find it interesting to keep on financing intensification or modernisation investments, thus boosting irrigated agriculture and increasing its own chances of recouping heavy *sunk costs.*

The concept of *sustainability cost* as described above is essential, for it constitutes the lowest price the State can accept. If the water price does not cover the sustainability cost and exceeds the Strategic Value of water for farmers (for at least one given existing crop), this means that a long-term public subsidy through water charges will be necessary to maintain that irrigated crop in the country or region considered. The opening up of agricultural markets and the new transparency in world trade will make this practice impossible in the future.

Figure 3: Sustainable allocation of water



Note: In this example, the price of 1.10/Fm³ based on sustainability cost includes the costs of the upstream dam and the distribution system, whereas on a full-cost basis this price would be about 2F/m³.

On the other hand, it does not seem economically sound to dismantle entire sectors of irrigated agriculture on the principle that the *full cost* of water should be covered... at all costs! This would mean that today's irrigators would have to pay for investments which will also be used by future generations, thus justifying a certain amount of public subsidies to help start up the economic development process.

So, when embarking on the true-price process in irrigation, it is essential to have a good understanding of *strategic values* of water to be able to derive demand curves by farm types and by region. Economic data on irrigated crops are not always available. This is one negative consequence of the disappearance of public irrigation agencies: the overall regulation of irrigation investments and of agricultural production requires States to allocate some funds to data collection and processing that "privatised" agencies can no longer afford. It should not be forgotten that economic references to be looked at also concern rain-fed crops, so as to be in a position to correctly appraise water value by comparison between alternative agro-economic systems.

4. Is water pricing useful for controlling water allocations?

The points made above assume that an essential pre-requisite has been met: the clear identification of the economic agents who buy and sell irrigation water, and can also measure the traded economic good. This is an often heavy but always decisive task, which precedes and accompanies the true-price process in irrigation: going away from the idea that water is a free gift from the State, towards the concept of an irrigation water "service" to a "client" farmer. The critical point of how this transfer should be conducted is the subject of many workshops. Let it just be said that, wherever water is scarce, it is very tempting to use the newly established economic links between "supplier" and "customer" to try to regulate water management through prices.

Indeed, after the beneficial disengagement of the State from direct management of irrigation schemes, some think that the regulation of water management can also be taken care of solely by price mechanisms. To what extent is such price-based regulation reliable?

Water allocation regulation consists in inciting each economic agent to respect the volume of water allocated by the public authority. Is the pricing of water sufficient to avoid crises in scarce water systems? Can it settle intersectoral disputes between competing uses? Can it improve water distribution between farmers?

4.1 Quotas and pricing: instruments for allocation regulation

In water-scarce regions, water quotas are—more or less clearly—allocated to farmers, by sub-basin or by region. For the public authority, the problem is to ensure that these allocations are respected. The answer is usually of the law enforcement type, forbidding off-takes and suing trespassers. This type of regulation generates economic inefficiency and, sometimes, corruption. Therefore, it is highly tempting to use the price of water to avoid disputes between users, provided that all participants have been identified and the service billed has been clearly defined.

From analysis of the marginal value of water (marginal value is defined here as the value of the additional production that is brought about by one additional m^3 of water applied during the irrigation period), a method of water pricing can be derived with a view to attempting such regulation. It will necessarily be step-pricing, i.e. a discontinuous series of price levels, increasing with water demand. The higher price step, which will counteract the marginal value, must be higher than the lower price step, which itself is calculated to cover at least the sustainability cost and also to secure the farmer's income.

The fairly simple system set up in the Neste system consists of:

- an allocated quota, priced at a fixed total which is the same whether the user takes it all or takes less;
- an over-consumption price, for using more water than the quota.

The overall volume quota must be compatible with the limited resources allocated to irrigation as opposed to other competing uses. For a given existing irrigated area there exists a corresponding volume quota per hectare, which has to be regulated with a price step high enough to deter over-consumption.

But efficient regulation is based on understandable and practical water charges, within a freely negotiated contract: bills are useless if they cannot be recovered. Too high over-consumption prices can only lead to jeopardised contracts and then to legal prosecutions, which is precisely the regulation mode to be avoided.

The Neste system example shows that a price step between average price and over-consumption price exceeding 0.60 or 0.80 F/m^3 would not be socially acceptable at present. This approach provides useful strategic guidelines for fixing the volume quota per hectare. In consideration of the marginal value graph, this

highest price step clarifies the concept of socially acceptable minimum quota. If the quota is too far below the optimum needs (less than 80% of those needs) the system does not work in a dry year: then, crisis can be frequent, with stalled contracts and prosecution by the public authorities.

4.2 Best practices in water pricing and water resources development

Stemming from this discussion, three basic ideas can be emphasised:

- Water *step-pricing* can help to regulate the allocation system if the quota and the *over-consumption price* are set in consideration of the *marginal value* of water and the social acceptability of the water charge.

- *Quotas* that are too low compared to the crop need cannot be regulated by pricing, and lead to economic inefficiency linked to enforcing inapplicable rules. The quest for equity at all costs in a system with limited resources leads to the same result.

- Increasing water resources in a tight system makes it possible, over and above the direct economic benefits, to rebuild collective regulation based on a sound *quota + price contract* which will leave each farmer free to manage his irrigation efficiently according to his own water value function.

Such an effort to adapt the strategy of water pricing, together with the investments needed to create new water resources, is necessary to help farmers face open market competition: guaranteed and clearly contracted water supply, full responsibility in irrigation management without public intervention.

But it is clear that such a system of price regulation can only work smoothly within a narrow range of economic variables, water price and water value. And it is the State's responsibility not only to identify this range but also to be ready to lay down rules on economically "offside" behaviours (high water value crops, exceptional water shortages, and irrational collective wastage). Only this type of strong State makes it possible for the managing agency to make efficient and economic use of price regulation.

The main advantage of such regulation is to give back to farmers the freedom to optimise their choice of crops and their management of irrigated or non-irrigated agriculture, this optimisation being more and more complex in the context of competitive world markets.

One prerequisite to the efficiency of this economic approach lies in the identification of the relevant agents (managing agency, individual farmers, water user groups), the clear content of their contract relations (water price, allocated water volume), and the capacity to measure the traded economic good (water meters). It is indeed a move towards water markets (Kosciusko-Morizet et al. 1998). But analysis of the value of irrigation water—particularly its marginal value—shows that it would be unwise to go further along this line, especially when it comes to free bidding for water quotas, given, on the one hand, the disproportion between the marginal value

and the socially acceptable price of water and, on the other hand, the necessary equity in the sharing of a highly socially-valued good, this feeling of equity being necessary for water pricing to be efficient.

5. Conclusion and lessons learned

The role of service-oriented organisations in irrigation and water management is now largely accepted as a prerequisite for implementing good control of water allocation and ensuring the sustainability of economic development (Malano et al. 1999). The transfer of management to water users' associations under control of an integrated basin authority is one possible solution, frequently described but too recent to be completely convincing. In fact this type of solution often leaves unanswered the two important questions raised at the beginning of this paper, i.e. how to balance the budget by raising the water price and how to reach a fair sharing of scarce water among users. If water management is transferred to water users' associations, the process must be implemented carefully. The main idea is to develop "self-management without abandonment" by transferring to socially strong users' associations responsibilities adapted to their capacity, while keeping a tight partnership with a professional water manager.

French history of irrigation management emphasises the efficiency of some other solutions, such as management by the SARs, mixed public-private companies linked to the Government by concession contracts. With the experience of such management, we can propose two recommendations in the very difficult debate on water pricing and allocation:

- Firstly, it is recommended that a cautious but firm move towards Sustainability Cost Pricing; that is, charging the necessary amount to ensure the sustainability of the assets—i.e. operation, maintenance and renewal costs, or what has been called Sustainability Cost earlier in this paper—but not trying to recoup the full financial cost of initial investment or of the most recent rehabilitation. To correspond exactly to sustainability, the price charged must cover all costs incurred in delivering each drop of water from the dam to the crop. At this level of cost recovery, there is no further need of current subsidies for staff, for repairs, for energy or for future rehabilitation: the subsidies' "vicious circle" is broken. Such development is sustainable, even though it is not designed to recover the initial investment.

- Secondly, it is recommended to use step pricing, based on water metering, in order to facilitate control of the allocations in a fair and transparent water sharing system. In case of water scarcity the implementation of a joint quota system is necessary due to the high marginal value of water during the irrigation period. The collective regulation has to be based on a sound quota + price contract with the service provider, which will leave each farmer free to manage his irrigation efficiently according to his own water value function. But in a "closing" basin, the development of new resources must also be implemented in order to ensure the governability of the system. The success of controlled water management, as developed in the Neste system has been founded on joint-management of demand and

resources, with the implementation of necessary new reservoirs during the last 10 years. In France it is now very difficult to take such decisions. The transfer of experience in water management can be based on such methods, if governance, after the period of "decision without consultation," avoids the current tendency towards "consultation without decision."

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Institutional Arrangements in the Murray-Darling River Basin

Darla Hatton MacDonald and Mike Young
Policy and Economic Research Unit,
Commonwealth Scientific and Industrial Research Organisation,
Australia

Abstract

The institutional arrangements in the Murray-Darling basin are an evolving set of rules which manage the conflicting interests of the Commonwealth of Australia, four States and a Territory. Governments and water users share the common understanding that the basin is the heart of Australian agriculture and water is viewed as a precious resource. The high-level vision is that water must be used according to its highest and best use while ensuring that water is provided for the environment. Australia has been undertaking significant water reforms in areas such as full-cost pricing, water trading and the separation of policy and regulation from the day-to-day management of water related infrastructure. There have been further movements towards involving the community at various points in the management of the resource. Consultation with the varied stakeholders is viewed as an important means of resolving conflict in the basin.

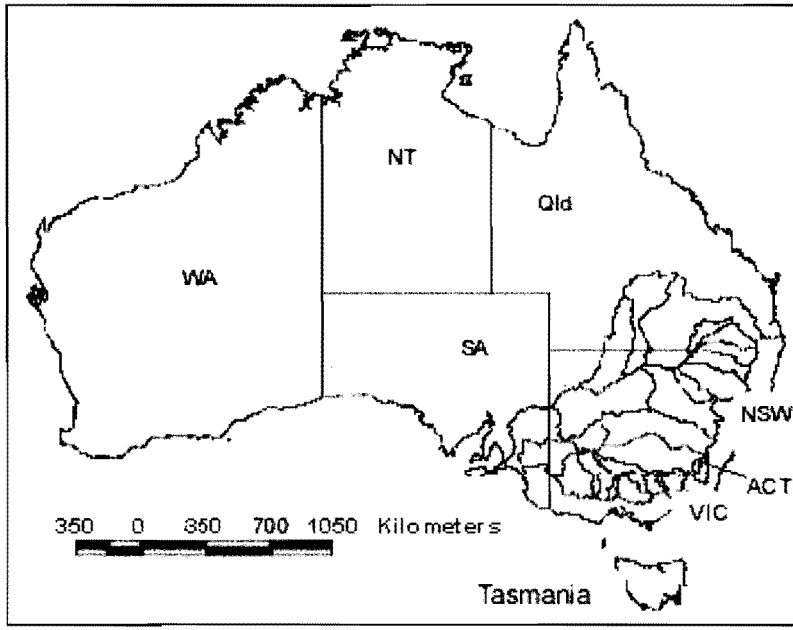
1. Overview of the basin

Managing water resources in the Murray-Darling basin is a lesson in resolving conflict across jurisdictional lines. The layers consist of a council, a commission and series of high level groups interspersed with community representatives. These layers make up the forum where strategies and policies are set out for sharing the water and managing the serious problems of water quality in the basin. Water is fundamental to the region's economy and a strong commitment to using water according to its highest and best use has emerged in Australia. As part of a National Competition Policy, Australia has embarked on major reforms which include expanding water trading and moving to full-cost pricing of the resource.

The Murray-Darling River basin comprises a large geographical area, approximately one million square kilometres or one-seventh of the land mass of Australia. With a total length of 3,780 km, it is the fourth longest river system in the world. The total area is roughly equivalent to the area of France. An overview of the Murray-Darling basin can be seen in Figure 1.

The Murray-Darling River basin contains half the Great Dividing Range and some of Australia's highest mountains. The high catchments provide a significant amount of water to the system. However, much of the basin is flat with extensive plains or low undulating areas less than 200 metres above sea level. The basin covers 75 percent of the State of New South Wales, 56 percent of the State of Victoria, 15 percent of the State of Queensland, 8 percent of the State of South Australia and the entire Australian Capital Territory (Murray-Darling Ministerial Council, 1987).

Figure 1: Map of Australia with state lines and the outline of the Murray-Darling basin



Legend: WA – Western Australia
NT – Northern Territory
Qld – Queensland
VIC – Victoria
NSW – New South Wales
SA – South Australia
ACT – Australian Capital Territory

Source: CSIRO

The Murray-Darling basin is defined by the catchment areas of the Murray and Darling Rivers and their many tributaries. The source of the Murray is in south-eastern Australia in the Australian Alps. The Murray flows across the southern section of the continent to form the border of New South Wales and Victoria before flowing out through South Australia to the Southern Ocean. The longer Darling River drains the northern half of the basin from Queensland into New South Wales. These two major rivers come together quite far downstream, just to the east of the border of South Australia, some 250 km from the sea. A right-bank tributary of the Murray,

the Murrumbidgee, drains important agricultural areas of central New South Wales, between the two major rivers. These rivers have extremely low gradients and as a result the mean flow of water down these rivers is slow.

Over two-thirds of the water that would have flowed to the Southern Ocean, is now diverted. Over the last 100 years, the Murray-Darling basin has been transformed by construction of major weirs, locks and storages on the rivers. The Snowy River Scheme, a major hydro-electrical power system, was constructed over a 25-year period beginning in 1949. The scheme diverts about 1,140 GL (gigalitre: million m^3) per year of water from the Snowy and Eucumbene Rivers, which are outside the south-east boundary of the basin, into the Murray and Murrumbidgee valleys, making more water available for irrigation. People living in the Snowy River Catchment are now arguing for some of this water to be returned to them.

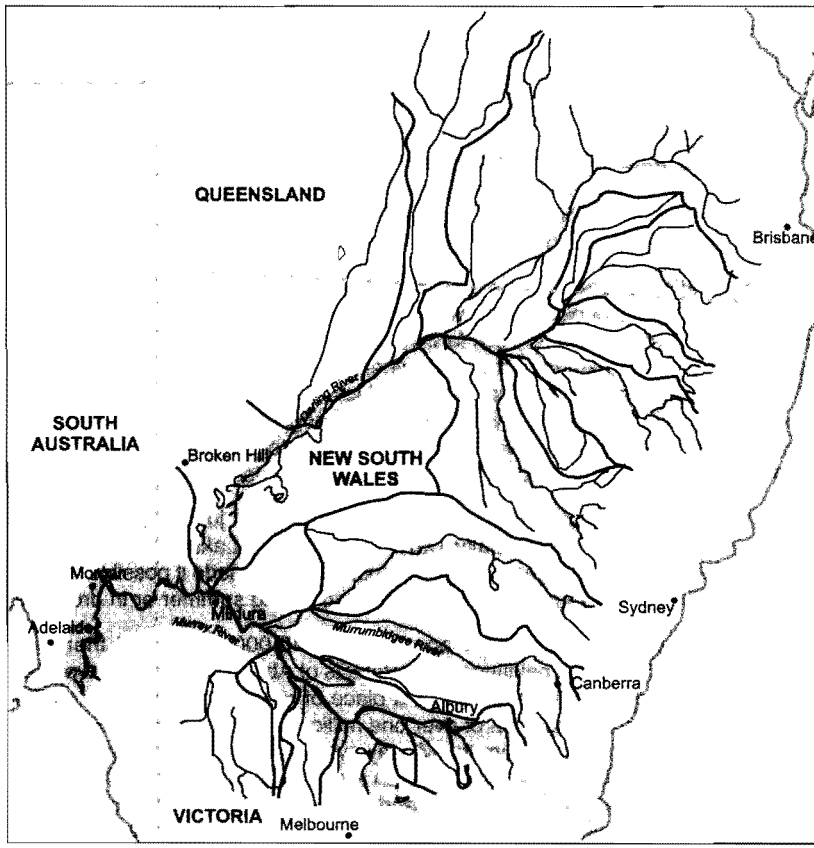
Land degradation of one form or another is present throughout the basin. The problems include loss of biodiversity, wind and water erosion, dryland and irrigation-induced salinity, soil acidity and soil fertility and structure decline. Dryland salinity is a problem unique to areas of the world where there are naturally occurring salts in the soils. With land clearing and the introduction of European style agriculture in the basin, the groundwater levels have risen bringing the salts to the surface. For the rivers, salinity levels have also increased due to irrigation, dryland salinity and the drainage of naturally occurring saline groundwater.

The total volume of water storage capacity in the basin is just less than 35,000 GL. The major storages, especially Dartmouth, Hume, Lake Victoria and the Menindee Lakes and other river regulatory structures have made it possible to store water during wet periods and release it as needed during summer or in droughts.

The basin has been populated for an estimated 40,000 years and there are significant sites where cave paintings and artefacts of Aboriginal culture have been found. As well, the basin is important as a place of recreation and tourism. The City of Adelaide with a population of over one million people draws an average of 40 percent of its water needs from the Murray system. There are a large number of wetlands throughout the basin, some which are considered to be of international significance and listed as Ramsar Wetlands. The basin provides the breeding habitats for many species of water-birds, fish, invertebrates and plants.

The importance of the basin to Australian agriculture is evident by the fact that 43 percent of the total number of farms in Australia are in the basin representing 45 percent of the crop area. Within the agricultural sector, crops, pastures and grasses are the largest value component of agricultural production in the basin, with a gross annual value of $7.9 billion (Australia Bureau of Statistics). Irrigation dominates the landscape in the basin. Irrigated crops and pastures in the basin represent 72 percent of Australia's total area of irrigated land. Irrigation is essential for improved dairy, cotton, rice and horticulture (in particular viticulture). (MDBC *http://www.mdbc.gov.au/tour/irrigation.htm)*

Figure 2: Murray-Darling basin: branches and tributaries



Source: http:\\www.mdbc.gov.au

2. Water resources in the basin

One of the more remarkable features of the Murray-Darling basin is the climatic variability that is observed. Within the basin, rainfall varies from 1400 mm per year in the highlands to 300 mm in the northwest (Murray-Darling Ministerial Council, 1987). Australia's climate, compounded by the variability of its rainfall, means that virtually all of Australia's river systems are subject to considerable variability of flows from one year to another. According to Brennan and Scoccimarro (1998) annual variations from maximum to minimum flows range from 300:1 to 1000:1 in Australia. Extremes of 10 000:1 have been reported for the Darling River. The northern Darling system is essentially a summer rainfall system, while the southern Murray system is essentially a winter rainfall system.

The Murray and Murrumbidgee Rivers experience relatively more reliable precipitation and as a result stream flow is much more reliable than in other parts of the basin. The largest variability seems to occur with the Darling River and its tributaries where massive floods can occur as well as times when the rivers cease to flow.[1] The Murray-Darling basin has a relatively low mean annual discharge in comparison with the other river systems in the world; in fact it is a small one in terms of discharge or runoff.

3. Geo-political organisation of the basin

The previous section highlighted the unique physical characteristics of the Murray-Darling basin. Australia is a commonwealth of States and Territories. Due to the geographic size of the basin, it crosses the boundaries of States and includes one Territory. The Murray-Darling River basin is managed by individual States but there are overarching bodies that co-ordinate many of the efforts of State and territory governments at the basin level. Water resources are largely under the jurisdiction of the States and Territory governments. Rather than amending the Constitution, a Murray-Darling basin Commission has been formed to manage inter-jurisdictional processes and conflicts in an organised manner.

The Commonwealth (or Federal) government does participate in water and water resource management through other means such as legislative and executive capacity. In particular, the Commonwealth government uses financial assistance to the States and Territories under section 96 of the Commonwealth Constitution (Fisher 2000, p.35). However, these financial incentives must not be shown to discriminate between States. This is a form of co-operative federalism where the Commonwealth and State governments come to agreements and the Commonwealth relies on the States to implement agreements within their respective jurisdictions.

As a result of the Constitutional framework, different bodies of legislation and institutional arrangements have evolved in each of the States. To follow the elaborate layers of committees, management groups and other arrangements that are necessary to

[1]Water flow becomes an issue later in the report when we discuss security of water allocations.

are necessary to manage the basin (and other resources in Australia), it is necessary to introduce the key bodies that shape Commonwealth, State and Territorial government policy on water. The institutional arrangements in the basin are in a process of evolution as the States and Territories move towards market-based systems of resource allocation.

An over-arching policy, which affects most sectors of the Australian economy, is the National Competition Policy. The States, Territories and the Commonwealth have committed themselves to a process of creating a level playing field for all by facilitating effective competition. The goal of this process is to promote economic efficiency and economic growth. The policies are articulated in what has become known as the Hilmer report on National Competition (Hilmer 1993).

In order to facilitate these competitive reforms, the Commonwealth government has placed funds in a pool to be distributed among States and Territories on the basis of progress of implementing reform (each step is known as a Tranche). Thus, States and Territories have a financial incentive to implement the policy framework. The size of payments promised varies among States. The payments are not large enough to finance reform, but have been sufficient to ensure that serious steps are taken to implement the reforms.

3.1 Council of Australian Governments

The Council of Australian Governments (COAG) predates the National Competition Policy. Co-operation among the States to achieve agreed-upon goals has required that entities such as COAG exist. COAG is charged with implementing principles of the Hilmer Report, including water reform. COAG is composed of heads of Federal (Commonwealth of Australia) and State/Territory governments plus a representative from local government. Water is one of many sectors that come under the purview of COAG.

COAG has developed a national policy called the COAG Water Reform Framework for the efficient and sustainable reform of Australia's rural and urban water industries. Many of the States and Territories had been moving in these directions prior to COAG. In developing its framework, COAG adopted a position that required a consistent approach to water reform throughout Australia. The key elements of COAG's water reforms are:

- All water pricing is to be based on the principles of full cost recovery, and cross-subsidies must be made transparent;
- Any future new investment in irrigation schemes, or extensions to existing schemes, are to be undertaken only after appraisal indicates they are economically viable and ecologically sustainable;
- State and Territory governments, through relevant agencies, are to implement comprehensive systems of water allocations or entitlements, which are to be backed by the separation of water property rights from land and include clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality;

- The formal determination of water allocation entitlements, including allocations for the environment as a legitimate user of water, is to be undertaken;
- Trading, including cross-border sales, of water allocations and entitlements is to be allowed within the social or physical and ecological constraints of catchments;
- An integrated catchment management approach to water resource management is to be adopted;
- Resource management and regulatory roles of government are to be separated as far as possible from water service provision;
- Greater responsibility is to be given to local areas for the management of water resources;
- Greater public education about water use and consultation in the implementation of water reforms and appropriate research into water use efficiency technologies and related areas is to occur.

Source: http://www.affa.gov.au/water-reform/facts2.html

Each State or Territory was given the flexibility to adopt its own approach to implementation depending on its own unique institutional and natural characteristics, but it was agreed that the full framework would be implemented by the year 2001. A key feature of the COAG framework was the State and Territory agreement to a tranche payment system, where access to payments was conditional upon delivery of reform milestones.

COAG Water Reform process is being further developed by the High Level Steering Group on Water. This group consists of the Chief Executive of each State, Territory and Commonwealth Department directly responsible for water. The head of MDBC is not represented on the High Level Steering Group on Water but its members with a few exceptions, are members of the Commission.

3.2 Murray-Darling Basin Ministerial Council

The Murray-Darling Basin Ministerial Council (MDBMC) was established in 1985 with amendments to the Murray-Darling Basin Agreement. The Ministerial Council advises the Council of Australian Governments as appropriate on matters relating to the implementation of the framework for water reform. The Ministerial Council consists of the ministers responsible for land, water and environmental resources in each of the signatory or contracting governments, the Commonwealth, New South Wales, South Australia, Victoria, and Queensland, with each government limited to a maximum of three members. Its prime functions are:

> *generally to consider and determine major policy issues of common interest to the Contracting governments concerning effective planning and management for the equitable efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling basin; and to develop, consider and, where appropriate, to authorise measures for the equitable, efficient and sustainable use of such water, land and other environmental resources . (Murray-Darling Basin Agreement 1992, Clause 9)*

Being a political forum, the Ministerial Council has the power to make decisions for the basin as a whole because of the presence of Ministers representing each of the States and Territories. Resolutions of the Council are arrived at through consensus. This means that decisions taken by the Council represent in theory a consensus of governmental opinion and policy across the basin at a point in time. However, the Ministerial Council relies on the States to implement any decisions taken. An overview of the high-level organisation of Murray-Darling basin can be seen in Figure 3 and detail concerning the Murray-Darling Basin Commission is discussed below.

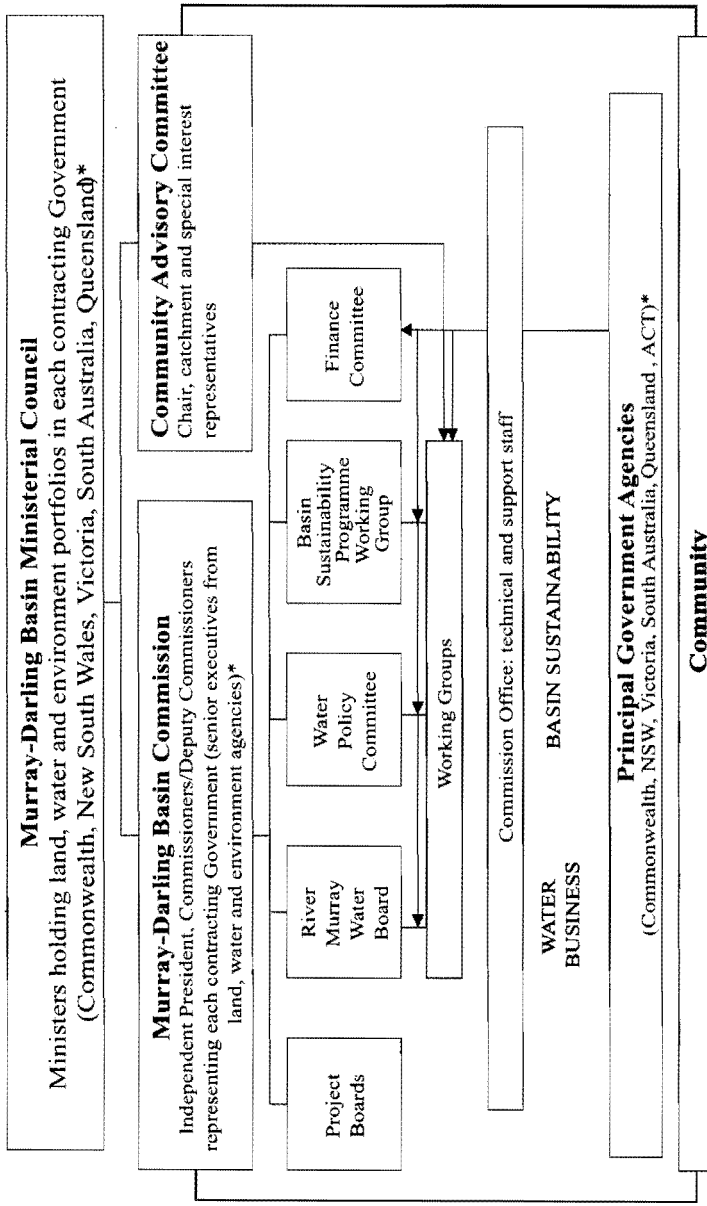
This organisational chart highlights how the State and Commonwealth governments co-ordinate their efforts to provide a high-level structure that is responsible for the basin. It is interesting to note that within this high-level structure a place has been made for a community advisory committee which reports to the Ministerial Council. The committee serves as a two-way communication channel between the Ministerial Council and communities living in the basin. In the last few years, the community advisory committee has considered a number of controversial topics such as dryland salinity, implementation and monitoring of the Cap on water diversions and floodplain management. The committee was able to communicate the issues to the community and provide a "reality-check" concerning the human dimensions of problems. The committee has also been considering issues relating to Aboriginal involvement in natural resource management and recognition of cultural heritage in the basin. (MBDC 2000) The first two tiers of the structure have been stable for many years, but the third tier of project boards, policy committees, etc, changes regularly. The Commission's staffing structure was changed radically in 1999.

3.3 Murray-Darling Basin Commission

The Commission is the executive arm of the Murray-Darling Basin Ministerial Council. It also works co-operatively with the States. The Commission is responsible for managing the River Murray and the Menindee Lakes system of the lower Darling River and advising the Ministerial Council on matters related to the use of the water, land and other environmental resources of the Murray-Darling basin.

The Commission comprises an independent President, two Commissioners from each contracting government (i.e., the Commonwealth, New South Wales, Victoria, South Australia and Queensland) and a representative of the Australian Capital Territory government. Each Contracting Government also has two deputy

Figure 3: Organisation of the Murray-Darling Basin Commission



* Participation of the Australian Capital Territory is via a memorandum of understanding

Commissioners and the Australian Capital Territory has one deputy representative. Apart from the President, Commissioners are normally chief and senior executives of the agencies responsible for management of land, water and environmental resources.

The Commission is an autonomous organisation equally responsible to the governments represented on the Ministerial Council as well as to the Council itself. It is a rather unusual entity in that it is neither a government department nor a statutory body of any individual government.

The Commission has a couple of key functions that include:

- advising the Ministerial Council in relation to the planning, development and management of the basin's natural resources;
- assisting the Council in developing measures for the equitable, efficient and sustainable use of the basin's natural resources;
- co-ordinating the implementation of, or when directed by Council, implementing, those measures; and
- giving effect to any policy or decision of the Ministerial Council.

The Commission must balance equity considerations as well as manage and distribute the water resources of the River Murray in accordance with the Murray-Darling Basin Agreement. The Commission began with a mandate to manage water quantity that has gradually extended to include water quality issues and, to a limited extent, related land resource management issues. In the late 1980s, it was given a mandate to initiate, support and evaluate integrated natural resources management across the Murray-Darling basin.

The Commission must work in co-operation with the Contracting Governments, committees and community groups to develop and implement policies and programmes. This co-operative approach reflects the Constitutional reality and the importance placed on government-community partnerships and brings to participants and end-users the benefit of shared concerns and expertise, jointly developed and integrated solutions, and avoids duplication of effort. *(Source: http://www.mdbc.gov.au/about/about_mdbc/the_commission.html)*

3.4 Other committees involved in water reforms

There are a couple of key ministerial committees[2] that have been charged with putting the policy framework in place in each State and territory in line with COAG reforms. Two groups in particular, Agriculture and Resource Management Council of Australian and New Zealand (ARMCANZ), and Australian and New Zealand Environment and Conservation Council (ANZECC), have provided policy

[2]Under the Australian system of government, ultimate responsibility for policy implementation rests with a Minister. To be a Minister, one must first be elected to Parliament and then selected for a position in Cabinet. Departments are constrained and guided by legislation and are subject to the direction and control of a Minister.

of Australian and New Zealand (ARMCANZ), and Australian and New Zealand Environment and Conservation Council (ANZECC), have provided policy directions in relation to water needs for agriculture and the environment. These Ministerial committees are supported by Standing Committees of senior officials.

ARMCANZ and ANZECC are forums for government ministers to co-ordinate efforts. The High Level Steering Group on Water, which consists of department heads, provides the ties between government agencies and the policy setting committees such as ARMCANZ and ANZECC. There are a number of other committees which involve lower level government officials where the details concerning how to implement these policies are worked out. The committees have been key in implementing reforms concerning full-cost pricing and the creation of the environment for the competitive provision of water.

4. Co-ordination of various agencies

Co-ordination is achieved via a constellation of Councils and bodies that often involve the same people. There are links between COAG, ARMCANZ and ANZECC through the ministers who are members of cabinet. Agreements entered into by the States will necessarily reflect approval by the Ministers who sit in Cabinet.

The Murray-Darling Basin Commission is also an important point of co-ordination. Each year, each State develops a three-year rolling plan that outlines the outcomes to be achieved against basin sustainability objectives in the management regions. The management regions correspond to the catchments in New South Wales, Victoria and South Australia. A consolidated three-year rolling investment plan, based on State plans, then provides a summary of the investments being made across the basin. This allows for some evaluation of progress towards sustainability goals.

In Australia, there is a recognition that States must work together on resource management issues. The process works because of the processes embodied within institutions to resolve issues. Characteristically, new agenda issues are approached by setting a vision and then negotiating the detail once a consensus concerning a vision is achieved. A second feature is the complex web of people involved. It is common for many of the Commissioners to chair subcommittees, sit on the High Level Steering Group for Water, and be the head of a natural resource management department. These same people also interact through Committee processes, like ARMCANZ, ANZECC, etc.

5. How to share the water

In the Murray-Darling River basin of Australia, water is used for passive, environmental and consumptive purposes. Historically, access to the Murray-Darling basin began with a framework that enabled virtually whoever wanted to use water for consumptive purposes to do so. Moreover, most of the infrastructure used to deliver water was paid for by governments and supplied at subsidised prices.

The combination of drought and water quality has become a significant issue for water users throughout the basin. Events such as droughts, algae blooms and

increases in salinity provided impetus for renegotiating how to share the water in Murray-Darling basin. Views on the situation are coloured by location in the basin. Queensland, New South Wales, Victoria are upstream States and South Australia is a downstream State.

5.1. Priorities amongst users

In general across States, the consumption of water by people and animals is the highest priority, followed by agriculture. Most water licences and legislation indicate that water needed for domestic purposes and livestock production is a prior right. That is, people may not interfere with the rights of others to consume water for stock or domestic purposes.

The importance of the environment has been underlined through a number of policy statements that have been issued. However, where in the list of priorities the environment is actually placed is not always well defined in practice. An example is the Draft Environmental Impact Statement (EIS) on Corporatisation of the Snowy Mountains Hydro-electric Authority, released by the Commonwealth (Department of Industry, Science and Resources 2000). The EIS outlines how water levels in the Snowy River might be restored through water savings in the Murray-Darling but

[r]ather than recommending specific trade-offs between economic and environmental interests, or between competing environmental interests, the EIS has sought to compare and contrast the various advantages and disadvantages for each group of stake-holders of reducing water releases to the Murray-Darling basin in order to provide increased flows in the Snowy River. (Industry, Science and Resources 2000, p. 2)

This reluctance indicates the difficulties that governments, communities and businesses face in placing the environment in a list of priorities. However positive steps have been taken as 100 GL has been set aside for the Barmah-Millewa Forest. The Barmah section of the forest is a Ramsar wetland indicating that this is a site of international importance. (MDBC 1999)

All levels of government have committed themselves to an Inter-Governmental Agreement on the Environment. This agreement commits them to a set of principles designed to ensure that all resource use and development in Australia is ecologically sustainable. Indicative of this change in emphasis, the New South Wales government recently reduced most irrigation allocations by 10 percent in the basin so that "allocations" to the environment could be increased. At this stage, however, no formal quantity of water has been allocated to the environment.

5.2 Allocating water among States

The basis for allocating water across States is largely the product of historical use. New South Wales and Victoria have engaged in intensive agriculture since the turn of the century and growing pattern of use can be seen in Figure 4. As this indicates, through the 1980s the amount of water being diverted in the basin

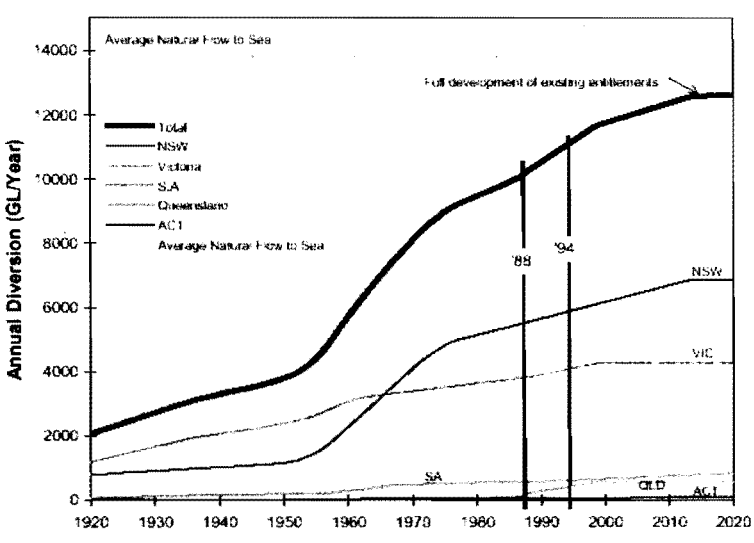
began to increase significantly. In 1993, a decision was made by the MDBMC to prepare a water audit. The audit would:

- establish water use in the basin;
- describe current level of development;
- document recent trends; and
- assess the implications of those trends.

The MDBMC was concerned about the health of the basin. Water salinity was increasing, algal blooms were occurring more frequently and biodiversity appeared to be declining. For the downstream State of South Australia, the situation was thought to be quite serious.

It was acknowledged by the MDBMC that water usage could not continue to increase within the basin. As a result, an overall Cap on water diversions has been introduced, limiting the volume of water to what would have been diverted under 1993–94 levels of development.

Figure 4: Historical use of the Murray-Darling basin water by the States, and projections as of 1995 without a cap



Source: MDBMC (2000)

Perhaps, the most dramatic impact of the Cap has been an increase in water trading. The ability to move water to its highest and best use has resulted in significant increases in the price of water. Trade in water has been occurring in Victoria and New South Wales since the early 1980s. Trading became particularly important and widespread with droughts, diminished supplies, the Cap on water and in some areas, decreases in water allocations. The property-right reforms that are underway in the States and Territory will further facilitate trade.

Most of the states are putting in place legislation that separates title to land and water and allows licences to be traded either permanently or temporarily.[3] For example, in South Australia, it is now possible for a person who owns no land to hold a water licence as an investment and sell water on an annual basis to any interested party. A system of well-defined property rights is not a requirement for water trading though it certainly facilitates more efficient trade.

5.3 Water trading within and among States

The development of markets for water is well established in some States such as New South Wales and Victoria. In New South Wales, water trading was active and total sales amounted to 11 percent of total entitlements to consumptive users in 1997–98. Much of the trade involves temporary transfers of water. Until the new legislation is passed, land and water licences are not separate. Permanent transfers would require cancellation of the licence of the transferor and the issuing of a new licence to the transferee. Temporary trades are essentially "leases" of a licence. As well, the crops grown in New South Wales do not necessarily require high security water rights. In South Australia, the situation is considerably different where the irrigation of grapes requires a very secure source of water. Most trades in South Australia are permanent.

In Victoria and the other States, there are significant issues to resolve with respect to third party impacts. The States have been allowing trade to expand slowly in order to assess the impact on environmental health and water quality. There are also costs associated with allowing water to leave an area. Irrigation schemes and communities are struggling with this issue.

The next step in the water reform agenda is an interstate water trading pilot project. Under a pilot project, trade in water in the Mallee Region of South Australia, Victoria and New South Wales is permitted. The geographic area covered is the Murray River between Nyah and the Barrages at the mouth of the Murray, and the licences from the Darling River which are supplied from Lock 10, near the junction of the Murray and Darling rivers. The Mallee region was selected for two reasons. First, the same type of agricultural activity (irrigated production of fruit, vegetable and grapes for wine) is prevalent in the region. Second, the price per megalitre (ML) of water is relatively uniform throughout the region.

[3]At the time of writing, New South Wales had a new water bill ready which was expected to be enacted in the near future.

Only high-security entitlement[4] holders engaging in the permanent transfer of water are allowed to participate. Holders of private high-security licences in New South Wales, of water licences granted under the Water Resources Act of 1997 in South Australia, and of private diversion licences in Victoria, are allowed to participate. Even within this region, trading may have an impact on water supply, as interstate trades can have an effect on other users. If water is coming from a different source, such as another reservoir or another river, there will be transmission gains and losses along the system. As water moves down the rivers and channels there are more options for storage and therefore there is increased security. To reflect these security issues, a set of exchange rates have been developed.

Temporary trading between States, outside the interstate pilot project, has been put on hold by the Minister for Natural Resource in Victoria. The difficulty appears to be in the way each state accounts for water use. New South Wales has a system of continuous accounting and Victoria has a "use it or lose it" system. Under this suite of arrangements, a Victorian water user could transfer water to New South Wales, carry it forward to the next season and bring it back without "losing" it. Victoria was worried about this because its allocations are based on the assumption that every year a proportion of the water would be lost. If this feature is abandoned, then all existing allocations may need to be reduced. Temporary interstate trades will not be allowed after February until the next irrigation season.

There are two types of trade: leases (for the season) and permanent sales. Prices for permanent sales fluctuate around A$1,000 per ML[5], in a range that has in recent years varied between about A$750–1,200[6].

5.4 Water quality issues

Salinity is too large a problem to be solved by one government. It requires co-ordinated interstate action and community co-operation. The central planks of the Murray-Darling Salinity Strategy are:

- salt interception schemes;
- changed operating rules for several lakes with a view to reducing evaporation and, hence, salt concentration;
- a suite of land management policies and programmes jointly funded by the States and the Commonwealth.

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[4]A high security entitlement is a licence for which the water will be provided except in severe drought conditions. A low or general security entitlement is a licence for available water which can vary from year to year.

[5]1 US dollar = 1.92 Australian dollars in October 2000.

[6]More information about the price issues can be found at: *<www.mdbc.gov.au/naturalresources/policies_strategies/projectscreens/pdf/watertrade_2yr.pdf>*

One of the unique features of this Strategy is the Victorian and New South Wales governments' agreement to manage water resources within agreed limits. These States cannot construct or approve any proposal that would increase salinity by 0.1 EC (unit of electrical conductivity)[7] or more in the River Murray at Morgan, unless they have access to salinity credits. Under the salinity credit scheme, the New South Wales and Victorian governments received an opening balance of salinity credits for 15 EC each. These credits reflect their past contributions to the cost of salt interception schemes. States can earn more credits by financing schemes that reduce the expected salinity load at Morgan. the Murray-Darling Basin Commission (MDBC) maintains a register of works undertaken and the salinity credit and debit impacts. The salinity impact of any proposed irrigation scheme must offset by acquitting credits in the register.

6. Water pricing

In the 1990s, many of the States were reforming pricing of water for irrigation and water for household consumption (and livestock watering in some cases). Basic principles of economics suggest that a resource will be used most efficiently where the competitive market would price the resource. This is usually taken to be the long run marginal cost (or the incremental cost per unit of water). Water and many other utilities have large fixed or "start-up" costs which leads to a decreasing-cost industry, where average and marginal costs decrease with the amount produced (at least over the relevant range). Thus, there is always a tendency for a few firms (often only one in a particular jurisdiction) to supply water. As well, pricing at marginal cost in a decreasing-cost industry means that average costs are not covered in the long run. In the long run, firms must cover their costs. Further, marginal-cost pricing will not allow for covering the costs of future expansions as are sometimes required in water systems.

These economic considerations are in part covered by the key elements of the water pricing policy of the Council of Australian Governments (COAG). In the case of pricing, the COAG reforms codified many of the policies which had been floating in policy circles at the time. The COAG pricing regime is to be based on:

- consumption-based pricing and full cost recovery for urban water and rural water supplies;
- the elimination of cross subsidies as far as possible and their exposure where they exist;
- cost recovery that includes environmental costs (externalities) and the cost of asset consumption as well as taking the cost of capital into account;
- positive real rates of return on written-down replacement costs of assets;

[7] 1 EC unit = 1 micro-Siemen per centimetre at 25°C.

- future investment in new schemes or extensions to existing schemes to be undertaken only after appraisal indicates they are economically viable and ecologically sustainable.

On a State by State basis, full cost pricing is at various stages of implementation. Cost recovery pricing is not a straightforward process to implement. Some States and Territories are further along this process than others. According to the Progress Report to the COAG, water sold in urban areas is sold on a cost recovery basis, though there is some question whether proper account is being taken of the environmental externalities.

New South Wales established the Government Pricing Tribunal which evolved into the Independent Pricing and Regulatory Tribunal (IPART). Both entities predate the COAG reforms. IPART reviews information on costs and revenues and makes a determination regarding bulk water prices. IPART considers for instance whether the department's costs represent an efficient level of service. Revising the price strategy of a resource is unlikely to be painless process. The extractive users in New South Wales, particularly the irrigators, mounted a noisy opposition to the potential increases in price. However, the tribunal conducted its review in a very public forum and consulted with interested groups across society. In the end, IPART was able to develop a set of pricing rules that were accepted for adoption at the national level by the Standing Committee on Agriculture and Resource Management. The rules are currently being used to guide the process of price reform across jurisdictions.

7. Conflict resolution

One of the key lessons of the Murray-Darling basin is that institutions can serve as mechanisms to resolve conflict. When institutions fail to resolve conflicts they must either evolve or be abandoned. As transaction costs amongst economic agents increase, in this case the various entities operating in the basin, there is an incentive to create institutions to internalise these costs.

7.1 Murray-Darling Basin Commission

The Murray-Darling Agreement is a prime example of institutional rules to manage conflict. Early conflicts arose between users of the River Murray for irrigation and navigation. However, an agreement between the States of New South Wales, Victoria and South Australia was not reached until after a series of severe droughts raised the cost of non-co-operation past the threshold for the three States.

The existence of the River Murray Commission from 1917 to 1985 speaks of the Commission's ability to work co-operatively with the States and to co-ordinate the construction and operation of some of the works on the river. Regulating the flows of the river clearly served the interest of the States (e.g., expansion of agriculture in the basin).

The Commission expanded its role over time but was not able to evolve into an institution capable of dealing with basin-wide problems such as salinity and the

declining health of the riverine environment. As States realised they could not resolve these issues within their own jurisdictions, and costs would continue to escalate with inaction, there was again the incentive to develop a new institution—the Murray-Darling Basin Commission which as discussed earlier has a broad mandate to bring about basin-wide solutions.

Over the last decade or so, the Murray-Darling Basin Commission has become increasingly aware of the need for the benefits of community consultation. To this end, in 1986 it established a community advisory committee that reports directly to the Murray-Darling Basin Ministerial Council.

Today, virtually all Commission programmes involve a large degree of consultation. Most policy reforms are, at least, discussed with the Council and explored through transparent media and meeting-based processes. Draft policies and/or strategies are then released and finalised after a period of time.

7.2 Irrigation schemes

Within the basin, most of the large irrigation schemes were created to deliver water and encourage the expansion of agriculture. The water reform process, the expansion of water trading and the Cap on diversions have changed the operating environment of these entities. These entities have evolved over time from being a means to put irrigation infrastructure in place, to becoming major water managers. One irrigation scheme, Colleambly Irrigation, has been evolving into a natural resource manager at a time when there is a crisis in confidence about the land and water management planning process and the impact that irrigation in New South Wales was having on the environment. The New South Wales government was moving to impose costly monitoring and reporting requirements. Colleambly perceived that it did not have time to wait for natural resource outcomes to demonstrate that it was a responsible resource manager. Colleambly chose instead to apply for ISO 9002 and 14001 accreditation.[8] The accreditation process provided a means of resolving conflict between Colleambly, non-governmental organisations and the media about the health of the river environment. The accreditation process proved successful in demonstrating commitment to the environment and a means of differentiating itself in a competitive environment.

7.3 Catchment boards

At the catchment level, people are most closely associated with environment and the water resources. Throughout the basin, there are catchment boards with differing levels of experience, expertise and power. Most boards engage in public consultation and have varying degrees of community involvement. This is a means of engaging people in the issues and it is also a process in education for most of

[8]ISO 9002 is an accreditation system where a set of procedures ensure a certain level of quality is in place. ISO 14001 is an environmental management system based on the same accreditation process.

the interested parties. Through consultation, boards as well as the public learn about the state of the catchment and the positions of the various parties with respect to what should be done. South Australia is currently the only state which gives boards the power to raise levies.

The water allocation planning process and the consultation process with the community are often cited by catchment managers as useful processes for uniting divergent interests. The chairs of catchment boards which are unable to navigate through conflict come under pressure to resign or not seek a renewal of their position. The process usually restarts with the appointment of a new chair.

7.4 The courts

Ultimately the court system is Australia serves as a place where remedies for conflict can be sought. Generally this is an expensive process for water users, States or Territories to engage in. These costs often serve as a means of motivating the different entities to work to solutions through other means.

8. Conclusions

The Murray-Darling River basin by its physical and geo-political nature is difficult to manage and is likely always to be a source of conflict due to its economic significance. The lessons from the basin can be summarised largely in terms of how conflict is managed. Managing resources sustainably has required innovative mechanisms to be put in place that will encourage reform, in an environment of co-operative federalism. The system of tranche payments has proven to be a means of encouraging States to move in a consistent manner through water reforms.

In Australia there is an unspoken philosophy concerning how much room there is concerning adherence to rules. There is generally some tolerance about minor deviations from rules but there is a point of no return where payments are frozen, governments go to the courts seeking remedies and voters lose confidence in their elected officials.

The myriad constellation of committees and groups of officials works reasonably well, despite the complexity of the arrangements. The key is the continuities created by Ministers and their Deputies by sitting on various committees. Trust between individuals has grown up over the years. As well, in these settings, moral suasion works as a mechanism to encourage States to act in a manner consistent with the common good.

Institutions such as the Murray-Darling Basin Commission and IPART in New South Wales have tended to use open transparent processes. The Commission operates to create consensus concerning a common vision or broad principles and negotiates the details later. The Commission will use a combination of moral suasion and public shaming to force States to honour commitments to the Cap on diversions and salinity targets within the basin. IPART has used the open public setting to prevent interest groups from hijacking the agenda from the goal of full cost pricing. These are the main issues explored in this paper.

Australia has done a number of things well in the basin. Capping water usage and establishing a salinity credit system represent major accomplishments. Adherence to these systems, where not all States bear the burden of salinity or benefit from enhanced environmental flows, is going to be the major challenge in the short term. Moving to full-cost pricing and expanding water trade have proven to be sources of conflict that are gradually being resolved through the institutions, which appear robust enough to survive the demands of water users in the basin.

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Integrated Water Resources Management: Lessons from Brantas River Basin in Indonesia

Rusfandi Usman
President Director, Jasa Tirta I Public Corporation
Malang, East Java, Indonesia

Abstract

The development area of a river basin involves an ecosystem unit, an economic development area, and an administrative unit. Development of the river basin concerns not only the area based on a hydrological boundary, but also a surrounding area. This concept is needed because development of the river basin may affect the surrounding area. Optimum development in the river basin should be followed by development of the surrounding area; otherwise the optimum tends to decrease.

The Brantas River, in East Java Province, Indonesia, plays a vital role in the economic region, not only for East Java, but also nation-wide. The Government has created more than 20 projects that have brought great economic benefit to the Brantas river basin, concurrently with national economic development.

The President of the Republic of Indonesia on February 12, 1990, issued Government Regulation No. 5/1990 which established a State-Owned Company, namely Perusahaan Umum (PERUM) Jasa Tirta (PJT I: Jasa Tirta Public Corporation) to address water resources management, and facilitate operation and maintenance of finished structures on the Brantas river basin.

The mission of PJT I is to manage the water resources in the Brantas basin so that they can be optimised in order to promote regional development, to accumulate profits and to contribute to the development of the entire nation.

1. Introduction

Life on earth depends upon water, which maintains and correlates all ecosystems within the planet, continually moving on and in the ground surface. Water characterises the river resources on which mankind is largely dependent for livelihood. A steady increase in population and in both agricultural and industrial activities has shown that the idea that water has always been an unlimited commodity is erroneous. Excessive use of water resources, as a logical consequence of economic development, has induced a range of national problems. Not only has the shortage of clean water supply become an obstacle for economic development, but also an increase in waste discharges has polluted natural water bodies. This has worsened with the reduction of forested lands and conversion of agricultural areas to settlements that in turn have changed the hydrological cycle remarkably.

2. The Brantas river basin

Indonesia, straddling the equator, is an archipelago nation with over 17,000 islands, of which about 6,000 are inhabited. It covers an area of 1,940 million km^2. Much of the nation's population of about 220 million people (1997) lives in the four main islands, Java, Sumatra, Sulawesi and Bali. Although the average population density of Indonesia is currently about 104 per km^2, Java, the most densely populated island, in area only 6.9 percent of the country, had a population density of 926 per km^2, or 110 million in1997.

The Brantas river basin in East Java Province has been one of the most productive and advanced granaries in Indonesia, because of ample water resources, tropical climate and fertile soil. This basin holds possibilities for further agricultural development. Industry located in the lower reaches around Surabaya port is also promising for future growth.

The overall characteristics of the Brantas basin can be summarised as follows. The length of the river is about 320 km, and the catchment area about 12,000 km^2. Average annual rainfall is 2,000 mm, equivalent to a volume of surface water runoff of about 12 billion m^3. The basin's population is about 14 million (1997).

Brantas river basin development is carried out as an integrated development based on a master plan which is reviewed every 12 years, projecting future socio-economic conditions and based on the national guideline goals. The plan is based on the philosophy of one river, one plan, one co-ordinated management. Up to 1998, four Master Plans have been worked out. Facilities that already built are as follows:

MASTER PLAN	OBJECTIVES	STRUCTURES FINISHED
MASTER PLAN I	♦ Flood control	▪ Sutami Dam (1970)
(1961)	♦ Irrigation	▪ Selorejo Dam (1973)
	♦ Hydro-power development	▪ New Lengkong Dam (1973)
	♦ Water supply (domestic and industrial)	▪ Porong river improvement (1977) ▪ Lahor Dam (1977)
MASTER PLAN II (1973)	♦ Irrigation ♦ Flood Control	▪ Brantas middle reaches river improvement (1977)
	♦ Hydro-power development	▪ Wlingi Dam (1977)
	♦ Water supply (domestic and industrial)	▪ New Gunungsari Dam (1981) ▪ Bening Dam (1982)
		▪ Lodoyo Dam (1983) ▪ Tulungagung Drainage (1987) ▪ Sengguruh Dam (1989)

MASTER PLAN	OBJECTIVES	STRUCTURES FINISHED
MASTER PLAN III (1985)	♦ Water supply (domestic and industrial)	▪ Brantas middle reaches rehabilitation (1990)
	♦ Irrigation ♦ Hydro-power ♦ Flood control	▪ Tulungagung hydropower (1990) ▪ Jatimlerek rubber dam (1992) ▪ Wlingi dam rehabilitation (1993) ▪ Menturus rubber dam (1993) ▪ Porong river rehabilitation (1993) ▪ Surabaya flood control (1995) ▪ Wonorejo Dam (2000)
MASTER PLAN IV (1998)	♦ Water resources conservation and management	▪ Integrated Watershed Management

3. Benefits of the development

The benefits achieved due to water resources development in the Brantas basin include:

1. Protection against 50-year flood.
2. The 233 MW capacity of hydropower plants, producing around 1.0 billion kWh of energy per year.
3. Total area of paddy irrigated from the Brantas river system is around 345,000 ha. In the dry season irrigated agriculture consumes approximately 80 percent of the available water in the river. East Java, since 1989, can supply more than 30 percent of national food production.
4. Supply around 300 Mm^3 per year raw water for drinking and for industries.
5. Fresh water requirement for brackish aqua-culture was estimated at 13.5 m^3/s for 11,000 ha in the Brantas delta, but due to limitations of water, water supply of brackish aqua-culture depends on the return flow from irrigation water use.

4. Post-construction problems

After construction, it is necessary to maintain the facilities in order to ensure maximum benefit and reach the planned technical life span. Adequate operation and maintenance (O&M) activities are necessary, but these activities encounter specific problems:

Institutions

To manage the basin, many institutions are concerned, and each has their sectoral responsibility. But co-ordination among sectors may be difficult in some situations, because each sector has previously had its own plan, strategies and objectives.

Management of water quantity and water quality

Water shortage occurs, if population growth and general economic development lead to an increased water demand (agricultural, domestic and industrial), while due to deteriorating water quality, the available water becomes unsafe to use. Effluent discharges of domestic as well as industrial wastewater have been increasing and hence, the pollution from wastewater is exceeding the assimilation capacity of the river.

Funding

The investment in new infrastructures, and the operation and maintenance cost are too huge to be covered by the government budget. It is necessary to increase participation of beneficiaries and the private sector in water resources investment and in the cost of operating and maintaining the infrastructures.

Conflict between water users and water usage

Water demands of beneficiaries have not been always fulfilled, especially in the dry season. On the other hand, some people use water in inappropriate ways. One of today's issues is that our life-styles tend to be wasteful of the available water resources. Often they use good quality water for other purposes, which actually need only lower quality.

Considering the limited amount of water, it is necessary to use available water resources wisely, avoiding conflict, and preserving the environmental capability to get sustainable benefits.

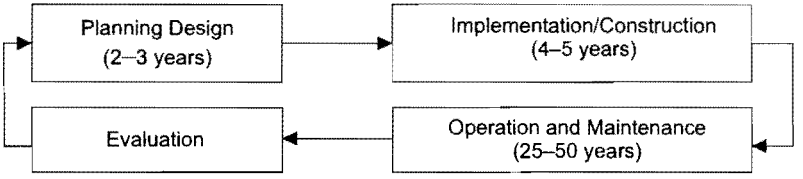
5. Perum Jasa Tirta (Jasa Tirta Public Corporation)

According to the laws and regulations, beneficiaries of water resources facilities are asked to contribute to the operation and maintenance of the facilities. Contributions from water users are not collected because projects are not authorised to collect these contributions. It is necessary to transfer the operation and maintenance of finished structures to a body that is duly authorised to collect contributions.

In Article 4 of Law No. 11 of 1974 on Water Resources, it is stated that the state's authority to manage water resources may be delegated to central or provincial governmental institutions or to definite corporate body where the requirements could be stated in Government Regulation. This is intended to give opportunity for public and private sectors to participate in developing the benefits of water resources.

After about 30 years of development, several river structures have been constructed along the Brantas River. The subsequent activities should be operation and maintenance (O&M). In the development cycle O&M is one of the main tasks for successful achievement of the objectives.

Development Cycle



The Jasa Tirta Public Corporation (PJT I) was established on February 12, 1990, by the government regulation No. 5/Th 1990. The main objective of establishing the corporation is to manage operation and maintenance of the facilities in the Brantas river basin.

The cost for operation and maintenance activities will be collected by PJT I from the beneficiaries. For the time being, the main source of funds will be from electricity, drinking water and industries. There is no obligation for farmers to pay water charges, although more than 80 percent of water in the Brantas River is for irrigation purposes. The government now is introducing a pilot project of Irrigation Service Fee in several provinces around Indonesia. The purpose of the pilot project is to show the farmers the importance of adequate budget to support the operation and maintenance of irrigation facilities.

6. Main tasks and working area of PJT I

Main tasks

Based on Ministry of Public Works Regulation No. 56/PRT/1991, Article 6, the main tasks of PJT I include:

a. Performing operation and maintenance of water resources infrastructure;

b. Water supply services;

c. Management of the river basin, including water resources conservation, development and utilisation;

d. Rehabilitation of water resources infrastructure.

Working area

PJT I conducts its activities, such as planning, construction, rehabilitation, operation and maintenance, supplying, conservation, supervision and control of water resources of 40 rivers in the Brantas basin.

Based on Article 8 clause (2), Government Regulation No. 5 of 1990, the management of other river basins by PJT I would be decided by the President upon the proposal of the Minister.

7. Integrated water resources management in the Brantas river basin

Integrated water resources management is taken to mean the process of formulating and implementing a course of action involving management of water and related resources for the purposes of achieving optimum allocation of water resources within a catchment area. With the Ministry of Settlement and Regional Development as the lead agency in this effort, this optimisation of water utilisation is meant to contribute to increase human welfare from improved agricultural, domestic and industrial use of water.

It is important to understand the need to intensify development efforts in upland areas. This is in response to a clear understanding, from experience with flooding, siltation and other downstream consequences of upstream activities, that a complex of inter-relationships links upland and lowland social and ecological systems. There is al[illegible] a clear sense that the past focus on the lowlands has been at the expense of upland areas, in terms of policy and programme attention. The consensus was, therefore, that a more balanced approach to the development of river basins should be adopted for the future.

This attention to social equity relates to another point on which agreement was reached, namely, that answers to problems of river-basin development and water resources management cannot be found solely from a technical standpoint, but must be reached through close attention to social and economic factors affecting use of natural and human resources. Technical answers to most of the problems faced in the case study basins are already known. This technical knowledge can be made useful, however, only if it is combined with knowledge of social and economic systems to develop viable solutions to problems such as upland soil erosion, low incomes of many rural inhabitants, inefficiency in irrigation and other water applications, and so forth. It was agreed that such social and economic knowledge could only be obtained through active participation of local residents in activities of river-basin development and water resources management. Table 1 shows these activities, which are explained below.

Table 1: Integrated water resources management (scope of works)

- Basic concept: one river, one plan, one co-ordinated management
- Operated by permanent institution, not by project
- Professional staff
- Adequate budget

<u>Maintenance of Structures</u>
- Dam
- River
- Tunnel
- Etc.

<u>Upper watershed Management</u>
(Co-ordination among parties concerned)
- Reforestation
- Demplot of land use planning

<u>Water Quantity Management</u>
- Water allocation for beneficiaries
  - Agriculture
  - Raw water for drinking water and industry
  - Electricity
  - Tourism
  - Fishery
  - Transportation
- Flood management
  - Telemetering System (real time data)
  - Reservoir operation rule

<u>Water Quality Management</u>
- Source of pollutant
  - Industry
  - Domestic
  - Agriculture
- Pollution monitoring
  - Periodical monitoring (daily, weekly, monthly)
  - Data's evaluation
  - Recommendation (law enforcement)
- Public awareness
  - Clean river programme guide line
  - Public campaign
  - Continuous action

7.1 Maintenance of structures

Maintenance activity is primarily to protect water resources structures (dam, reservoir, weir, check-dam, dike, sluice, conduit, etc). PJT I implements the following categories of maintenance activities:

1 Preventive maintenance in the form of routine periodical maintenance and small repairs to prevent serious damage.

2 Corrective maintenance in the form of large-scale repairs, rehabilitation and rectification in order to restore or increase the functions of water resources infrastructure.

3 Emergency maintenance is a temporary repair that has to be done soon due to some emergency condition, such as flood.

The management of the Brantas river basin needs the participation of beneficiaries. For example, farmers play a role in operating and maintaining the irrigation infrastructure, including paying irrigation service fee (ISF), and other beneficiaries pay water abstraction fee. The fees are used to manage the river basin.

The management of the Brantas basin follows the concept of sustainability, meaning maintaining the resources. The concept of sustainability co-ordinates and integrates the river-basin activities and environment, and is applied to all phases of development, i.e. planning, design, construction, operation and maintenance.

7.2 Upper watershed management

The categories and percentages of land use in the whole basin as of 1990 were: farm land 57 percent, forest 26 percent, homestead area 14 percent, and others 3 percent, respectively. On the other hand, according to the land use map prepared by East Java Province, in the year 2008, farm land will have decreased and forest and homestead areas will have increased, compared with those in 1990, by 10.2 percent and 21.8 percent, respectively.

Sediment yield in the Mt. Kelud basin mainly results from eruption of a volcano, Mt. Kelud. Wlingi dam reservoir, located at the lower reaches of the basin, was damaged by sediment deposition coming from the southern slopes of Mt. Kelud after an eruption in 1990. In order to settle this problem, a sediment bypass channel in the Putih River and *sabo* (sediment retention) works are being constructed. *Sabo* works in the Konto and Lesti basins are also being rehabilitated or constructed, to trap sediment discharge.

Two dams (Sengguruh and Wlingi), out of six, suffered from sediment caused by volcanic eruptions (Mt. Semeru and Mt. Kelud). To overcome this problem, besides construction of check dams, periodical excavations (dredging) have been done by PJT I in both reservoirs. Reforestation works are also underway, led by PJT I.

7.3 Water quantity management

A Water Use Right is the right to obtain and use water for a certain necessity. Water use right is stipulated in the Indonesian Basic Constitution of 1945, Law No. 11 of 1974 on Water Resources, and Government Regulation No. 22 of 1982 on Water Resources Management. In principle, water resources are governed by the State and utilised as much as possible for the welfare of the people. Based on this principle, water use prioritisation is given in the Governor of East Java Decree No. 316 of 1988 as follows: (a) domestic water, (b) irrigation, (c) plantation, (d) fishery, (e) industry, (f) hydropower, (g) flushing, (h) swimming-pool. In particular, the Government Regulation 22 of 1982 on Water Resources Management, Article 2, states about the principle and basis of water rights, that in the water management regulations the principles of public utility, harmony and conservation shall be applied.

Particularly for groundwater, it is stated in Law No. 11 of 1974, Article 5, Paragraph 2, and the Government Regulation 22 of 1982, Article 6, that groundwater sources and hot springs such as power and mineral springs are not under the authority and responsibility of the Minister responsible for water resources, but they are under the Minister of Mines and Energy. However, this division between surface water and groundwater is considered inappropriate and will be re-aligned in the reformed policy for water resources development and management.

7.3.1 Licensing

Licences for water utilisation are issued by the Local Government, supported by technical recommendations from PJT I.

Technical recommendation from PJT I is important to ensure the balance of water supply and demand. Water in the Brantas River is used for various purposes. The main consumers are irrigation (80%), raw water for drinking, industries, fishponds, and urban flushing (20%) and electricity (which does not consume the water). Water allocation from PJT I to the users is on a contract basis. Users, except farmers, have to pay a fee to PJT I to cover operation and maintenance cost. The tariff is decided by the Government after discussion between PJT I and users.

7.3.2 Dry season operation rule

Water management in the Brantas River is co-ordinated by a body called Panitia Tata Pengaturan Air (East Java Provincial Water Board; EJPWB) headed by the Vice-Governor of East Java Province. The water allocation pattern consists of two kinds of Operation Rule (OR) that are for the dry season (June–November) and the rainy season (December–May).

The procedure of preparing the dry-season OR is as follows. In May users submit water demands to PJT I. By simulation and weather forecasting, PJT I prepares a draft dry-season OR. At the end of May the draft OR is discussed in the EJPWB and if all agree, it is then signed by the Vice-Governor. Implementation of the OR is done by PJT I with monitoring in 10-day periods. If there is deviation from predictions, or conflict of interest in the field, some members of EJPWB discuss and review the OR if needed.

7.3.3 Rainy season operation rule

Preparing the rainy season OR follows the same procedure as for the dry season. The important issue in the rainy season OR is flood management.

PJT I has prepared a Guideline for Flood Forecasting, Flood Warning and Flood Fighting on the Brantas River. Subjects of this book include critical locations along the river (levees), protection methods, materials and equipment available for flood fighting in warehouses along the river, names, addresses, and telephone numbers of staff involved, hierarchy of information to be submitted, etc.

To monitor rainfall intensity in the basin and discharge along the Brantas River, a tele-metering Flood Forecasting and Warning System (FFWS) has been installed, consisting of 26 rainfall stations and 31 water-level stations, covering 12,000 km^2 of catchment area, with the Master Station located on the main office of PJT I. Field data are transferred to the Master Station every 30 minutes in real time. The basic concept of flood control is one river, one plan, one co-ordinated management.

The purpose of establishing a flood forecasting and warning system is to prevent or mitigate damage and to ensure the safety of inhabitants. Flood-fighting activities are performed by flood defence teams. People living near the river are enabled to take necessary actions for flood protection, by giving them flood information with enough time allowance. Information on a coming flood such as scale, arrival time of peak, etc. is to be given to inhabitants well in advance, if occurrence of flood is judged to be inevitable.

7.3.4 Water quality management

Water quality control plays an important role for sustaining benefits in the Brantas River and its tributaries.

Legally, PJT I should have active participation in supervising and controlling the Brantas River water quality. The task of PJT I on water quality control is to support the Central and Provincial Governments. One continuous activity of PJT is water quality monitoring along the Brantas River at 50 sampling points and 41 sources of industrial pollution. The samples are tested by PJT I's Laboratory. These data can be used by the Local Government of East Java to control polluting activities. By using simulation computer programming, it can also develop a strategic action plan for pollution abatement in short, medium and long terms to achieve the river water quality objective.

The main pollutant sources in the Brantas River, based on a study in 1989, are industry, domestic users and agriculture.

To reduce pollutants from industries the Government issued a regulation that all industries have to install waste water treatment plants (WWTP). For small industries (home industries), it is difficult to follow the regulation. For some large industries the WWTP are not always operated.

More difficult to control is pollution coming from domestic waste. The people use the river water for many purposes. Because of low income and less awareness of environment protection it takes time to educate the people.

Pollution from agriculture is not a significant factor causing deterioration of water quality. Agricultural activity is done during the rainy season when the flow of water in the river is big enough to neutralise pollution.

Clean river programme

To minimise pollution discharge into the river, Government initiated a programme called the Clean River Programme (CRP) in 1989. PJT I and other parties promote the CRP through several activities. Pollution control is carried out by the Environment Pollution Control Committee (KPPLH) which is established by the Governor Decree, and consists of all agencies concerned. In KPPLH there are four Working Teams, for Clean River Programme, Clean Town, Domestic Waste Pollution Control and Industrial Waste Pollution Control respectively, PJT I sits as Vice Co-ordinator I of the Team for the Clean River Programme.

Effluent discharge standards are currently stated in the Governor Decree 136 of 1994, however, this is being updated involving all agencies concerned, co-ordinated by the Provincial Office of the Environmental Impact Management Agency or BAPEDALDA.

CRP Campaign

Public education is carried out in co-ordination with the Department of Home Affairs, Universities, Non-Governmental Organisations and Moslem traditional boarding schools, for the following groups of people: on land and water conservation, to people in villages and students of Moslem traditional boarding schools in the upper reaches; on water pollution control, to industry managers, high school teachers and students; on mining and land use in the river corridor, to the people and the village officials; on environment protection, to high school students.

The success of public education programmes is usually constrained by economic conditions. Although no specific assessment has been undertaken, the physical condition shows that so far public education has a good achievement proved by positive social control given by the public.

Law enforcement

Law enforcement is focussed on large industries. Many large industries do not operate their WWTP continuously. Difficulties of law enforcement include poor regulation, poor staff and difficulties of obtaining evidence. On the other hand, maybe, global co-operation is needed between developed and developing countries. Many large industries come from developed countries. What is their role to protect the environment?

After several years of hard work, the people along the Brantas River have now come to the stage of understanding about environment protection, but not yet to do it. Some industries already applied to the court of justice. More time is needed, before environmental conditions will be completely protected. Public campaigns have to be continued.

8. Stakeholder identification and participation

8.1 Water resources stakeholders

Stakeholders in water resources can be classified into three main groups:

a. **Government** as the "owner and regulator" plays the role of controlling and policing water, and exercising public authority. It has the right to a part of the profit gained by the River Basin Management Agency while on the other hand it is obliged to contribute its funding for activities towards public safety and welfare.

b. **River Basin Management Agency** (RBMA) as the "operator" has the concession to manage water and its infrastructures, and develop its management system. It has the right to collect contributions from beneficiaries and receive contributions from the Government for public safety and welfare activities. It is also obliged to render prime services, promote public and private participation, give contribution to the owners, and to be accountable in performing tasks to shareholders and stakeholders.

c. **Society** as the "users" have the right to receive good services and participate in decision-making processes. They are expected to use water efficiently, take part in sustaining the environment, provide financial contributions for water resources management (WRM) and provide constructive social control.

The proportion of population below the poverty line (US$ 800/year) in the Brantas river basin after the economic crisis of 1998 is about 46.3 percent (1,193,075 households out of 2,578,139). Conflict of interest among stakeholders is still manageable, even though during the dry season the available water is not enough to cover all sector water demands. The irrigation water user, as the biggest water consumer (almost 80 percent of manageable water during the dry season), receives only 60 percent–80 percent of their water demand.

8.2 Organising stakeholders

Stakeholders are organised through the Water Resources Committee (WRC). The Vice-Governor is the chairman and Provincial WRM Office is the secretary. The WRC membership consists of high-level provincial officials from relevant sectors, RBMA and representatives of stakeholders i.e. Electricity State-Owned Company, Municipal Water Supply Corporation, industries (represented by Industry and Trade Provincial Office), farmers (represented by Irrigation Committee), universities, etc. The WRC is supported by some Technical Work Groups for specified fields, such as water conservation, water allocation, pollution control, flood control, sand mining, etc.

The role of the WRC is to assist the Governor in preparing the water resources management plan (policies, strategies, planning and programming) as well as to co-ordinate all regulatory aspects and to solve technical problems related to implementation of the plan. This WRC is responsible to accommodate various interests, and to govern the water management rules applied throughout the province.

8.3 Access to water for poorer people

Specific water users (for commercial uses: electricity, municipal water supply, industries, horticultural estate) should have water use permits from the Government. Once the permit is issued, the RBMA should secure the water allocation for their utilisation. The water users are obliged to pay water service tax and fee to the Government and the RBMA. Based on this permit, the RBMA and the user sign a Water Service Contract, which specifies the rights and obligations of each party.

On the other hand, social uses (irrigation water uses, human daily activities etc) and non-specific water users (municipalities), are not obliged by law to have water use permits. These users are not obliged to contribute water service tax and fee. Most of the non-licensed water users are poorer people in urban and rural areas.

In dry seasons when available water is not enough to cover all demands, irrigation users always have reduced water allocations. Irrigation Water User Associations distribute water among farmers under the guidance of District WRM Offices. The Municipal Water Supply Corporation supplies water for poorer urban people through public water-taps (10% of total distributed water). The RBMA supplies raw water to the sector users at their water intake based on an agreed allocation pattern.

Through the on-going national reform of water resources policies, it is intended to develop water use rights for irrigation and maintenance flow in order to have equitable access to water for the poorest people.

9. Institutional and policy issues

9.1 Institutional framework

One objective in the establishment of PJT I was to develop and implement the concept of an institutional framework for WRM, by establishing a permanent, neutral, professional and accountable institution to perform equally the principle of a healthy corporation and general utilisation of water resources, based on public, private and community participation.

The main strength is that WRM in the Brantas river basin performed by PJT I is a national pilot project for future WRM institutions in Indonesia. The weaknesses of the implementation of the system in other river basins in Indonesia are:

a. Limited capacity of the society to contribute to WRM cost;

b. Not all of the beneficiaries pay the cost borne for WRM;

c. Price of water does not encourage the private sector to participate in WRM.

d. Less awareness by the people means less social control on water resources issues.

After 10 years of the pilot WRM institution, the Government made the decision to implement the management system developed by PJT I in other strategic river basins.

9.2 Water rights

Based on the Indonesian Basic Law, the water right is in the hands of the State. The people have only water use right. Only specific beneficiaries have permits to use the water and permits to discharge their effluent to the river. For social use (farmers, etc) and non-specific beneficiaries (municipal) it is not necessary to have permits. In the near future, water use rights will be implemented for all water users. For the time being, the permit system does not allow tradable permits.

9.3 Water allocation mechanism

Stakeholders' participation in decision-making processes is conducted in the WRC. In water allocation, for example, the mechanism can be explained as follows:

a. The initial concept of water allocation is prepared by the RBMA with computer simulation based on water demand and water supply projection. The draft water allocation plan is discussed in the Technical Work Group and submitted to the WRC for approval.

b. The water allocation is then conducted by RBMA. If a significant deviation exists, RBMA makes a review and prepares the revised pattern, which will be discussed by the Technical Work Group and submitted, to WRC for approval.

Water distribution among sectors is done by the RBMA, while water distribution in irrigation areas is done by Water Users' Associations under guidance of District Water Resources Technical Management Units.

10. Water accounting

Land utilisation differs in each part of the basin, especially affected by topography. Most of the arable land is utilised for productive farming (38%) and the rest of is used for forest, settlement and non-agriculture activities. Critical land that is subject to erosion is estimated 17 percent of the Lesti Catchment and 18 percent of the total Brantas upper reach. Features of the Brantas river basin are shown in Tables 2 to 5.

Table 2: Main features of the Brantas river basin

Main river		Kali Brantas (320 km)
Geographical co-ordinates		110°30' – 112°55' E and 7°31' – 8°15' S
Average temperature		25.5° C
Relative humidity		82%
a)	Total catchment area	11,800 km² (25% of East Java)
b)	Total reservoir capacity	
	• Gross storage (initial/present)	525 / 297 million m³
	• Effective storage (initial/present)	378 / 245 million m³
c)	Water availability	
	• Average precipitation	2,000 mm/year
	• Run-off coefficient	about 0.50
	• Potential flow	11,800 million m³/y
d)	Water utilisation	
	• Irrigation	2,400 million m³ (79.9 %)
	• Domestic	225 million m³ (7.5 %)
	• Industry bulk supply	133 million m³ (4.4 %)
	• Maintenance flow	204 million m³ (6.8 %)
	• Fisheries (irrigation return flow)	41 million m³ (1.4 %)
	Total	3,003 million m³ (100.0 %)

Table 3: Precipitation in the Brantas river basin (1995–1999)

Units: mm

Month	Average	Maximum	Minimum	Season
January	343.83	566.72	181.90	Rainy season
February	306.62	554.03	193.25	Rainy season
March	297.33	512.51	88.75	Rainy season
April	203.00	389.57	49.31	Rainy season
May	110.55	324.65	12.14	Dry season
June	61.23	224.64	0.11	Dry season
July	40.54	271.81	0.00	Dry season
August	19.79	96.47	0.00	Dry season
September	28.46	152.33	0.00	Dry season
October	81.45	353.43	1.65	Dry season
November	176.33	393.66	25.12	Rainy season
December	278.93	473.35	124.25	Rainy season
Total	1,948.06	3,434.26	1,228.05	

Source: PJT I (2000)

Table 4: Population

Description	Java Island	East Java Province	Brantas River Basin
Area (km^2)	132,206	47,938	11,800
Population:			
• 1980	91,269,528	29,188,852	11,996,000
• 1990	107,581,306	32,503,991	13,004,000
• 1995	114,733,486	33,844,002	13,534,000
• 2000 (projected)	122,811,842	35,570,386	14,224,370
Density (person/ km^2)	929	742	1,205
Percent to East Java	125.2	100.0	162.4

Source: Indonesian Statistical Office (2000)

Table 5: Growth of Gross Regional Domestic Product in the Brantas basin

Units: %/year

Sector	1984–1985	1985–1992	1993–1995	1996–1998
Agriculture	3.1	3.2	0.5	11.6
Industry	4.7	10.7	12.2	15.4
Services	7.3	7.3	7.9	13.5
Gross Domestic Product	5.5	6.7	7.7	9.8

Source: Final report of Master Plan IV (1998), Indonesian Statistic Office (1999)

The Gross Regional Domestic Product (GRDP) of the basin amounted to 39,018 billion Rupiah in 1995 (note: US$1=Rp 2,250 at bank exchange rate during 1995), which was 58.9 percent of the GRDP of East Java and 9.4 percent of Indonesia's Gross Domestic Product (GDP). GRDP per capita of the basin was US$1,269 in 1995, which was 46 percent and 44 percent, respectively higher than the rates for East Java (US$872) and all Indonesia (US$880). After the economic crisis in 1997, the GRDP of the basin was estimated 45,428 billion Rupiah in 1998 (US$405). The basin's economic growth was led mainly by the industry sector after the mid-1980s.

10.1 Water resources utilisation

Sources and uses of water in Surabaya Metropolitan Area (SMA: Gresik, Bangkalan, Mojokerto, Surabaya and Sidoarjo) in 1998, and estimates of future demand, are shown in Tables 6 and 7.

Table 6: Sources of water

Units : m^3/second

Brantas River	47.84
Treated surface water	1.43
Spring/well	0.53
Other surface water	0.12
Total existing supply	49.92

Source: East Java Water Balance Team (1998)

Table 7: Water use in SMA

Units: (m^3/second)

	1998	2000	2005	2010	2020
Industry	3.96	4.53	11.58	27.30	90.04
Irrigation	41.41	41.41	33.28	29.17	20.58
Domestic	10.69	13.35	19.33	25.74	41.93
River maintenance	7.50	8.64	11.49	14.34	20.00
Total demand	63.56	67.93	75.68	96.55	172.55

Source: East Java Water Balance Team (1998)

Table 8: Overall demand and supply in SMA

Units: m^3/second

Year	1998	2000	2005	2010	2020
Demand	63.56	67.93	75.68	96.55	172.55
Supply capacity (1998)	49.92	49.92	49.92	49.92	49.92
Deficiency (without action)	(13.64)	(18.01)	(25.76)	(46.63)	(122.63)

Source: East Java Water Balance Team (1998)

Note: The balance does not include brackish water fisheries

11. Major Issues and Strategies

11.1 Major issues

Water resources will be the limiting factor in development of the region. The water demand is estimated to be tripled in the next 20 years, while water resources development is already limited. Wonorejo Dam, which will be in operation in 2001, is the last favourable dam site in the basin.

Water quality degradation is a problem especially in the down stream area: Surabaya River and Porong River. The total pollution load in the basin has increased almost threefold during the last 10 years: 125 ton BOD/day in 1989 became 330 ton BOD/day in 1998, of which 62 percent is from domestic users and 38 percent from industries.

Watershed degradation promotes erosion and sedimentation. The sediment load in Sutami catchment area is estimated about 3.2 million m^3/y in 1998, meaning an increase by almost threefold during the last 30 years.

11.2 Strategic plan

The main strategies for addressing these major issues are:

- Promote stakeholders' participation in the decision-making process to get their commitments in the implementation of a WRM plan.
- Public education to promote positive social control from the public.
- Implement economic and other instruments to promote efficient use of water, abate pollution load and develop sources of funds for WRM budget.
- Develop and implement consistently Land and Water Conservation Plan.

Projections of future water quantity and water quality under this plan are shown in Tables 9 and 10.

Table 9: Water quantity

Units: m^3/second

Year	1998	2000	2005	2010	2020
Deficiency (without actions)	(13.64)	(18.01)	(25.76)	(46.63)	(122.63)
Action plan:					
• Demand efficiency	6.21	7.10	10.22	18.35	58.51
• Supply efficiency	3.60	3.60	3.20	3.20	2.80
• WR development					
- Wonorejo Dam		8.02	8.02	8.02	8.02
- Umbulan Spring			4.45	4.45	4.45
- Beng Dam *)				9.50	9.50
- Kd. Warak Dam					3.50
• Final balance	(3.83)	(2.86)	0.13	(3.11)	(35.85)

Source: Surabaya Development Programme (1998)

*) Pumping scheme: Brantas river will be pumped to the reservoir during rainy season.

Table 10: Water quality

Units: ton BOD/day

Year	1998	2005	2010	2020
Projected load without actions	330	395	442	565
Domestic load	205	224	234	257
Industrial load	125	171	208	308
Maintenance flow (m^3/sec)	7.5	7.5	7.5	7.5
Projected load with actions *	330	208	177	118
Domestic load	205	182	151	92
Industrial load	125	26	26	26
Maintenance flow (m^3/sec)	7.5	11.5	14.5	20.0

Source: Pollution Control Master Plan (1998)

*The water quality objective will be achieved in 2020 if targeted pollution load abatement can be realised.

12. Financial aspects

12.1 Sources of funds

In order to achieve sustainable WRM, budget availability for river basin management needs to be secured. This requires that beneficiaries gradually bear costs for river basin management through the application of the principles of Users Pay, Polluters Pay, as well as Government Obligation (for funding social services and public safety and welfare measures, such as flood control, water pollution control, land and water conservation, and irrigation).

Funds obtained from beneficiaries are used for operation and maintenance activities. Investment budget may be obtained from: 1) Corporate internal funds, 2) Government Budget, 3) Local or foreign loans, and 4) Other reliable sources (Joint ventures, Municipal Bonds, etc.). The major cost components are indicated in Table 11.

Table 11: Components of cost

Direct Costs	Indirect Costs
• Operation and Maintenance	• Personnel expenses (for Head Office)
• Watershed conservation	• General expenses (for Head Office)
• Personnel expenses (for WSD Offices)	• Travel expenses (for Head Office)
• General expenses (for WSD Offices)	• Depreciation
• Travel expenses (for WSD Offices)	• Marketing expenses
	• HRD expenses
	• Public Education cost

Note: WSD Offices: Water Services Division Offices

12.2 Fund-collection process

In principle, PJT I should negotiate the fee tariff with the sector users. Then the agreed tariff is proposed by PJT I's Board of Directors to the Ministry of Settlement and Regional Development (MSRD). After getting recommendation from the Ministry of Finance and the Governor, the Ministry approves the fee tariff.

The fee paid by the users is collected by PJT I in collaboration with Provincial Tax and Retribution Offices which already have a well-established collection system. The non-fee payer (social and non-specific users) pays to the government in other forms of tax (land and building tax etc). The government then gives subsidy to finance activities relating to social services and public safety and welfare.

12.3 Methods of assessment of water service fee

Based on the Government Regulation No. 6/1981 the fee should be calculated to cover: 1) operation and maintenance; 2) depreciation; 3) interest; and 4) fund for further development. Considering the capability to pay, the fee is calculated only for operation and maintenance cost recovery.

The water service fee is calculated by the RBMA based on the following methodology:

(a) Listing of all major water resources infrastructures.

(b) Identification and calculation of operation and maintenance activities of each infrastructure.

(c) Distribution of cost among functions for multipurpose facilities (separable or joint cost).

(d) Derivation of proportions for allocating operation and maintenance cost for each sector user (based on the gross benefits received by sector users).

(e) Derivation of operation and maintenance costs for respective function for all facilities.

(f) Derivation of amounts of power generation (kWh/year) for electricity, water used (m^3/year) by other sector users (municipal water supply, industries).

(g) Calculation of water service fee for each sector user to recover operation and maintenance costs.

It is very difficult for the RBMA to make a tariff agreement. There is no guideline issued by the Government in calculating fee. Through the on-going National Reform of Water Resources Policies, it is intended to issue a Government Regulation on the guideline for calculating water service fee and waste water discharge fee.

12.4 Budget approval process

(a) Four months before effectiveness of the following fiscal year, the Board of Directors prepares the next Yearly Corporate Budget and Work Plan, based on the operation and maintenance work plans proposed by each Water Services Division, by considering the recommendation of RBWRC and PWRC.

(b) Before submitting the Yearly Corporate Budget and Work Plan to the MSRD and Minister of Finance, it is discussed and approved in principle by the Supervisory Board. The Board of Directors and Supervisory Board hold several meetings to discuss both the technical and financial matters.

(c) Approval of the Yearly Corporate Budget and Work Plan is obtained from the Minister of Finance after recommendation from the MSRD.

12.5 Effects of the financing system

During the last 10 years, the tariff level of water service fee has increased as shown in Table 12. The progressive tariff and increasing tariff level stimulate the application of recycling technologies for major industrial water users, such as sugar-cane factories. For the time being, it is difficult to have equity and adequate access for poor people. The Government Obligation Principle cannot be implemented due to the Government's budget limitation. Equitable access to water could be improved after the implementation of water use rights for irrigation and for environment (maintenance flow) and commitment of Government in realising Government Obligation Principle.

Table 12: Tariff level

Unit: Rupiah

Water Users	Units	1990	2000
Electricity State Owned Company	Rp/kWh	6.00	13.61
Municipal Water Supply Corporation	Rp/m^3	16.00	35.00
Industries	Rp/m^3	16.00	52.00*

*Basic tariff level for progressive tariff system

Note: In mid-2000, 1 Rupiah = 0.0115 US cent at nominal exchange rate

13. Present condition of PJT I

The following is a summary of the main features of PJT I at present.

Beneficiaries' contribution for operation and maintenance

Beneficiaries' contribution in 1999 reached Rp 27 billion (US$ 4 million). Even though this does not cover normal operation and maintenance budget requirements, it leads to these results:

- Increasing regional revenue as the result of orderliness in water allocation and tariff determination in Brantas river basin;
- Cost burden from government budget allocation for Brantas river basin could be minimised and allocated for other basins.

Improvement of water resources infrastructure functions

Improvement of operation and maintenance has resulted in improved functioning of water resources infrastructure, which directly contributes to management improvement.

Company performance in 1991–1999

The company's audit up to the fiscal year 1999 is considered excellent, proving satisfactory results from application of the cost recovery principle.

Public/Private and community participation in water resources management

Water resources management operated by PJT I makes it possible for public as well as private sectors to participate in water resources development and management in the basin.

ISO 9001 Certification

Certification of ISO 9001 for Design, Operation and Maintenance of Water Resources Infrastructures in the Brantas river basin issued by SGS International Certification Services, has proven professional water resources management practices by PJT I.

14. Conclusion

14.1 General view of the Corporation

The Brantas river basin has been a valuable natural resource for many years. It was essential for food production; to support national economic development, water is considered as a strategic commodity.

- The development of the Brantas river basin has been carried out since 1961 as an integrated development through a series of Master Plans with the basic concept of one river, one plan, one co-ordinated management. The benefits of development include flood control, food production, drinking water, industrial water, electricity production.
- In order to overcome the post construction problems, the Government of Indonesia established the state-owned corporation PJT I on May 12, 1990.
- The management of water resources in the Brantas river basin is carried out as an integrated management operated by PJT I. The scope of activities of PJT I are: water quantity management, water quality management, maintenance of water resources infrastructure. PJT I has implemented Quality Assurance System ISO-9001, issued by Yarsley International Certification Services Limited, London, No. Q.9755 on May 12, 1997.
- To operate these activities, PJT I collaborates with related agencies, such as: East Java Provincial Water Resources Committee (Panitia Tata Pengaturan Air) for water allocation, Commission for Environmental Pollution Control and Abatement (KPPLH) for pollution control.
- The funding for operation and maintenance of water resources in the Brantas river basin mainly comes from the contributions of beneficiaries: State Electric Power Company, Regional Drinking Water Supply Company and Industries.
- In the future, PJT I will be extended to cover other rivers in Indonesia.

14.2 Management problems

- The formula to compute the unit water rate is not established yet. This is needed, from the point of view that water revenue should be reliable and stable for the long-term sustainability of the corporation.
- The operation and maintenance contribution from beneficiaries excludes depreciation. In the future it may be necessary to establish a water rate formula including depreciation and other factors.
- Up to now farmers do not pay operation and maintenance contribution. Most of the irrigation water users still keep the old perception that the charge for water used is included in the tax they pay.
- Due to lack of awareness, water taken by the farmers is not efficiently utilised. Some farmers take more water than their actual needs. As a result, farmers downstream face water shortage problems in the dry season.
- River water quality has seriously deteriorated throughout all the Brantas River. The reason is untreated wastewater from industry, domestic users, agriculture and livestock breeding which has been drained into the river.

- At present, the upstream area of the basin has been considerably devastated and existing reservoirs have suffered from sedimentation.

Basin Management in a Mature Closed Basin: The Case of California's Central Valley

Mark Svendsen
Consultant in Water Resources Management
Philomath, Oregon, USA

Abstract

The American State of California is a mature water economy in which available water is nearly fully allocated. The state has a well-developed hydraulic system which enables water to be moved from areas of surplus to deficit, and allows trading and sales of water and water rights, though such transactions are still limited. The state is overwhelmingly urban and still growing rapidly, leading to large projected increases in municipal water demands over the next 20 years. Additional allocations to municipalities are expected to come from allocations currently devoted to agriculture.

Procedures for managing water at the basin level have solid, if complex, underpinnings in law and tradition. Surface water rights are based on both riparian and appropriative doctrines. However, groundwater is only lightly regulated and is currently seriously overdrafted. Management is pluralistic, with multiple sources of power and authority. Many decisions are negotiated, rather than handed down, and then formalised as legally-enforceable agreements among the involved parties. Others are litigated, and reliance on the courts for dispute resolution is heavy.

The various interests, including the natural environment, are represented by capable and well-funded advocates. Decisions are generally considered in open fora with the full range of interests represented. Many of the actors involved have come to realise that past reliance on litigation to resolve disputes does not necessarily lead to optimal solutions, and there is a broad interest and willingness to experiment with alternative models of decision-making and dispute resolution.

1. Introduction

1.1 Basin management

River basins are managed at two different levels. At the higher level, the basin level, overall policies and plans are set, resources are allocated and regulations written and enforced. At the use level, regulated water deliveries are made to users of water, who may be irrigators, urban residents, industries, wetlands, or natural river reaches. This paper focuses on the first level of management, the basin level, and examines the way in which basin level management functions are performed in the large interior Central Valley of California. The Central Valley comprises what Bandaragoda (c1999) terms an *advanced* river basin, one which is already well developed in terms of physical infrastructure and effective institutions for integrated water resource management.

Issues of particular interest here are the interplay of political forces which support alternative water uses, the currently changing priorities accorded to alternative water uses, and processes and institutions whereby allocational and regulatory activities at the basin level are directed and co-ordinated. One central issue of global significance is the extent to which one apex organisation must be in control of the highest level of decision-making in a basin. Berkoff (1997), for example, has asserted that "if water is to be managed holistically, all aspects must be co-ordinated by one ... agency." The present study suggests that this assertion does not apply universally and raises questions about the conditions under which different models of basin-level management would be most effective.

1.2 California's Central Valley

California's Central Valley is home to millions and one of the premier agricultural regions in the United States, containing 6 of the top 10 agricultural counties in the country. California itself has 33 million residents and is the most populous state in the nation. An overwhelming 97 percent of the population live in urban areas.

The state as a whole has abundant renewable water resources which, in addition to meeting environmental, urban, and agricultural needs, generate 42 percent of the utility-produced electricity in the state. Irrigated agriculture generates 81 percent of California's total agricultural revenue on 30 percent of the state's farmland. Agricultural also provides 14.4 percent of the state's employment, though only 2.1 percent of that is engaged in direct production activities. The remaining 12.3 percent works in input production, marketing and processing, and wholesale and retail sales. The state is also blessed with a magnificent and varied natural environment—the Pacific coast, the Sierra Nevada Mountains, broad inland valleys, wetlands, and the southern deserts. All of these features—the environment, urban concentrations, power generation, and agriculture—require water for their sustenance and operation.

Several features of California's situation make it especially valuable as a case for study.

- Firstly, California comprises a sophisticated economic environment in which water is used for a wide variety of purposes and is treated more as a commodity than as a common pool resource.
- Secondly, intense competition over water has emerged in what Seckler (1996) would call a *closed water system* – one in which there is little new water left to develop. This competition includes agricultural, municipal and industrial (M&I), and environmental interests and is driving rapid change in the institutions which allocate, regulate, convey, and use water.
- Thirdly, the responses to changing public priorities have been characterised by pragmatic problem-solving behaviour. This has made California a virtual laboratory for innovative solutions to problems of water reallocation and management, environmental quality, efficient water use, and water quality management.

2. Basin hydrology[1]

2.1 Supply

California possesses abundant water resources, receiving nearly 250 billion[2] m^3 of precipitation annually in average years. Of this amount about 65 percent is used by trees and other natural vegetation. An additional 10 percent flows to the Pacific Ocean or other salt sinks unchecked and unallocated. The remaining 25 percent runoff is available as a renewable water supply for urban, agricultural, and environmental uses[3].

Developed surface water resources in the state total about 80 billion m^3, of which nearly half are set aside as required environmental flows[4]. About 12 percent of the total has been developed under Federal Government projects, 5 percent by the State of California, and 17 percent by local government entities. An additional 8 percent comprises water imported from the Colorado River basin under a multi-state water-sharing agreement using facilities also constructed by the Federal Government.

In addition to surface water sources, an additional 15 billion m^3 is available as renewable groundwater (see footnote 5). Present withdrawal rates are higher than this, resulting in an overdraft of about 1.8 billion m^3 annually, some 12 percent of the renewable total. Furthermore, the rate of overdraft is increasing and was 10 percent greater in 1995 than it was in 1990. To some extent, this overdrafting is a consequence of 1992 federal legislation which reallocated water away from irrigators to environmental uses. This has led to supply deficiencies of up to 50 percent for some Central Valley irrigators and caused them to turn to lightly regulated groundwater as a replacement supply.

Most of California's precipitation falls as snow in the mountains of northern California and in the Sierra Nevada range, which comprises the high backbone of the state running from north to south along its eastern flank (Figure 1). A second range of much smaller hills, the Coastal Range, fronts the narrow coastal plain in the west, creating a broad alluvial valley between the two ranges. This Central Valley is an area of rich soils and favourable growing conditions for a wide variety of crops and is the heart of California agriculture. In it, more than 200 types of crops are grown and from it comes 45 percent of the nation's fruits and vegetables. Two major river systems drain the Central Valley and some 158,000 km^2 of watershed, the Sacramento River in the north, and the San Joaquin River in the south. The two

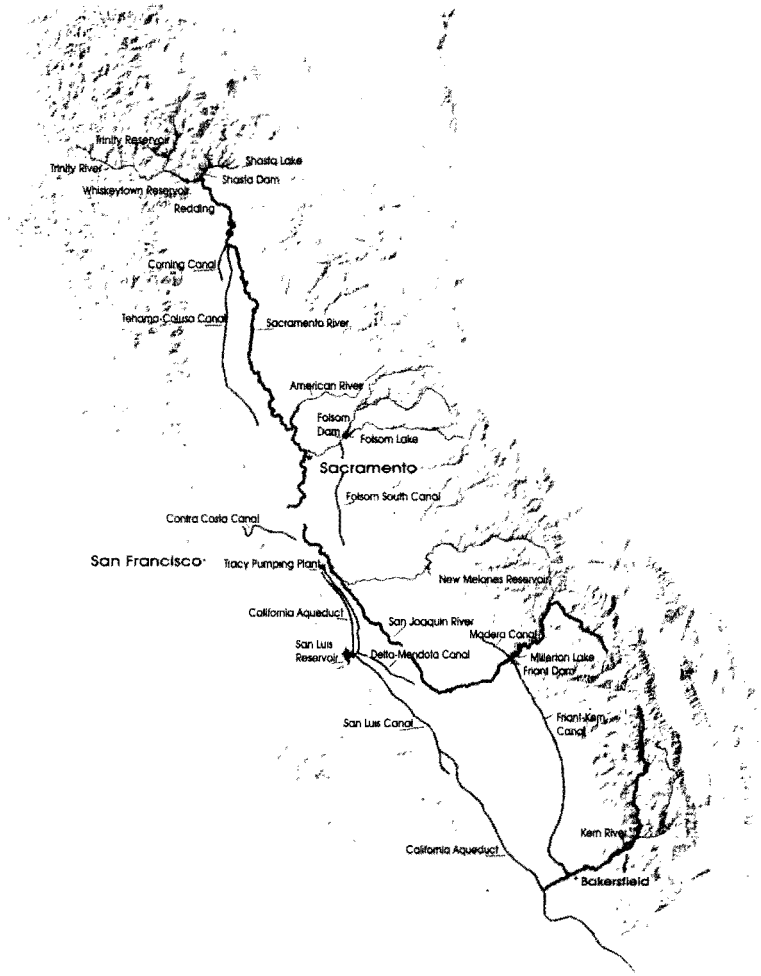
[1]Data for this section is drawn largely from DWR (1998).

[2]*Billion* is defined here as 10^9.

[3]A portion of the water specifically designated for in-stream environmental use also flows to the Pacific Ocean.

[4]The total of developed surface and groundwater is greater than the 25 percent of precipitation designated as available runoff because of reuse.

Figure 1. California's Central Valley



rivers meet in the Sacramento-San Joaquin Delta (the Delta), just inland of San Francisco Bay, from where they flow into the Bay and out to the Pacific Ocean.

The fact that two-thirds of California's water is in the north, while the bulk of agricultural land and the largest population centres are in the south has led to two massive engineering projects designed to transport water from north to south. These are the federal Central Valley Project (CVP) and the State Water Project (SWP).

The CVP was constructed in the 1940s by the Bureau of Reclamation, the federal irrigation development agency. Construction was begun in 1935 as a part of a massive depression-era public works programme. The project is anchored by Shasta dam in the Cascade Mountains in northern California which stores water for use in the south. Water from Shasta and several smaller dams is routed down the Sacramento River to the Delta, which it crosses in a network of natural and artificial channels. Some of the water is used to irrigate land along the Sacramento River to the north, but most crosses the Delta to be lifted 60 meters into the Delta-Mendota Canal (DMC). The DMC supplies 32 irrigation districts in the San Joaquin Valley with water.

The second project, the SWP, was developed in the 1960s by the State of California. Its backbone, the California Aqueduct, parallels the DMC south from the Delta before continuing on to southern California. Its primary purpose is to convey M&I water to desert cities in the south (70%), principally the greater Los Angeles area, though it does supply irrigation water (30%) as well. Together these two projects deliver about 7.3 billion m^3 of water annually to the south.

2.2 Demand

2.2.1 Current patterns

Overall demand for developed sources of water is dominated by environmental reservations (46.5%) and by irrigated agriculture (42.5%)(Table 1). Municipal demand currently makes up 11.0 percent of the total.

Table 1: Average water-year water uses, 1995 and 2020

	1995		2020	
	Volume (10^9 m^3)	Share (%)	Volume (10^9 m^3)	Share (%)
Urban	10.8	11.0	14.8	14.9
Agricultural	41.7	42.5	38.9	39.1
Environmental	45.6	46.5	45.6	45.9
Total	98.0	100.0	99.3	100.0

2.2.2 Changing patterns of demand

Projections for 2020 (DWR, 1998) anticipate only a very modest expansion in available supply (1%), but with important shifts in the composition of use. While environmental uses of water are expected to remain constant, urban[5] demand will expand by 37 percent and agricultural water use will shrink by nearly 7 percent to accommodate this growth. Additional developed supplies will be devoted entirely to urban use.

The federal Endangered Species Act, passed in 1973, established the legal framework for protecting species of plants and animals listed as *threatened* or *endangered* and the allocation of water for their preservation where necessary. The listing of winter run Sacramento River salmon as endangered under this act in the early 1990s was the first important application of the law in California that had a significant impact of water allocation in the Sacramento-San Joaquin Valley. A far more sweeping change was wrought by the Central Valley Improvement Act, passed by Congress in 1992. This act reallocated a portion of the water, which the federal government had contracted to deliver to irrigation districts, to the ecosystems of the Sacramento-San Joaquin Delta. This reallocation has resulted in significant shortfalls in supplies to many of the irrigation districts in the San Joaquin Valley.

2.2.3 Urban use

Driving the growth in urban water use is projected growth in the California population of nearly 50 percent between 1995 and 2020, as a result of continuing in-migration from others regions of the country and from abroad. The demand for water caused by this growth completely overshadows modest potential reductions in per capita water use of about 6 percent if household level best management practices are fully implemented[6].

2.2.4 Agricultural use

California has more than 3.6 million hectares of agricultural land under irrigation, 80 percent of it in the Central Valley. Projections for 2020 indicate a modest reduction of about 130,000 hectares (3.6%) in the total irrigated area, resulting mainly from urban encroachment, land retirement due to drainage problems, and more competitive economic markets for agricultural products[7]. In addition, changes in cropping patterns and irrigation technology and practices will yield small reductions in the rate of water use per hectare (an estimated 2.4% of 1995 use levels).

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[5]Urban use includes residential, commercial, industrial, and institutional uses of water

[6]If explicit conservation practices are not implemented, per capita urban demand will increase by about 6 percent.

[7]There is potential for much more significant reductions if major proposed conversions of agricultural land to wildlife habitat are implemented.

2.2.5 Environmental use

Environmental water use comprises several categories of flows that have been set aside for environmental purposes. These are:

- Dedicated flows in designated "wild and scenic" rivers (64%)
- In-stream flow requirements in other rivers established by water right permits, court actions, agreements, or other regulatory actions (17%)
- Required Sacramento-San Joaquin Delta outflows (15%)
- Wetlands freshwater requirements (4%)

Note that while there are other environmental uses of water, the above uses are distinguished by being managed and quantifiable. Most of this environmental water allocation is brought about by legislative and regulatory processes rather than through the water right permitting process which authorises agricultural and municipal uses.

2.3 Summary

California is well endowed with renewable water resources. Of the 250 billion m^3 received as precipitation annually, about one-quarter is available for various allocated uses. About half of this allocated water is set aside for instream environmental uses. The remainder (just over 50 billion m^3) is available for withdrawal for agricultural and urban uses. Groundwater, though abundant, is currently overdrafted by about 12 percent of the renewable total and exploitation continues to expand.

Two major plumbing projects, one Federal and the other State, transfer water from the wet north to the arid south of the state. Water moving though both of these systems must transit the Sacramento-San Joaquin Delta "in the open", where it mixes with water in the Delta and contributes to it. The Delta is also important environmentally, and it serves as the nexus of the debate over the future of California water.

According to the most recent version of the California Water Plan, urban demand, is expected to grow by 37 percent over the next quarter-century, while agricultural water use shrinks by 7 percent and environmental use holds constant. Additional allocations to environmental uses are being promoted, however, and if they are adopted additional reallocation of agricultural water will be the likely outcome.

3 Legal, policy, and institutional environment

3.1 Water rights

Water in California, as in the United States in general, is regarded as a good belonging to all and held in trust by the State[8]. Management of water, and allocation of rights to use water, are responsibilities of the individual states. Rights to use water in California comprise a complicated mixture of types, priorities, and levels of security. Groundwater and surface water rights are treated separately, and surface water rights, which are the most important, include both *riparian* and *appropriative* rights. Underlying and articulating the various elements of the allocation scheme are a number of state and federal laws and numerous court cases, each of which establishes precedents upon which subsequent cases build.

Riparian rights to surface streams are available, under common law, to the owners of property abutting streams. Water abstracted under a riparian right cannot be applied to plots of land which do not abut the stream and cannot be transferred to other uses removed from the riparian land. They comprise about 14 percent of rights to non-imported surface water in California.

Appropriative rights to surface water are more flexible and comprise the remaining 86 percent of non-imported surface water rights. Appropriative rights are granted through a permitting process managed by the State of California. Appropriative rights can be for use at points removed from the stream of origin and are subject to transfer and change of purpose. Maintenance of an appropriative water right requires continuous beneficial use, and the courts have held that appropriative rights can be lost after five years of non-use. Riparian rights are neither created by use nor lost by non-use.

Groundwater use is only lightly regulated. There is no permitting process for groundwater exploitation, which is available, in the first instance, to owners of overlying land for reasonable beneficial use on those lands. Groundwater users establish rights simply by use. Rights are correlative with the rights of other owners, meaning that if the water supply is insufficient, the supply must be equitably apportioned. Subject to future requirements on overlying lands, "surplus" groundwater may be appropriated for use on non-overlying lands. Again, no permit is required.

This very vague and permissive specification of rights to groundwater has two important implications. Firstly, as pressure on nearly fully allocated surface water sources continues to build, users turn to groundwater to make up deficits, leading to a serious and growing problem of overdrafting in many portions of the state. Secondly, groundwater is a magnet for litigation as water users joust over such terms as "surplus", "sufficient", "reasonable", "equitable" and "beneficial." Development of a suitable institutional framework for managing groundwater in the state is urgently needed but proceeding slowly.

[8]This is the Public Trust Doctrine, derived from Roman Law.

3.2 Actors

There are seven important groups of actors involved in basin-level water management in California, in addition to the general public. These are the mangers, the service providers, the users, the regulators, advocacy groups, elected officials, and the courts. Some groups, such as regulators, service providers, the courts, and elected officials, consist of both federal and state level actors, while others are purely local. The main actors in each category are discussed briefly below.

3.2.1 Managers

The most important managing organisations are two California state organisations—the Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB). The DWR replaced the Office of the State Engineer in 1956, assuming responsibility for planning and guiding development of the state's water resources. Over the past 45 years it has grown from 450 staff to a level ten times that in 1967 before dropping back, and now employs about 2,000. DWR operates on an annual budget of about $1 billion and is a division of the state public administration under a director who is accountable to the state governor. Its responsibilities are primarily technical and operational, but do include some regulatory functions. Major responsibilities include the following:

- Preparing and updating the California Water Plan every five years
- Operating and maintaining the State Water Project
- Protecting and restoring the Sacramento-San Joaquin Delta
- Dam regulation and flood protection
- Public education
- Providing technical assistance to local communities

The SWRCB performs functions which are managerial, regulatory, and quasi-judicial in nature. It thus occupies a special niche in the overall set-up. Among its important responsibilities are the following:

- Allocating rights to appropriate (use) surface water
- Adjudicating disputes over rights to water bodies, such as the Sacramento-San Joaquin Delta
- Establishing water quality standards
- Guiding and overseeing the nine Regional Water Quality Control Boards

Board appointments are made by the governor and the make up of the Board is as described in the box on the following page.

Regional Water Boards under the SWRCB do not allocate water rights but manage and regulate water quality through the following kinds of action:

- Writing waste discharge permits
- Implementing contamination clean up operations
- Monitoring quality and use of regional groundwater and surface water
- Inspecting discharges and enforcing state and federal water quality laws

Regional Boards consist of five members who are also appointed by the governor.

3.2.2 Service providers

At the basin level, the most important water service providers are the United States Bureau of Reclamation (USBR or "the Bureau") and DWR. The USBR is an agency of the Federal Government housed in the Department of the Interior. The Bureau constructed most of the federally-financed water conveyance and control facilities in the state, including the pivotal Central Valley Project (CVP), and operates the storage and delivery facilities it has constructed. However, while it retains operating responsibility for the upstream portions of the CVP, it has recently transferred operating responsibilities for the portions of the system lying south of the Delta to an association established and controlled by San Joaquin Valley water users, the San Luis-Delta Mendota Water Authority (SLDMWA). Users have proposed that they assume responsibility for the upstream portions as well, but action on that step is more controversial.

The other major water storage and conveyance project in the state, the State Water Project (SWP), is operated by DWR, which constructed the facilities using state resources.

3.2.3 Users

Principal water users are the various districts which purchase water and deliver it to the members or residents in the district. Districts are generally organised to supply irrigation water to farmers or municipal water to urban residents. Districts are incorporated as non-profit entities under state law and are self-governing. The largest share of managed surface water is delivered to agricultural users, most of whom are in the Central Valley. Other users include the state Department of Fish and Game, conservation districts, hydropower facility operators, and DWR and the USBR for flood control operations. Freshwater navigation, though significant in the past, is of minor importance today.

Evolution of a Water Control Agency

1940s Serious water-quality problems emerged in California, including outbreaks of water-borne diseases and degradation of fishing and recreational waters. In 1949 a fact-finding committee highlighted cumbersome and unreasonable laws and administrative procedures, multiple jurisdictions, limited and conflicting interests, and overlapping authorities as roots of the evident problems. The committee concluded that the state's limited water resources could only be extended through planning to maintain water quality while at the same time allowing maximum economic use and reuse. It recommended a central focus point at the state level to co-ordinate water pollution control activities.

1949 Legislation created a **State Water Pollution Control Board** consisting of nine gubernatorial appointees representing specific interests and four ex officio state officials. Its duties included formulating state-wide policy for pollution control and co-ordinating the actions of various state agencies and political subdivisions of the state in controlling water pollution. The same legislation created nine **Regional Water Pollution Control Boards** in major watersheds. These regional boards had responsibility for administration, investigation, and enforcement of the state's pollution abatement programme. Five gubernatorial appointees, representing water supply, irrigated agriculture, industry, and municipal and county government in the region, served on each regional board.

1959 The 1949 law was revised and broadened on the basis of 10 years of experience. State ex officio members were removed from the board, increasing its separation from the state administrative machinery.

1963 The state board was renamed the **State Water Quality Control Board** and given the broader mandate of water quality control, replacing the more limited earlier focus on sewage and industrial waste control.

1967 A proposal to consolidate water-related functions, including water quality control functions, within the Department of Water Resources was rejected on the grounds that this would create conflicts of interest internal to DWR. Instead quantity and quality management functions were consolidated external to DWR by merging the State Water Quality Control Board and the State Water Rights Board into the **State Water Resources Control Board**. The "State Water Board" consists of five full-time members mandated to protect water quality and to determine rights to surface water use. Members are appointed by the governor and fill specialised roles on the Board, e.g. attorney versed in water law, two civil engineers with expertise in water rights and water supply, a water quality member, and a public member.

1969 A new Water Quality Control Act was passed which retained the basic structure of state and regional boards but provided a new regulatory framework for waste discharges to both surface water and groundwater. This act served as a model for the federal Clean Water Act, passed three years later.

Source: http://wwwdwr.water.ca.gov

3.2.4 Regulators

Water-related regulation centres around provisions of federal and state laws, protecting endangered species and maintaining drinking water quality. The federal Endangered Species Act of 1973 is the most important of these and is enforced by the national Environmental Protection Agency (EPA). Of the endangered species affecting water use in California, the most critical are the listed runs of salmon. Technical regulations and certifications relating to salmon are made by the National Marine Fisheries Service (NMFS) while criteria for other animal species are set and supervised by the federal Fish and Wildlife Service.

State environmental regulators also list endangered species, and this list includes some which are not on the federal list. The state Fish and Game Department supervises enforcement of water quality and quantity requirements relating to state-listed species.

The State Water Resources Control Board and its subtended regional boards bear overall responsibility for surface water and groundwater quality in the state. The Federal Clean Water Act and the California Water Quality Control Act, both aimed at pollution control, are enforced by these boards.

3.2.5 Advocates

One of the most dramatic recent changes in the cast of characters in the water drama in California, and in the United States, is the emergence of environmental advocacy groups as potent political actors. Most groups are membership-based and supported and often draw on grants from charitable foundations. Some focus on a single issue—a resource or species—while others have a broader range of interests. The group *Friends of the River* is an example of a resource-focussed group which is largely concerned with restoring free-flowing rivers in California, while the *Sierra Club,* based in California but national in scope, is an example of a group with a wide range of conservation interests beyond water. There are about 20 environmental groups in California interested in water issues. These groups are linked through an *Environmental Water Caucus* which meets every couple of weeks. Accompanying expanded federal and state environmental regulation over the past 25 years has been greatly strengthened requirements for transparency in regulatory processes.

3.2.6 Elected officials

Legislators at both the Federal and State levels write the laws providing the framework for water resource management in the state. Although establishing systems for allocating water resources is in the purview of the state legislature, the federal government exerts a powerful influence on water allocation by applying the terms of the federal Endangered Species Act. This act constrains water-related construction projects in various ways, and can require increased in-stream allocations of water for fish species classed as threatened or endangered. The governor is a particularly important figure in the state water resource management picture, controlling appointments to the State Water Board and the regional Water

Quality Boards and as the head of the state administrative apparatus which includes the important DWR. The US Congress also influences allocation through its ability to mandate changes in water permits which are held on behalf of the US Government by the US Bureau of Reclamation. Water quality is regulated by both federal and state statutes.

3.2.7 Courts

Both State and Federal courts hear cases relating to water. Where the US Government is a party to the litigation, a Federal court must be the venue, as State courts cannot have jurisdiction over the Federal Government. Almost all of the cases heard are civil cases rather than criminal cases, involving disputes between parties rather than violations of state or federal law.

A Federal judge in the Central Valley indicated that about 20 percent of his caseload consisted of water cases, and that the volume of water-related cases had increased considerably over the past nine years. Cases have also increased in complexity. The introduction of the Federal ESA and the listing of a number of fish species in important California rivers have played a major role in this increased complexity. The integration of Public Trust Doctrine into California water law[9] has also made decisions more complicated. Throughout this period of change, the NGO sector has increasingly become a "third presence" in nearly every significant civil case, seeking to include the environmentalist viewpoint into the deliberation.

Major drawbacks to the heavy reliance on the court system for dispute resolution are the often drawn-out nature of proceedings, their expense, and the difficulty of reaching sound decisions through adversarial proceedings. A Federal Judge interviewed cited approvingly an old adage, "hard cases make bad law." Increasingly attention is shifting to various modes of alternative dispute resolution.

3.3 Essential functions

Burton (1999) has identified 11 essential functions of basin management. A somewhat modified listing of these functions is shown in Table 2, crossed with the key actors identified in the previous section. These functions are replicated, as appropriate, across four broad categories—surface water, groundwater, wastewater disposal, and agricultural return flows. Cells are marked to indicate an actor which is active in a particular functional area. Information is drawn from interviews, printed materials and Internet postings. A number of interesting points emerge from an examination of Table 2.

[9]Accomplished by a decision of the state supreme court in 1983 in a suit filed by the National Audubon Society.

Table 2: Essential basin management functions and key actors

Key Actors	Surface Water									Groundwater							Wastewater					Ag Returns			
	Plan (basin-level)	Allocate Water	Construct Facilities	Distribute Water	Maintain Facilities	Monitor Quality	Ensure Quality	Protect Against Flooding	Protect Ecology	Plan (basin-level)	Allocate Water	Construct Facilities	Withdraw/Distribute	Maintain Facilities	Monitor Quality	Ensure Quality	Construct Facilities	Operate Facilities	Maintain Facilities	Monitor Quality	Enforce Quality	Construct Facilities	Maintain Facilities	Monitor Quality	Enforce Quality
Dept of Water Resources	•		•	•				•		•															
WRCB/RWQCBs		•				•	•		•						•	•				•	•			•	•
USBR	○		•	•	•					○												•			
SL-DM Water Authority			○	•	•																	•	•	•	
Irrigation Districts	○		•	•	•	○				○		•	•	•								•	•	•	
Municipal Water Districts	○			•	•	•				○		•	•	•			•	•	•						
Industries	○				•					○		•	•	•			•	•	•						
US EPA/NMFS/FWS CA EPA/FGD									•																
Advocacy Groups (NGOs)	○					○	•		•	○					○	•									
Courts		•					•		•							•					•				•
CALFED	•								•																
U S Congress		○																							

Note: • indicates activity; ○ indicates limited activity.

Note: WRCB = Water Resources Control Board, RWQCB = Regional Water Quality Control Board,
USBR = United States Bureau of Reclamation, US EPA =U S Environmental Protection Agency,
NMFS = National Marine Fisheries Service, FWS = U S Fish and Wildlife Service,
CA EPA = California Environmental Protection Agency, F&GD = California Fish and Game Department,
NGO = (environmental) non-governmental organisations, CALFED = California/Federal Bay-Delta Program.

- A comprehensive planning function rests with the state Department of Water Resources. This responsibility covers surface water and groundwater in both quantity and quality. Although technical analyses and modelling are done by DWR, extensive interaction with a variety of stakeholders in the planning process makes planning a widely shared activity. The primary planning document is the State Water Plan, which is updated in a process led by DWR every five years.

- Surface water allocation and water quality assurance are assigned to a single state agency, which is independent of the other state agencies engaged in planning or system operations. The WRCB is autonomous, though it is political to the extent that the members are appointed by the governor of the state. The U.S. congress assumed a certain amount of *de facto* allocational authority in passing a 1992 law which directed the USBR to reallocate water from agricultural users with whom it held contracts to environmental uses. Federal and state courts also play important roles in the allocational process by resolving disputes over allocation.

- Enforcement of water quality standards rests with nine regional boards with strong local ties but under the overall guidance of the state-level WRCB. The courts also play significant roles in interpreting disputes related to water quality.

- Retail water delivery services are, for the most part, in the hands of user-controlled districts. Such irrigation and municipal water supply districts are financially autonomous and self-regulating. They usually obtain water from wholesale suppliers through legally-enforceable contracts.

- Groundwater is the most lightly-planned and regulated segment of the state's water resources. There is little control over abstractions and the state is in a serious overdraft situation.

- Advocacy groups (environmental NGOs) make up an important third presence in most important disputes involving water. This is a relatively recent development but has profoundly changed the way in which decisions are made, and modified their outcomes. These groups also play important roles in joint consensual processes, such as CALFED and the American River Water Forum, which are being used increasingly to develop mutually acceptable plans and agreements over contentious water-related issues.

- There is a certain conflict within the DWR regarding its dual roles as wholesale supplier of water, water resource planner, and regulator. Transparency of process appears to keep these potential conflicts in check. Although not included in the table there is a significant conflict of interests internal to the U S Army Corps of Engineers, which is charged with wetland permitting and protection, but is primarily a construction and operating agency with close ties to the congressional appropriations process.

3.4 Co-ordinating processes

Managing an important publicly-held natural resource will always involve multiple actors, differing interests and perspectives, and relational dynamics. This is true even in situations where a single agency is responsible for all aspects of basin water management, as there will be winners and losers among users of basin water resources and factions within the managing agency having differing perspectives and interests.

In California, where there are many discrete actors in the water resource allocation and management picture, co-ordination and decision-making have long been critically important functions. Traditionally, the courts, both federal and state, have provided a critical dispute resolution function. As the Sacramento-San Joaquin basin has closed and water become relatively more scarce, disputes have become more frequent and the number of interested parties has grown, making proceedings more complex. There is presently growing interest in various forms of Alternative Dispute Resolution, including the use of mediation, arbitration, and special masters.

There is also growing reliance on processes of shared consensual decision-making to replace the more typical two-stage process of a technical decision made by a government agency, followed by extensive and lengthy litigation initiated by unsatisfied parties. The most prominent example is the ongoing CALFED process, which tackles some of the most contentious water-related problems in the state, as shown in the box at right.

Bay-Delta Problem Areas

- Ecosystem restoration
- Water quality assurance
- Levee system improvement
- Water supply reliability

CALFED is a consortium of federal and state government agencies with management and regulatory responsibilities in the Bay-Delta system. It was formed in 1994 with the mission of developing a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system, the heart of the Central Valley hydraulic system. CALFED spent its first two years identifying and defining problems and a further four years assessing the environmental implications of various actions which might be taken. It is about to begin an implementation phase that could last 30 years and cost $10 billion.

What sets CALFED apart from other programmes is the fact that problems and solutions are being discussed from the outset in an open forum with participation that spans the entire range of water-related interests, and that it is proposing an entire basket of measures which will address the four problem areas in an integrated, complementary, sustainable way. Fundamental principles guiding the process are shown in a second box. Striking is the commitment of all participating parties to make the CALFED approach work. This commitment arises in part from the fear that if the process fails, years of litigation will follow in a far more adversarial process of dispute resolution.

	CALFED Solution Principles	
Affordable	—	solution can be implemented and maintained with the foreseeable resources of the CALFED stakeholders
Equitable	—	solution will focus on resolving problems in all problem areas
Implementable	—	solution have broad public acceptance, legal feasibility and will be timely and relatively simple compared with alternatives
Durable	—	solution will have political and economic staying power
Reduce conflicts	—	solution will reduce major conflicts among beneficial users of water
No redirected impacts	—	solution will not solve Bay-Delta problems by exporting them elsewhere

3.5 Enabling conditions

The essential functions and actors' roles depicted in Table 2 provide a static view of responsibilities. Additional attributes of well-functioning basin governance[10] systems relate to their dynamics. We term these attributes which provide the context for functional performance *enabling conditions.*

Enabling conditions are features of the institutional environment at the basin level that must be present, in some measure, to achieve good governance and management of the basin. These attributes are not specific to any one actor, but apply to all actors and their interactions and comprise necessary (but not sufficient) normative conditions for success. Basic enabling conditions are shown in the box at right. While a full analysis of these factors is well beyond the scope of this paper, a brief sketch of each, in the context of California, is given to illustrate the concepts and indicate broad strengths and weaknesses.

[10]The term *governance* is used is a somewhat different sense here than in Burton's list of essential attributes, of which it is one. Here the term refers to the rules providing the context for multi-actor basin management and the processes and activities engaged in by those actors operating within this set of rules.

3.5.1 Political attributes

Representation is generally well developed, with groups having similar interests allied into various associations. These associations are supported by the members with funds for representation and litigation. Environmental concerns are represented by NGOs which have grown over the past 25 years in number, resources, and influence. Supported by protections provided by federal and state endangered species laws, they now enjoy power commensurate with the other major players.

Enabling Conditions
Political Attributes
Representation of interests
Balanced power
Informational Attributes
Process transparency
Information availability
Information accessibility
Legal Authority
Appropriate institutions
Adequate powers
Resources
Human
Financial
Institutional
Infrastructural

3.5.2 Informational attributes

The availability of information and transparency of decision-making processes in the United States, and in California, has also expanded over the past quarter-century. These changes have been driven by requirements in environmental protection laws, by the existence of the world-wide web, and by growing public demand for information and openness. It is now a rare decision-making process that is not characterised by ready availability of technical information, public hearings, and extensive opportunities for public comment.

3.5.3 Legal authority

The system of water rights, though complex, is relatively well specified in law and through cumulative court decisions. Rights to surface waters are more clearly spelled out than those to groundwater, and the latter area is one where a stronger and more appropriate legal basis is required. There is a sound legal framework underlying user-based districts which provide such services as irrigation, domestic water supply, groundwater management, and wetland conservation. Districts are self-financing and self-governing and generally work effectively.

3.5.4 Resources

Though participants always feel that financial resources are inadequate, both financing and human resources within the basin management system appear generally adequate. There is a well developed physical infrastructure for transferring water around the state, and from neighbouring basins, and a steady stream of additions and improvements to it. Environmental restrictions and concerns, however, make infrastructural design a far more demanding process than it previously was, and have stymied completely some proposed projects, such as the peripheral canal around the delta. New institutional forms (along with a legal basis for them) will likely be required in the future to legitimise and implement consensual agreements reached by ad hoc bodies such as CALFED, but the need for these is still evolving.

4. Salient characteristics of California basin management

A number of important features characterise basin water management in California. These are summarised below.

- **Multiple sources of authority and power.** No single public agency manages water resources in California's river basins. Instead, decisions are made and enforced by a number of state and federal agencies. Integration is provided by the State Water Plan, various regional plans and processes such as CALFED, the centralised system of surface water rights, and the court system.

- **Dynamic interplay of competing interests.** An even broader group of actors participate in and influence decision-making. These actors are from both public and private sectors. They debate in a variety of fora to assert their points of view. These include public hearings, the media, and the courts. Extensive lobbying of public officials also takes place behind the scenes. Decisions emerge from this interplay.

- **Adequate representation of all interested parties.** Major parties in the water debate are well represented and financed. These include municipal water districts, agricultural water districts, public water supply agencies, state and federal environmental regulators, and environmental NGOs.

- **Heavy reliance on legally-enforceable contracts and agreements.** Many of the water-related decisions made take the form of contracts or agreements between two or more parties, rather than administrative decrees. This requires confidence on all sides in the enforceability of the agreements.

- **Separation of operating and regulatory functions.** Regulatory functions are generally handled by organisations which are independent of federal, state, and user-controlled operating agencies.

- **Adequate databases on hydrologic processes and capacity to research new issues.** Extensive measurement and data collection programmes have created a large database of information on California water resources and their uses and impacts. Equally importantly, a strong technical capacity exists in the private sector to conduct additional assessments, on a consulting basis, as needs arise.

- **Open access to information and generally transparent decision-making processes.** Information on water flows, water quality, wastewater quality, water rights, and so on is available to the public and is generally accessible through the world wide web and in publications and public records. Decision-making processes are

generally conducted in the open and include public hearings[11]. Moreover decisions reached are accessible to challenge in court and decisions over controversial issues often are so challenged.

- **Self-financing autonomous districts as retail service providers.** Retail water service delivery is typically handled by irrigation or water districts, which are user-controlled, self-financing, non-profit quasi-municipal entities incorporated under state law. This vastly simplifies the service delivery problem by reducing the number of major "users" to several hundred from tens of thousands.

- **Important role of an impartial court system in resolving disputes.** Federal and state courts are regularly called upon to settle disputes brought to them as civil suits. Without this service, the water resource management system in the state would be unworkable.

- **Well-defined system of water rights (except groundwater).** There is a clear system of allocating and protecting rights to surface water which provides reasonable security to users. Protection of groundwater is presently more problematic.

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[11]As is always the case, real compromises are often hammered out in private by a smaller group of participants. Nevertheless, the compromises reached must be capable of standing up to public and interest group scrutiny when they are announced.

Section E

Case studies of shared river basins

River basins described in this section cross borders between countries, or they are themselves borders between countries

Institutional arrangements are required to prevent conflict about water, and to facilitate orderly and equitable procedures for use and development of their resources

These papers describe two cases from Europe, the Rhine and Danube basins, and two from southern Africa, the general inter-country protocol on shared water, and the specific issues along the Limpopo

German Experiences in River Basin Co-operation

Robert Hollaender
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Bonn, Germany

Abstract

Germany has a long history of gradual development of frameworks for co-operation on shared waterways. Germany's geographical location, with parts of several major trans-boundary river basins in its territory, has stimulated the need for co-operation with neighbours. The paper describes the evolution of co-operative institutions on the Rhine, and draws the lesson from this that these institutions must evolve over long periods of time, as the partners gradually recognise the value of co-operative frameworks. This history also shows that co-operation may develop through addressing one issue at a time, rather than seeking early establishment of a comprehensive framework.

The latter part of the paper reviews Germany's role in recent years in fostering international exchanges of experiences on these issues, and presents summaries of the recommendations of a series of such international meetings.

1. Introduction

Germany has been co-operating with its neighbour countries in various ways for a long time. Due to its geographical location and political development it has a wealth of experience regarding the management of trans-boundary waters. This is based on experiences from water resources management, federal co-operation between individual Federal Länder[1] within Germany, co-operation between Germany and other riparian states on trans-boundary waters, co-operation with other European Union (EU) Member States and co-operation within the European regional organisation of the United Nations, the UN-ECE.

Various parallel uses of waters are the norm in Central Europe. Multiple utilisation of waters can, in principle, lead to conflicts. The fact that such conflicts could be largely avoided or resolved peacefully is due only partly to comparatively favourable climatic conditions. It is mainly due to national and joint efforts to solve water pollution problems. Preventing water pollution is a prerequisite for the multiple utilisation of waters by various parties.

Based on its own experiences, Germany has in the past been involved in a range of international initiatives beyond Europe's borders, as a partner and supporter of co-operation on managing trans-boundary waters. The issue of co-operation on trans-boundary waters is gaining political weight as one of the safety-relevant aspects of international co-operation.

[1]Germany is a federation of 16 states called Länder.

2. Germany's experience

Germany shares its four biggest rivers—the Danube, Elbe, Oder and Rhine as well as a variety of smaller rivers, with its neighbouring countries. Development on the Rhine is in many respects characteristic of the joint use of trans-boundary rivers.

2.1 Historical development of co-operation for the use of the Rhine

For a long time, the most important trans-boundary use was the transport of goods. The Central Commission for Navigation on the Rhine (ZKR), which now has its headquarters in Strasbourg, dates back to the Vienna Congress (1815). With the re-ordering of European politics after Napoleon, the principle of navigational freedom in international waters was also established. A commission was set up to create the possibility of monitoring compliance with common regulations for the Rhine and an opportunity for the riparian states to discuss all issues relevant to navigation on the Rhine.

In 1831, 16 years later, agreement was reached on the first standard principles for navigation on the Rhine. Another 37 years later, the Rhine riparian states transferred sovereign rights (courts with jurisdiction over navigation on the Rhine) to the ZKR with the Mannheim Convention (1868). The majority of these rights still exist today.

Parallel to political development for the promotion of navigation on the Rhine, extensive river training began on the Rhine at the beginning of the 19th century. The aims were to reduce the danger of flooding at certain locations, and to stabilise the river course. This was the subject of widespread political debate. Many landowners, downstream towns and countries fought the plans, because they would have to reckon with loss of land, they feared negative impacts for economic development, or because their territory was affected by an increasing danger of flooding. These objections brought a halt to construction in 1827. Development of the Rhine to stabilise the river course and to regulate the flow rate was continued between 1842 and 1876 only after difficult multilateral negotiations and on the basis of an inter-governmental treaty.

However, negative effects on ecology and navigability were linked to this development. Further development, to secure navigation as far as Basel (in Switzerland) began in 1906, on the basis of inter-governmental agreements, and finished in 1960. In 1974 and 1977 the two final weirs, with locks for generating electricity, were completed.

In addition to its uses as a waterway and for supplying drinking water, the Rhine and its tributaries were also used for the supply of water to industry (in particular the chemicals industry), for energy generation and for draining waste-water from rapidly growing towns and cities, from industry and mining. In the course of development and the increase of pollution, one of the main uses of the water, for fishing, which was still an important source of protein for the population at the beginning of the 20th century, decreased. Traditional professional fishing could not compete against the newly developed industries.

At the beginning of the 20th century, the developing industry and the growing population led to rapidly increasing pollution of water resources in some German tributaries of the Rhine catchment area. This led to tough competition for water among commercial and industrial users. The discharge of pollutants and untreated domestic wastewater resulted in environmental pollution and had negative effects on human health. In order to solve these problems, industrial enterprises and municipalities along these waters formed associations and began to manage the water jointly, with the goal of ensuring a good supply of drinking water for the population both in a quantitative and qualitative sense, and to meet the water requirements of industrial enterprises. These associations still exist today and operate water storage systems and extensive wastewater treatment facilities.

2.2 International co-operation to protect waters

Co-operation between the Rhine riparian states within the framework of the International Commission for the Protection of the Rhine against Pollution (ICPR) began in 1950, initially without the legal framework. In 1963, co-operation was given this legal foundation with a Convention. In 1973, the European Community acceded to this Convention.

A characteristic of the ICPR and other international water protection commissions in which Germany is involved are the relatively small offices with few personnel. The ZKR, with its sovereign duties, has more than double the staff of the ICPR. In the water protection commissions the Member States work together within the framework of action plans and programmes. The programmes are elaborated and adopted jointly and subsequently implemented nationally. The focal points of this work include the rehabilitation of particularly polluted water hot spots, definition of reduction targets for priority pollutants, reduction of diffuse substance pollution, warning and alarm plans in the case of accidents, flood protection, and renaturisation.

These decisions are a matter of recommendations to the negotiating parties, not legally binding agreements. Over a period of several years, however, ministerial conferences of the Rhine riparian states were also held, the results of which have a high degree of political obligation. In addition, special agreements were also adopted for some particularly important issues within the framework of the Rhine Protection Commission. Thus in 1976 a Chemical Convention was signed as well as a Chloride Convention, for which an additional convention was adopted in 1991.

To solve the asymmetrical conflicts brought about by pollution problems (for example the discharge of salt from mines on the Upper Rhine), it has proved very beneficial that the Rhine riparian states not only co-operate with regard to waters, but that as EU Member States, they also have a considerably more wide-reaching interest in co-operation.

Co-operation on the management of trans-boundary rivers in the EU is to be intensified in future and more strongly formalised with the EU Water Framework Directive.

2.3 Other forms of trans-boundary co-operation

As well as the form of governmental co-operation in commissions, there are also a multitude of other forms of trans-boundary co-operation, both regionally and locally, for example hydro-electric power plants on the Rhine, municipal waste-water treatment plants used jointly by communities on the border, joint emergency drills on Lake Constance, and co-operation agreements between companies of the German chemical industry and port authorities in the Netherlands.

2.4 River basins as development areas

In the broadest sense, the Rhine riparian states all had a comparative level of industrialisation. On the whole, the uses of the water have developed in parallel, if not always in agreement. Conflicts and competition for use between the riparian states were primarily quality or pollution conflicts, rather than conflicts concerning shortages or levels.

Today, approximately 50 million people live in the Rhine catchment area. Not only is the river one of the most navigated inland waterways in the world, but also extensive farming and all types of industrial production are carried out in its catchment area. Most German, Swiss and Dutch chemical production occurs in this catchment area. No other river basin in the world has so many chemical plants. Numerous water works use water from the Rhine for drinking water production to supply around 20 million people; industry uses water for production and cooling processes.

After many years of trans-boundary co-operation, the Rhine river basin has become a closely linked, highly developed economic area. Co-operation among the riparian states, regions, municipalities and citizens now comprises all forms of business and cultural exchanges.

3. German initiatives for river basin co-operation

Beginning with the Round Table on global water politics and co-operation for trans-boundary water management, at Petersberg, Bonn in March 1998, a series of conferences has been organised, to promote river basin co-operation, by the German Federal Foreign Office, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry for Economic Co-operation and Development, together with the World Bank. Following the Petersberg Round Table, these continued with a Round Table on the experience of international river and lake commissions, at Villa Borsig, Berlin, in September 1998, and a regional meeting on co-operation in river basins in the Baltic Sea region, at Vilnius, Lithuania, in June 1999.

As well as this series of conferences, Germany hosted a workshop on the role of bi- and multi-national commissions in trans-boundary waters in Bonn in September 1999 within the framework of the permanent Water Management Working Group of the UN/ECE Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes (ECE Water Convention). The principal outcomes of these meetings are summarised in the following paragraphs.

3.1 Petersberg Round Table, 1998

The Petersberg Round Table produced the following recommendations:

- Water should be seen as a catalyst for co-operation. Water alone is not the cause of conflicts. Potential conflict arises only in conjunction with other causes.
- Critical factors for successful co-operation are
  - (a) a shared vision,
  - (b) sustained political commitment and broad-based public support,
  - (c) broad-based partnerships, and
  - (d) environmental management.
- Integrated approaches are required, which should focus on co-operation at the regional level. International river basin commissions are to be supported as facilitators of communications, as a forum for establishing shared goals and for proposing steps to achieve these goals.
- It is important to strengthen institutional frameworks by
  - (a) enhancing confidence-building measures,
  - (b) strengthening legal instruments both regionally and globally,
  - (c) strengthening the capacity of government, in particular in transition and developing countries, and
  - (d) using economic instruments.

3.2 Villa Borsig, Berlin, 1998

Representatives of international river and lake commissions from different regions with varying tasks, methods of working and structures were invited to the exchange of experience at Villa Borsig. The fundamental lessons from the wide spectrum of experience presented included the following:

- A realistic view of the development and environment context is required.
- Commissions are not static in their nature. Conventions and agreements must give consideration to the possibility that the role of commissions could alter or be extended.
- There is no single model or approach to co-operation.

- The development process of conventions and legal instruments is as important as their substantive content.

- Common institutions and administrative structures should be developed in a step-by-step process, corresponding to growing trust and increased experience.

The representatives listed *inter alia* the following points as challenges and issues for the future:

- Changing the paradigm of supply-side management and shifting to integrated water resource management, which incorporates incentive for demand-side management and which can open up new opportunities for trans-boundary co-operation;

- Sharing benefits rather than sharing water, while recognising that agreements on such equitable sharing cannot be static;

- Promoting efficient water use, incorporating the aquatic environment's need for water, taking measures to prevent environmental pollution and to minimise waste-water;

- Considering the effects of development projects on the lower course, estuary and coastal areas, as well as the particular ecological sensitivity of lakes and reservoirs:

- Relations in a catchment area can be disrupted by national development plans of riparian states for exclusive use of common water resources. Consideration should be given to the fact that the capacity to analyse and inform policy positions and decisions varies from country to country;

- Acquiring and sharing information are fundamental and critical factors for the development of trans-boundary waters.

The participants recommended strengthening co-operation of commissions within the framework of the Global Water Partnership (GWP).

3.3 Vilnius, 1999

The Round Table at Vilnius, on experience of trans-boundary co-operation for water management in the Baltic Sea region, served the regional reinforcement of the principles of co-operation elaborated in Bonn and Berlin.

3.4 Bonn, 1999

Representatives of river basin commissions from the ECE area took part in the workshop of the joint commissions of the Water Management Working Group of the ECE Water Convention in Bonn in 1999. The conclusions included the following:

- Co-operation is possible only when parties recognise the principle of a balance of interests, rather than making their own interests absolute priority.

- It is general experience that interests often appear incompatible for individual points. In such cases it can be helpful to deal with several problems together (package solutions). Incorporating issues outside water management is thus possible here.

- Building confidence by dividing more complex amendment processes into stages and small steps is very important. Every goal reached jointly increases the community feeling and makes subsequent co-operation easier.

- With agreements, it sometimes makes more sense to choose a form of regulation which is not necessarily legally or internationally binding. Politically binding arrangements in a more compliant form lead to the development of greater confidence when these arrangements are complied with, although they are not binding in the strictest sense of the word.

4. Conclusions and theses

Our own experiences domestically and the results of German initiatives for river basin co-operation raise the following points for discussion:

- The development of co-operation on trans-boundary river systems requires patience and perseverance. Co-operation in the Rhine basin has a tradition of almost 200 years.

- Co-operation in river basins opens up new, additional economic opportunities. The founding members of the European Economic Community (now the European Union) are all countries from the Rhine catchment area.

- Co-operation in river basins should not be restricted only to government level. Co-operation on many different levels supports economic integration and is beneficial to all riparian states.

- It is important to promote willingness and capacity for comprehensive information exchange between riparian states.

- Various approaches can be used to promote willingness to co-operate among riparian states. In the area of water management, approaches can include joint projects for water protection (e.g. wastewater treatment), traditional water uses (e.g. fishing, transport) or regional development of new uses (e.g. dams for generating energy or developing new irrigation projects). Successful co-operation projects are essential for further co-operation.
- The existence of a comparable level of development is helpful for co-operation between riparian states of a trans-boundary water body. This is not only for economic and social aspects, but also for the strength of state institutions and the capacity to implement provisions and legal conditions included in the field of water management.
- Joint planning processes tend to be initiated for individual goals. This speaks well for step-by-step development. Area-wide and extensive water management planning contains more potential for conflict and is made easier by incorporation into an existing area-wide and extensive co-operation framework.

The Danube River Basin: International Co-operation in Water Management

Wolfgang Stalzer
General Director,
Ministry of Agriculture, Forestry, Environment and Water Management,
Vienna, Austria

Abstract

Co-operation among the countries of the Danube basin has developed gradually over the past two centuries. Navigation was an early subject of collaboration, because of the river's status as a major route across much of southeast and central Europe. Since the political changes in east Europe around 1990, a new era of intensive collaboration has occurred, with the focus now largely on the control of pollution, although navigation remains also an important concern. The paper describes the various agreements, implementing organisations and mechanisms, through which the countries of the basin are currently arranging to institutionalise their responses to these shared concerns.

1. Basic information

The River Danube has the second largest catchment area in Europe, and in yearly flow it is equal to the Volga. Along its 2,870 km long course from the Black Forest in Germany to the Black Sea it touches 10 countries, and a total of 18 countries (Figure 1) contribute to its catchment area of 817,000 km″ (old planimetry). About 83 million people live in the basin. The ethnic, socio-economic and religious background of the Danubian people is also quite diverse. In order to show the spread of the socio-economic side, Romania contains somewhat over a quarter of the people living in the Danube basin, but can presently only contribute 5.7 percent of the GDP (Gross Domestic Product, expressed in hard currency, on an exchange rate basis) created in the basin. In contrast to this, Germany and Austria have 11.0 percent and 9.3 percent, respectively of the Danubian population, but create at present 39.4 percent and 32.5percent, respectively of the Danubian GDP. Expressing the GDP in hard currency and on an exchange rate basis does not show the true picture, and a purchasing-power comparison would in certain respects give a better insight.

Table 1 gives a general overview of key statistics of the basin, and their distribution among the 13 principal flow-contributing countries. The "flow at mouth" is shown as 6,860 m≈/s. It originates predominantly from high precipitation in the Alps, the Dinarian ridge (between the Adriatic Coast and the Sava River) and the Carpathian Mountains. The areas in the upstream states, Germany and Austria, contribute strongly to this flow; the runoff "at mouth" from Austria alone is 22 percent, whereas the territory of Austria is 10 percent of the Danube's catchment area.

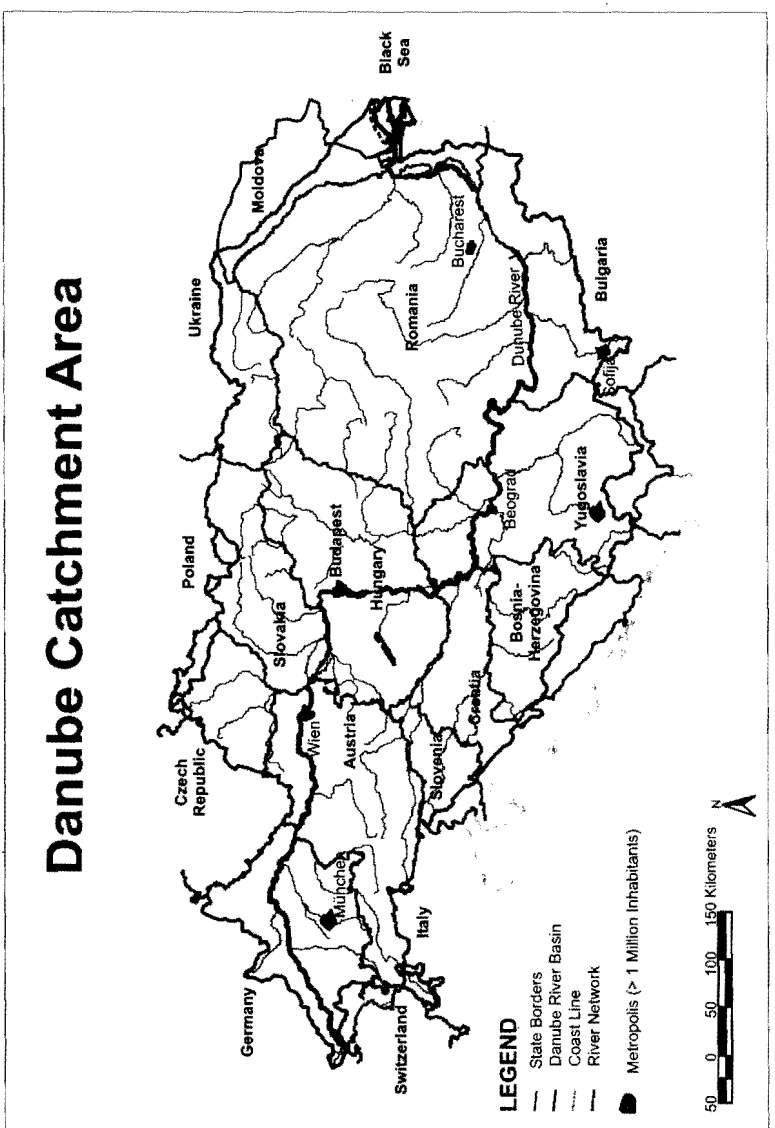
Table 1: Danube river basin: population and economic activities

Country	D	A	CZ	SK	H	SLO	HR	BH	YU	BG	RO	MD	UA	Total
Population in DRB (millions)	9.1	7.7	2.8	5.2	10.2	1.7	3.2	2.9	9.0	3.9	21.2	1.1	3.1	81.1
% of country population	11.1	95.1	27.2	96.3	100	85.0	66.6	76.3	86.5	47.0	93.8	25.8	6.1	36.4
% of DRB population	11.0	9.3	3.4	6.3	12.3	2.0	3.9	3.5	10.8	4.7	25.5	1.3	3.7	97.7
Catchment area (100 km∆)	59.6	80.7	25.6	47.5	93.0	21.8	34.9	31.6	98.1	48.2	232.2	11.6	32.7	817.0
% of DRB area	7.3	9.9	3.1	5.8	11.4	2.7	4.3	3.9	12.0	5.9	28.4	1.4	4.0	100
Run-off contribution (m0/s)	801	1,536	174	324	176	206	388	352	1,093	232	1,177	86	294	6,857
% of DRB discharge	11.7	22.4	2.5	4.7	2.6	3.0	5.7	5.1	15.9	3.4	17.2	1.3	4.3	100
Run-off per person (m0/day)	7.61	17.24	5.37	5.38	1.49	10.47	10.47	10.47	10.47	5.13	4.80	6.76	6.76	7.14
National GDP (billion US$y)	2,034.1	196.1	48.9	19.5	44.5	17.4	18.8	4.1	15.5	9.9	34.6	1.9	49.7	
Annual GDP/person (US$)	25,606	24,691	4,771	3,662	4,382	9,053	3,919	776	1,462	1,118	1,532	1,624	981	
GDP within DRB (Billion $)	225.8	186.5	13.3	18.8	44.5	14.8	12.5	3.1	13.4	4.7	32.5	0.5	3.0	573.4
% of DRB GDP	39.4	32.5	2.3	3.3	7.8	2.6	2.2	0.5	2.3	0.8	5.7	0.1	0.5	
Nitrogen load (100 t/year)	68	77	15	30	31	20	23	36	72	23	121	8	28	551
% of nitrogen load	12.3	13.9	2.8	5.4	5.6	3.5	4.1	6.5	12.1	4.1	22	1.5	5.1	100
Phosphorus load (100 t/year)	3.7	3.8	1.1	1.7	3.8	1.3	2.2	2.2	7.0	4.0	12.7	1.4	4.0	48.9
% of phosphorus load	7.6	7.7	2.2	3.5	7.7	2.7	4.5	4.6	14.4	8.1	26.0	2.9	8.1	100

Legend: Country abbreviations

D	Germany	HR	Croatia
A	Austria	BH	Bosnia-Herzegovina
CZ	Czech Republic	YU	Yugoslavia
SK	Slovakia	BG	Bulgaria
H	Hungary	RO	Romania
SLO	Slovenia	MD	Moldova
		UA	Ukraine

Figure 1: Map of the Danube river basin



The use of water as a basis of life and economic well-being for 83 million people has always been in the forefront. In regard to the River Danube per se, its dominant use as a waterway and the harvesting of its hydropower potential have gone hand-in-hand. Along the main river this potential is big in its upper reach—till downstream from Bratislava, and where the river carves its way through the Carpathian and Balkan mountain chain (the "Iron Gates").

Along the German part of the Danube, 22 power-generating plants have been erected, with a total average capacity of 1,912 GWh per year; between Austria and Germany 1 plant (850 GWh/year); along the Danube in Austria 9 plants (14,274 GWh/year); downstream from Bratislava 1 plant (2,024 GWh/year); and the 2 plants along the Iron Gates (between Romania and Yugoslavia) can generate 11,400 GWh/year. Thus a generating capacity along the main river course of 28,546 GWh/year exists, and more along the tributaries to River Danube.

Inland navigation on the Danube had strong yearly increases, before the Kosovo Conflict. In Austria the transported load was 23 million tonnes/year. Since the spring of 1999, transport along the whole river (between Kehlheim in Bavaria, Germany, and the Black Sea) is not possible, as three wrecked bridges hinder inland navigation at Novi Sad (Yugoslavia). Assuming that the transport route will be free again, it is predicted that by 2010, 35 Mt/year will be transported in Austria.

2. Development of bi- and multi-lateral co-operation in water management

The River Danube has for millennia formed an element that has both separated, and acted as a border, but it has also united. The Danube was, for example, the north-eastern border of the Roman Empire; the Sava-Danube line formed for more than two centuries the border between the Habsburg and Ottoman Empires; the division of Europe during the time of the Cold War split the Danube basin; and the Kosovo Conflict has again shown it as a separating element.

An uniting element of the River Danube has always been its capacity as a waterway. This fact entered into international treaties quite early. During the Congress of Vienna (1815), free navigation on the Danube, as an international waterway was demanded. The Habsburg and Ottoman Empires, which controlled large parts of the river, were not happy about this demand, and it was not fully covered. The transport volume started to increase only with the advent of the steam engine (and later the diesel engine). The actual internationalising of the Danube as a freely accessible waterway occurred after the Crimean War in 1857. In 1948, the Soviet Union, Romania, Bulgaria, Yugoslavia, Hungary and the Czechoslovak Republic signed a further international treaty covering inland navigation along the River Danube. It is valid for the whole navigable course of the river. Since then the seat of the Danube Commission (formally, the Danube Navigation Commission) has been at Budapest.

The aims of the Danube Commission have been and are the following:

- Assuring free access to navigation on the River Danube, in line with the interests and sovereign rights of the riparian states;

- Creating conditions favourable for navigation;
- Ensuring that the Contracting Parties to the Convention keep their national courses of the River Danube navigable;
- Checking and unifying nautical, legal and technical norms.

The number of Contracting Parties has increased since 1948, and it also changed. Austria became a Contracting Party. Then, with the dissolution of the Soviet Union, first Ukraine and later Moldova (after having bought 900 m of shoreline from Ukraine) joined, as well as Germany, and with the disintegration of the former Federation of Yugoslavia, Croatia. The separation of Czechoslovakia into the Czech Republic (non-riparian along the river Danube) and Slovakia transferred Czechoslovakia's rights to Slovakia. The accession of Germany also brought a re-definition of the navigable part of the River Danube. It now begins at Kehlheim (in Germany) and goes via the Sulina Channel in Romania to the Black Sea.

With the opening of the Main-Danube Channel, (connecting the Danube to the River Main which in turn flows into the Rhine), a waterway now exists that stretches from the North Sea to the Black Sea. As soon as the three wrecked bridges at Novi Sad are cleared (which will be undertaken with European Union money) it will again be fully navigable.

Issues of floods and flood protection, irrigation and drainage, and river engineering have usually been dealt with bilaterally (or small-scale multilaterally) between the neighbouring states concerned. The treaties, therefore, were called "border treaties," and relevant commissions were charged to deal with such "border issues." One of the first such treaties in the Danube basin was set up between the Kingdom of Bavaria and the Austrian Monarchy in 1820. Such bilateral treaties were, since 1945, systematically transformed into state treaties to be implemented by Joint Commissions. The relevant "frame" for such treaties varies— they could refer to the border section of a river, to parts of the states concerned, but also to parts of catchment areas. Examples include treaties between Austria and Czech Republic, Austria and Slovakia, Slovenia and Hungary, Hungary and Romania, Slovenia and Croatia, and Croatia and Hungary.

For hydropower uses specific bilateral treaties, dealing with a relevant power station, have been established. Examples of this include hydropower use along the border section of the River Inn, a tributary between Austria and Germany, or the hydropower stations along the Iron Gates between Yugoslavia and Romania. One such international treaty, namely the one between Hungary and Slovakia on the hydropower use below Bratislava and above Nagymaros in Hungary, became internationally known by the one-sided unwillingness of Hungary to fulfil it.

The sufficient quantitative availability of water resources initially limited bilateral and international co-operation to questions of navigation, flood protection and forecast, defining of state borders and marking them in nature, irrigation and drainage, alerting in case of accidents and other emergencies, etc. Only with increased economic growth, that was linked with increased material fluxes and an increased input of

matter into the environment, the trans-boundary issues of water pollution control and the protection of aquatic life have been recognised.

In 1991, a trilateral treaty between Austria, the European Community and Germany entered into force. This treaty was the first one in the upper Danube basin that actually covered issues of water pollution control and the protection of aquatic life through a type of "basin approach" and by co-ordinating the objectives to be achieved by means of emission limitations, the fixing of in-stream targets in flowing water-bodies, the agreeing of the validity of the combined approach, and by introducing an assessment of polluting discharges via an inventory.

3. International co-operation in water management

3.1 Initial period

Regional multilateral and basin-wide international agreements did not come into being due to the geopolitical cleavage during the period of the Cold War. With the exception of navigation on the River Danube, international co-operation in the field of water management was confined to the scientific level, such as the International Association on Danube Research (IAD), and the International Hydrological Decade under UNESCO, which gave rise to the IHP/OHP-Danube. IAD was founded in 1956, under the umbrella of the Societas Internationalis Limnologiae (SIL: International Society for Fluvial Studies); it enabled the exchange of experience and views across the "Iron Curtain."

The co-operation in the frame of IHP/OHP-Danube came into being after the end of the International Hydrological Decade, 1965–1974; it is bound into the work of the UN system (UNESCO; WMO). This international programme links colleagues from the water field working in administration, universities and scientific research institutes, and in their co-operation they cover issues of hydrology, flood forecasts, the riverine regime and sediment transport in the whole Danube basin.

Further initiatives came after the geo-political changes accompanying the dissolution of the Soviet Union. Examples were the Arbeitsgemeinschaft Donauländer, an association of provinces or states along the Danube (the driving forces were Bavaria, Upper Austria, Lower Austria, Vienna and regions along the River Danube) in 1990, and Internationale Arbeitsgemeinschaft der Wasserwerke im Donau-Einzugsgebiet (IAWD), a co-operating body of the water works organisations, in 1993.

Initiatives started at national level just before, during or after 1990, are summarised in the following sections.

3.2 Bucharest Declaration

The Bucharest Declaration was signed in 1985; its aim was to arrive at multilateral co-operation along the main course of River Danube. The activities of the Bucharest Declaration foresaw the following issues:

- The assessment of water quality at "border profiles," which may be a crossing of the river by the border, or, where the border is in-stream, at the beginning or the end of such in-stream border stretches;

- The development of and agreeing on methods for arriving at national River Danube-related water balances, and using the associated data to arrive at a water balance for the whole Danube basin;

- The exchange of national predictions for floods and ice hazards.

The Convention on Co-operation for the Protection and Sustainable Use of the Danube River (Danube River Protection Convention, DRPC)—presented in detail in section 4, below—stated that the work achieved in the framework of the Bucharest Declaration would be taken over into the framework of the DRPC, and this has been undertaken in 2000.

3.3 Helsinki Convention

Based on agreements reached in the CSCE (Council for Security and Co-operation in Europe) Conference on the Environment at Sofia (Bulgaria) in 1989, the Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes (known as the Helsinki Convention) was signed in 1992 at Helsinki (Finland). This is a Framework Convention, and it holds all the kernel elements of a modern tool for water (quality) management, such as the combined approach between the emission and the in-stream principles, combating polluting discharges at source, the preventive principle, the non-allowance of shifting pollution from one environmental sector (for example, water) into another (for example, air), and the need for applying, for example, best available practice in agriculture. This Helsinki Convention is thus a framework that urges the states riparian to international river basins or bordering international lakes to arrive at Conventions for international co-operation, applied to the respective river basin.

3.4 Environmental Programme for the Danube River Basin (EPDRB)

The formulation of the Danube River Protection Convention (DRPC) started in 1990. Parallel to this the multilaterally active donors (knowing that, with the geopolitical changes of 1989/90, a large amount of work was to be undertaken) agreed to bundle their activities, and they thus created at an operational level the Environmental Programme for the Danube River Basin (EPDRB).

The main donors were the European Union, through the Phare-Multicountry Programme and the Tacis Programme (Technical Assistance to the Commonwealth of Independent States: the ex-members of the Soviet Union), the UN / World Bank System, through the Global Environmental Facility (GEF), and smaller donors supplemented. EPDRB started work in 1992. The EPDRB Task Force was the formal decision-making forum on activities to be undertaken, and it united the donors (EU; UN-WB-GEF; European Investment Bank; European Bank for Reconstruction and Development; and others), the states from the Danube basin and NGOs. The states eligible for donor funding were all the "states in transition." The implementation

of the programmes, which had also to be agreed upon by the donors, was in the hands of the Programme Co-ordination Unit (PCU), initially based at Brussels and from August 1994 to the end of October 2000 at Vienna.

The activities initiated covered:

- support for the setting-up of institutions charged with in-stream monitoring (including related quality control and data management) and the setting-up of the warning system;
- preparation and implementation of regional studies, feasibility and pre-investment studies;
- writing of and agreeing on the Strategic Action Plan (SAP) 1994, which introduced water pollution control strategies and was signed at a Ministerial Conference at Bucharest;
- implementation of the SAP via selected projects;
- funding of the PCU.

The SAP itself has the following core elements, in line with the Danube River Protection Convention (DRPC), which in 1994 had not yet entered into force:

- improving of aquatic ecosystems and biological diversity in the Danube river basin, including reduction of the pollution discharged through the River Danube into the Black Sea;
- preserving and improving of deficits in the fields of water quantity and water quality in the Danube river basin;
- avoiding negative impacts of accidents;
- improving regional co-operation in water management.

In the period 1992 to 2000 about US$50 million were donated to eligible states, with the biggest donor being the Phare/Tacis programmes, followed by UNDP/GEF, and other donors. With the entry into force of the International Commission for the Protection of the Danube River (ICPDR: see section 4), all the work achieved under EPDRB has been transferred to the activities of the ICPDR; it will have to be fully integrated in the years in front of us.

3.5 UNDP/GEF: River Danube Pollution Reduction Programme

As mentioned above, UNDP/GEF also participated in the EPDRB. In the period 1997 to 1999, and also in implementing parts of the SAP 1994, the River Danube Pollution Reduction Programme (RDPRP) was funded by UNDP/GEF in eligible states; these eligible states were all the "countries in transition" (including the Federal Republic of Yugoslavia), but not Austria and Germany. The main items of this work related to the assessment—by means of national review workshops, and with donor support to national experts—of polluting discharges (separately for municipal,

industrial and agricultural point-source discharges), their allocation in project files, and the specifying of the relevant socio-economic frame, including the possibilities of funding the implementation of projects. The files contain information not only on point-source discharges, but also on wetland projects, and hints on how the efficiency of national administrations in the water field could be improved through capacity building. The involvement and integration of national experts and of active NGOs into the whole process was carefully considered.

All states in the basin participated in a Trans-boundary Analysis Workshop; the aim of which was the prioritising of the projects according to agreed criteria, such as efficiency, impact on uses or wetlands or protected areas, and also trans-boundary transfer of pollution. The Danube Water Quality Model, set up in this project, with all its remaining deficiencies, was a first trial to utilise such tool, and thus to contribute to the decision-making process.

The RDPRP was finished in 1999, with the following results:

- A knowledge base for priority issues of pollution loads and the environment in the Danube river basin, including a list of hot spots from the main pollution sources;
- The Danube Water Quality Model to give a first estimate, and thus to evaluate the flow of nitrogen and phosphorus through the Danube basin into the Black Sea;
- A revised Strategic Action Plan, prepared as a review of the policy for the Protection of the Danube river basin on the basis of existing analytical documents—National Review Reports and National Planning Workshop Reports;
- A feasibility study on possible new regional financing mechanisms, resulting in a proposal for the creation of a Danube Environmental Financing Facility;
- A project Database containing 421 projects, covering 246 hot spots in the Danube river basin, comprising 192 municipal, 113 industrial, 67 agricultural, 29 wetland-restoration projects and 20 projects classified as general measures, available for financing institutions and donor organisations.

4. Danube River Protection Convention

Based on the UN-ECE-Helsinki Convention of 1992, it was possible at the end of June 1994 to sign the Convention on Co-operation for the Protection and Sustainable Use of the Danube River (Danube River Protection Convention: DRPC) in Sofia, in the context of a Ministerial Conference.

The DRPC entered into force on 22 October 1998, after receiving the required nine relevant ratifications. The DRPC is directly open to all the states in the Danube basin that hold areas above 2,000 km^2 of the Danube's catchment area and are internationally recognised, plus those international bodies to which those Danube

internationally recognised, plus those international bodies to which those Danube basin states have transferred matters of competence contained in the DRPC. By autumn of 2000, the following states have become Contracting Parties (CPs): Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Romania, Slovakia, and Slovenia. The European Community is also a CP. Ukraine is a signatory, and Bosnia-Herzegovina is an observing state. Yugoslavia has asked for access to the convention, and the granting of this will depend on further political developments. This in the end will mean that 13 of the 18 states that contribute to the catchment area of the River Danube will hopefully be co-operating in the future under the common roof of the DRPC.

The objectives of the DRPC can be summarised as follows:

- Striving towards sustainable and equitable water management in the Danube river basin;
- Co-operating on fundamental water management issues in order to maintain and improve the aquatic environment in the Danube river basin;
- Combating water pollution with the aim of sustainability;
- Utilising the water resources potential for municipal, industrial and agricultural needs, and also taking care of the aquatic ecology;
- Maintaining and improving the status of aquatic ecosystems.

In order to achieve these objectives, the following general clauses have been introduced:

- Prevention, control and reduction of trans-boundary impacts;
- Specific water resources protection measures;
- Emission limitations and water quality objectives and criteria;
- Emission inventories, action programmes and progress reviews;
- Monitoring programmes;
- Obligations of reporting;
- Exchange of information;
- Communication, warning and alarm systems, emergency plans; and
- Mutual assistance.

The operational implementation of the DRPC is in the hands of the International Commission for the Protection of the Danube River (ICPDR), which was created with the entry into force of the DRPC. Every Contracting Party has full power to participate in the decision-making process of the ICPDR. The ICPDR has also

given access to its meetings to accredited observers. The Chair in the ICPDR rotates yearly, according to the alphabet (in English). The permanent supporting body of the ICPDR is the Permanent Secretariat, led by the Executive Secretary. The Secretariat has to support all the bodies, i.e. the ICPDR, Expert Groups, etc.

At present the ICPDR has the following Expert Groups:

AEPWS/EG: Accident Emergency Prevention and Warning System Expert Group. It was installed initially under the EPDRB. The main issues it has to cover relate to the assessment and prevention of accidental risks and alerting in case of trans-boundary accidents and emergency situations.

MLIM/EG: Monitoring Laboratory and Information Management Expert Group. It had also initially been installed under the EPDRB. The thrust of its work is on in-stream water quality, i.e. it has to deal with the Trans-national Monitoring Network (TNMN), related analytical questions, and related data handling and assessment.

EMIS/EG: Emissions Expert Group. Its core tasks are the assessing and documentation of polluting discharges (point source and non-point source) and follow-up of the list of projects stemming from the River Danube Pollution Reduction Programme.

S/EG: Strategic Expert Group. It is charged to deal with legal and special issues, in order to prepare decisions by the ICPDR.

Ad hoc EG WFD/RBM. This is the Group charged to deal with the preparations needed for the implementation of the EC Water Framework Directive (see section 5).

In order to ensure an optimal link between the EPDRB and the community of multilaterally active international donors, the ICPDR suggested that the former Task Force of the EPDRB be re-instituted as a special supportive body under the DRPC, and that it be called Programme Management Task Force (PMTF). Its membership comprises nationally delegated members (Head of Delegation; representative of the state charged to co-ordinate national funding issues), the representatives from the donor community, IFIs and NGOs. The tasks of the PMTF comprise co-ordination and implementation of multilaterally fundable activities, and the development of funding schemes for project implementation. The chair of the PMTF has, as yet, been with a representative of the donor community.

After having already co-operated in the interim period, i.e. before the DRPC entered into force, and having had the chance to utilise work funded by the EPDRB, the following results have been achieved:

- Full operation of the Trans-national Monitoring Network. The first yearbook of the TNMN covering all quality data of the year 1996 was prepared.

- Preparation of Emission Inventories of municipal and industrial discharges, allocated by states and by river sub-basins.

- Recommendation concerning treatment of municipal wastewater with suggestions to implement the EC Urban Wastewater Directive, including nutrient removal.

- Guidelines for the monitoring of wastewater discharges, with a view to develop a harmonised approach for future monitoring. The guidelines cover monitoring by Authority, self-monitoring, the storing of samples, the use of standards for sampling and analysis, including data management and reporting to the ICPDR every five years.

- Operation of the Danube accidental emergency warning system (AEWS). In 1999 the AEWS was working over almost the whole Danube basin, except the territories of Bosnia-Herzegovina and Yugoslavia. The AEWS transmitted information on five serious accidents in 1999.

- Installation of the information systems of the ICPDR with a basic level of water-related information from countries situated in the Danube river basin. The homepage of DANUBIS is http://www.icpdr.org/danubis.

- International Co-operation.

- Implementation of the UNDP/GEF Pollution Reduction Programme.

- EU PHARE/TACIS multi-country programme with main components like a feasibility study for regional centres for training of managers and operators of wastewater treatment plants, support of action for MLIM-EG and technical assistance to EMIS-EG and so on.

- Co-operation with the UNEP/OCHA Balkan Task Force, initiated and guided by UNEP and ICPDR. An international expert team conducted a sampling campaign in the vicinity of the war-damaged sites along the Danube. On the basis of this campaign, conclusions concerning the sources of pollution, the effects on environment and human lives, and the necessities of reducing the pollution were adopted.

- Co-operation between the International Commission for the Protection of the Black Sea (ICPBS) and the ICPDR with an ad hoc technical expert group set up from both organisations, and the development of a memorandum of understanding covering several strategic goals including: restoring the ecosystems of the Black Sea states to the condition of 1996; the long-term goal in the whole Black Sea basin to reduce the loads of nutrients and hazardous substances; to assess the ecological status of the Black Sea; and to increase the comparability of the data base.

5. The legal frame of the European Community: The EC Water Framework Directive

Within the European Union (legally: the European Community) agreement about a revision of the legal framework in the field of water protection policy has been

achieved by the passing of the EC Water Framework Directive in the European Parliament, and by the agreement of the Council of Ministers. By the same token the enlargement of the European Union relates to six states (Bulgaria, Czech Republic, Hungary, Romania, Slovakia, and Slovenia) that hold substantial territories in the Danube basin, and Poland is the 7th riparian state of the basin. Thus the territorial frame of the European Union, within which the existing rules have to be applied will be greatly expanded. As yet, only Austria, Germany and Italy, out of the 18 states within the basin, are European Union member states, but if the accession of all the states that have applied for membership proceeds, more than 75 percent of the catchment area of the River Danube will fall under the jurisdiction of the European Union. Other states, for example, Switzerland, hold association agreements with the European Union. This in the end will mean that the already existing binding legal obligations at the level of the European Union will over time expand into the Danube basin. They will for sure determine future developments in the field of water management and river basin management in the Danube basin.

European water policy is in process of being reorganised via the already mentioned EU Water Framework Directive. It is the aim of this Directive to establish a framework of order for achieving a good status in European waters. By doing so, further deterioration is to be avoided and the protection and improvement of the situation of aquatic ecosystems, and of terrestrial ecosystems directly depending on them with regard to their water regime, is to be achieved. The sustainable use of water based on long-term protection of existing resources is to be promoted, and the effects of floods and droughts are to be reduced.

The EU Water Framework Directive defines by the term "good status" a comprehensive protection of water resources, which

- in surface waters, comprises a good ecological status, involving the quality of the structure and the functioning of aquatic ecosystems, and good chemical status, which respects the quality aims to be defined, and

- in groundwater, corresponds to the quantitative and physico-chemical quality criteria.

In artificial or heavily modified water bodies, however, not a "good status," but a "good ecological potential" has to be guaranteed. Artificial or heavily modified water bodies can be made known by EU member states, where changes of artificial or altered characteristics of the water-body have effects on the broader environment, on shipping, on recreational areas, on the purposes for which water is stored—such as, for example, power generation, drinking water supply or other type of use—on regulations, on flood protection, on irrigation, on land drainage or on human development.

With this definition—and thus for waters characterised by excessive human activity—feasible quality aims can be formulated. Thus, particularly in areas and landscapes with intensive human use in water resources management, future-oriented improvements in the ecological sector can be articulated, and for this reason, systematic maintenance or improvement of aquatic ecosystems can be expected.

Consequently, from the point of view of water resources management, the implementation of the targets of the Water Framework Directive is to be adjusted to the relevant river basin, and thus is to be co-ordinated accordingly within this river basin. Although every EU member state is responsible for the implementation of the Framework Directive, the activities relevant for water resources management are to be harmonised and co-ordinated in trans-boundary river catchment areas. The instruments for such co-ordination can be chosen by the states concerned; however, relying on existing bilateral or multilateral treaties is possible. The ICPDR might be, for instance, the international co-operation body, but before deciding upon this future function the structure of the River Basin Management Plan has to be developed, including defining the national duties according to the international level.

Via the establishment of river management plans, in which—apart from a presentation of the characteristics of the river basin unit—there also has to be an analysis of anthropogenic activities and a documentation of protection areas as well as of control and monitoring networks, a uniform planning instrument for European water systems is to be developed. For the implementation of measures to achieve the agreed quality targets or other criteria, relevant programmes of measures have to be developed and must be presented in the management plans as well. The Water Framework Directive, however, also provides that there has to be participation of the public in this process of planning water resources management. This requires relevant documentation, which must also indicate the competent authorities. Homogeneous monitoring of surface water, groundwater, and of protected areas has to be developed. The results of this not only have to serve the respective national levels; they also have to serve the European Union level, in striving for agreed-upon targets. Additionally, the principle of recovery of cost and the polluter-pays principle are not only to be incorporated, but also implemented accordingly. Use has also to be made of the combined approach—i.e., reducing the emissions and at the same time striving to reach quality targets as steering instruments.

Practically, the Water Framework Directive represents a generation treaty with its present deadlines for presenting management plans and targets for a good status, which, in the long run, is intended to guarantee sustainable water resources management, characterised by maintaining a possibly near-natural in-stream quality, and respecting the natural water resources.

The European Community tries to support non-members by association agreements and other measures with a view to the administrative situation of these states in their struggle towards European harmonisation. With regard to the Danube river basin, this holds particularly true for various EU PHARE and TACIS programmes, which, so far, have been administered through the Environmental Programme for the Danube river basin. The development in the Danube basin thus is supported not only by legal instruments, but also by politically driven spending of financial means.

6. What else to come?

In the Danube basin there are a lot of ideas and stimuli in order to arrive at a co-ordinated approach in the field of water pollution control and water management. The geo-political changes in the period 1989 to 1990 and the expansion of the

European Union have opened new dimensions for co-operation. This co-operation will have to be well targeted in regard to the support it gets and how it should be developed. The main legal framework for this co-operation will be that of the European Union, and in this the EC Water Framework Directive (WFD) is in the forefront. The WFD is addressed to EU member states. It seeks to arrive within a set timeframe at a River Basin Management (RBM) Plan, where "River Basin District" covers the basin of a river that discharges into a receiving sea. The water bodies, which such RBM Plans will have to deal with, comprise all surface water bodies, including transitional waters and a part of the relevant shelf area, plus all groundwater. After acceptance by the Commission of the European Communities, the contents of this RBM Plan will be legally binding, and will subsequently have to be implemented within a set timeframe. One important task contained in the WFD is to ensure the needed co-ordination. In international river basins—like the Danube river basin—this co-ordination will be very demanding.

The EC WFD will not only bring obligations; it will also bring new challenges and new chances. This refers primarily to the assuring of truly sustained availability of the resource "water" within the given aquatic ecological frame for the people in the Danube basin, and, by the same token, agreed economic development under sustained environmental conditions.

Referring to the Berlin International Round Table, the following challenges can be formulated for the Danube river basin:

- The state of knowledge on the relations in aquatic ecosystems, from the river corridors to the receiving rivers, apart from proven water protection measures such as the reduction of point loads, requires new strategies and approaches for reducing diffuse loads.

- The pathways and the transport mechanisms of pollution loads in large river basins, such as the Danube river basin, are active for a long time, sometimes for decades. Thus, aiming at sustainability requires long-range planning, oriented far into the future.

- Trans-boundary water management must consider the changes of socio-political values and has to be adjusted to the sustainable treatment of the resource water. Individual interests, such as claims for utilisation and needs for protection, have to be adjusted through integral water resources management.

- International water commissions offer themselves as the bodies to deal with trans-boundary water resources management. In order to guarantee the necessary co-ordination, however, they require

  - careful shaping of administrative structures;

  - sustainable financing of the necessary administration;

  - national and external support.

- International co-operation for guaranteeing sustainable water management, however, needs

  agreement on the meaning of terms, and use of language by which it can be made sure that each partner understands the same;

  trust and openness on the part of all partners to establish monitoring and information systems;

  a definition of common criteria for data, their interpretation and the measures to be taken, derived from agreed data interpretation.

- Trans-boundary water management must be based on harmonised targets such as sustainability and safeguarding of the natural framework conditions as regards quantity and quality. The necessary basic principles like the precautionary principle, the polluter-pays principle, the willingness to cover the costs and cost efficiency, etc., have to be incorporated. Water resources management itself has to move from the supply side to the management of actual demand.

- A modern water protection policy needs participation of the public and related transparency.

- Water protection is a task of the community and serves public welfare. Its implementation needs a levelling out of burdens, and national as well as international support.

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Revised Protocol on Shared Watercourses in the Southern African Development Community

E. M. Mokuoane
Water Sector Co-ordinating Unit
Southern African Development Community
Maseru, Lesotho

Abstract

The paper describes recent progress by states of the Southern African Development Community towards establishing an agreed set of rules and institutions for the management of trans-boundary river systems. A protocol was established initially among 10 states of the region in 1995, and was further revised in 2000. The paper presents the general principles underlying the protocol, and the special provisions incorporated into the revised version.

Institutions established in connection with the implementation of the protocol are discussed, in particular the role of the Water Sector Co-ordinating Unit. The paper ends with a short presentation of progress in formulating a Regional Strategic Action Plan.

1. Background

The Southern African Development Community (SADC) is a regional grouping of 14 sovereign member states with one common goal of regional integration on the basis of balance, equity and mutual benefit for all peoples of the region. The grouping was formalised by the signing of the declaration and treaty (the SADC Treaty) on 27 August 1992 in Windhoek, Namibia by the then 10 member states, Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia, and Zimbabwe. The other four member states, Mauritius, Democratic Republic of the Congo, Seychelles and South Africa joined later by accession to the treaty. The treaty is the single most important document that outlines the vision, overall objectives and institutional framework of SADC.

Article 22 (1) of the Treaty provides for member states to conclude a series of protocols to spell out the objectives, scope of and institutional mechanisms for co-operation and integration. These protocols are developed, negotiated and agreed upon, covering various areas of co-operation, identified in article 21 (3) of the treaty. Each protocol, after negotiation by member states and approval and signing by a summit, becomes an integral part of the treaty. The SADC Protocol on Shared Watercourse Systems is based on this provision and it takes its power from it.

This protocol was developed as an offshoot of the development of one of the SADC projects under a broad programme called the Zambezi River Action Plan (ZACPLAN). The programme is made up of 19 projects called ZACPLAN Projects (ZACPROs in short). Project number two of the programme, ZACPRO 2 was the

Development of an Institutional and Legal Framework for the Management of the Zambezi River Basin. It was during the process of developing this project that member states felt that it would be improper to develop legal instruments for one basin, when there was no over-arching legal framework for the management of shared river basins within the SADC region. This was done in consonance with the provisions of the then newly signed treaty establishing SADC, as outlined above.

After several consultations and negotiations, starting in 1993, the protocol was finally signed by 10 member states, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, in Johannesburg, South Africa, on 28 August 1995. The development process had also included the carrying out of an analysis of national water legislation in SADC member states. The process of ratification was then initiated and the protocol came into force on 29 September 1998, after being ratified by the two-thirds of the signatory member states.

In the interim period other developments took place which will have a lasting impact on the protocol and its implementation. The most important of these developments was the establishment of a distinct and dedicated Water Sector Co-ordinating Unit by Council and Summit at their meeting in Maseru, Lesotho, in August 1996. Prior to the establishment of the Water Sector Co-ordinating Unit, regional water resources issues were carried out under the auspices of the SADC Environment and Land Management Sector.

The second development was the adoption of the United Nations Convention on the Law of the Non-navigational Uses of International Watercourses, in April 1997. These and other developments have led to significant amendments to the protocol as will be highlighted in the following paragraphs and sections below. A Protocol Implementation Programme was also developed during the process of ratification, was approved by the Water Resources Technical Committee in 1997, and has been included within the context of the Regional Strategic Action Plan on Integrated Water Resources Development and Management.

2. Provisions of the protocol and their implications

2.1 Outline

The SADC Protocol on Shared Watercourse Systems, the first-ever-sectoral legal instrument in SADC, was greatly influenced by various international water law instruments such as the Helsinki rules, the Dublin Principles, and Agenda 21. It recognises the international consensus on a number of concepts and principles related to water resources development and management in an environmentally sound manner.

The SADC Protocol on Shared Watercourse Systems covers all uses of surface water, including agricultural, domestic, industrial, and navigational uses. It follows principles laid out in international rules and conventions and is premised on the effort to maintain a balance between development needs in the national interest of member countries, and the needs for conservation and sustainable development. It aims to achieve and maintain close co-operation between member countries.

The protocol sets out rights and obligations of member states in respect of shared watercourse systems in the SADC region. The protocol can be divided into four main sections composing a total of 17 articles. These main sections are:

- Interpretation of terms and concepts;
- General principles;
- Institutional framework for implementation;
- Monitoring and dispute settlement.

2.2 Interpretation of terms and concepts

This section interprets the various terms and concepts that are used in the body of the protocol in order that there can never be misinterpretation of these terms as they are read in the protocol. About 14 concepts and terms are defined, covering areas of uses, and physical and management aspects of the protocol. These form a very important part of the protocol especially in relation to its implementation and dispute settlement.

This section was a subject of long and serious discussions and negotiations during the development of the protocol and during the subsequent amendment process. To this effect, three negotiations and consensus-building workshops were held, to try to come up with a set of definitions that would be acceptable to all parties, and would portray the meanings of concepts and terms, capturing the spirit of the protocol and the treaty. As has been mentioned above, some of the concepts take cognisance of and bear a strong influence of international legal instruments on the subject.

As a result of the amendment process, several terms have been enhanced or replaced by others that give a better representation of the provisions of the protocol. For instance the terms "basin", "basin state", and "drainage basin" have been replaced by the new concepts of "watercourse" and "watercourse state" which by definition covers the intended meanings ascribed to them. Other new terms have been introduced or their meanings expanded and subsequently defined, such as "environmental use."

2.3 General principles

The following is a summary of the general principles that guide the protocol and its implementation arrangements.

- Respect for the sovereignty of member states in the utilisation of shared watercourse.

  This principle recognises the right of member states to develop resources of shared watercourses within their territory. The principle stipulates, without necessarily being restrictive, the uses to which these waters can be put. These include agricultural, domestic, industrial,

and navigational uses. This differs slightly from the United Nations Convention, in that it includes navigational uses. Other uses are introduced, such as "environmental use" to enhance the practicality of this principle, especially for implementation.

- Application of rules of general or customary international law, community of interest and equitable utilisation.

  Member states party to the protocol undertake to apply in their respective water laws existing rules of customary international law, as well as respecting the community of interest in equitable utilisation of the shared watercourses. This is an important recognition of the responsibility of member states towards equitable utilisation of the resources of shared watercourses.

- Maintaining a proper balance between development and environment protection and conservation.

  This is a principle that recognises the importance of member states developing their resources in order to uplift the livelihoods of their citizens, while on the other hand protecting the environment that yields the resources. Member states here undertake to apply the principle of sustainable development.

- Co-operation on joint projects and studies.

  This principle is in support of the overall objective of SADC of co-operation in various fields of economic development. This is important to prevent potential conflicts that might arise as a result of uncoordinated development of shared watercourse systems and competing demands.

- Information and data sharing.

  This is strongly related to the above principle and is aimed at levelling the playing field and creating an enabling environment for negotiations for equitable utilisation of shared watercourses. The development of the SADC Hydrological Cycle Observing Systems (SADC-HYCOS) will go a long way in trying to address this issue. Information sharing is central to the co-operation and economic integration envisaged by the treaty.

- Equitable and reasonable utilisation of shared watercourse systems.

  Here member states undertake to use the resources of shared watercourse systems in an equitable and reasonable manner. This is in line with international water law principles such as the Helsinki rules and the UN Convention. Several aspects must be taken into consideration in order to achieve equity and reasonable sharing. Some of these are the natural physical characteristics of the watercourse, social and economic needs, existing and potential effects of the intended use, and guidelines and agreed standards of use.

- Use of discharge and abstraction permits or licences.

  This confers some responsibility on member states to regulate the use of the watercourse to ensure that adequate protection is given to the resource. This is already a practice in most member states although the level of enforcement differs from one state to the next. This principle supports the polluter-pays principle that is gaining acceptance in the global water sector. Monitoring for compliance and enforcement at the national level is very important for this to have any significant impact at a regional level.

- Obligation to notify about emergency situation, protection against pollution and use of installations for peaceful purposes.

  Signatories to the protocol have responsibility to notify potentially affected states about an emergency that originates in their territory and to take any necessary measures to ameliorate the impact of the situation.

  The principles are covered under the last paragraph of the Article 2 of the protocol. If the above principles are adhered to, the protocol will be easily implemented at both national and regional levels.

2.4 Institutional framework for implementation of the protocol

The protocol sets out an institutional framework necessary for effective implementation of the various provisions such as the ones mentioned above. The member states, signatories to the protocol and those that subsequently acceded to it, undertook to establish the institutions. These are:

a) A Monitoring Unit based at the Water Sector Co-ordination Unit;

b) River Basin Commissions between Basin States and in respect of each drainage basin (e.g. the Zambezi River Basin Commission, ZAMCOM);

c) River Basin Authorities or Boards in respect of each drainage basin.

The protocol elaborates objectives and specific functions of the proposed river basin management institutions. The objectives cover issues of monitoring, policy development, promotion of equitable utilisation, formulation of strategies and monitoring execution of joint development plans in shared watercourse systems. This is the functional part of the protocol and is the most important to address in the implementation of the protocol, both at national and regional levels.

2.5 Monitoring and dispute settlement

Monitoring for compliance in the implementation of the protocol is entrusted to the various institutions that will have been established.

The settlement of disputes, when they occur, was to follow the spirit of the treaty, that is amicable settlement, failing which arbitration can be pursued. Disputes that cannot be settled amicably will be referred to the SADC Tribunal for adjudication under Article 16 (1) of the treaty. Council can also be requested to render an advisory opinion in accordance with Article 16 (4) of the treaty. In the case of disputes being referred to the tribunal, the tribunal shall render a final and binding opinion.

3. Revisions of the protocol on shared watercourses in the SADC Region

3.1 Background

Following recent developments in the implementation of the protocol or in preparation for its implementation, substantial amendments have been made to it, which have implications for its implementation. The SADC Protocol on Shared Watercourse Systems has undergone several amendment workshops. This was to address the concerns expressed by Angola and Mozambique during the time of signing.

The Council then directed the SADC Secretariat and SADC Water Sector Co-ordinating Unit to solicit more concerns from member states, if any, and hold workshops to address them. Member states submitted their comments as requested and they were discussed on three different workshops. Consensus on the document was reached in the fifth and last workshop that was held in Johannesburg, South Africa, in March 2000.

Two documents were produced during that workshop, namely: The Amendment Protocol and the Consolidated Version Containing Original Provisions and Proposed Amendments.

3.2 Outline of the revised protocol

The revised protocol has six major sections:

- Interpretation of terms
- General principles
- Specific provisions
- Institutional framework for implementation
- Shared watercourse agreements
- Settlement of disputes

3.3 General principles

The principles still convey the same message as in the original protocol, but in this document they have been elaborated further for better understanding. The following is the list of principles and it will be recognised that they have the similarity with the original document.

- The state parties recognise the principle of the unity and coherence of each shared watercourse, and in accordance with this principle, undertake to harmonise the water uses in the shared watercourses and to ensure that all necessary interventions are consistent with the sustainable development of all watercourses' states and observe the objectives of regional integration and harmonisation of their socio-economic policies and plans.

- The utilisation of shared watercourses within the SADC region shall be open to each watercourse state, in respect of the watercourses within its territory and without prejudice to its sovereign rights, in accordance with the principles contained in this protocol. The utilisation of the resources of the watercourses shall include agricultural, domestic, industrial, navigational and environmental uses.

- The state parties undertake to respect the existing rules of customary or general international law relating to the utilisation and management of the resources of shared watercourses.

- State parties shall maintain proper balance between resource development for a higher standard of living for their people and conservation and enhancement of the environment to promote sustainable development.

- State parties undertake to pursue and establish close co-operation with regard to the study and execution of all projects likely to have an effect on the regime of the shared watercourse.

- State parties shall exchange available information and data regarding the hydrological, hydro-geological, water quality, meteorological and environmental condition of shared watercourses.

3.4 Specific provisions

The specific provisions in the revised protocol are:

3.4.1 Planned measures

(a) Information concerning planned measures

State parties shall exchange information and consult each other and, if necessary, negotiate the possible effects of planned measures on the condition of a shared watercourse.

(b) Notification concerning planned measures with possible adverse effects

Before a state party implements or permits the implementation of planned measures which may have significant adverse effects upon other watercourse states, it shall provide those states with timely notification thereof. Such notification shall be accompanied by available technical data and information, including the results of any environmental impact assessment, in order to enable the notified states to evaluate the possible effects of the planned measures.

(c) Period for reply to notification

(i) Unless otherwise agreed, a state party providing a notification under paragraph (b) shall allow the notified states a period of six months within which to study and evaluate the possible effects of the planned measures and communicate the findings to it;

(ii) This period, shall at the request of a notified state for which the evaluation of the planned measures poses difficulty, be extended for a period of six months.

(d) Obligations of the notifying state during the period for reply

During the period referred to in paragraph (c), the notifying state:

(i) shall co-operate with the notified states by providing them, on request, with any additional data and information that is available and necessary for an accurate evaluation; and

(ii) shall not implement or permit the implementation of the planned measures without the consent of the notified states.

(e) Reply to notification

The notified states shall communicate their findings to the notifying state as early as possible within the period applicable pursuant to paragraph (c). If a notified state finds that implementation of the planned measures would be inconsistent with the provisions of Article 3 (7) or (10), it shall attach to its findings a documented explanation setting out the reasons for the findings.

(f) Absence of reply to notification

(i) If, within the period applicable pursuant to paragraph (c), the notifying State receives no communication under (e), it may, subject to its obligations under Article 3 (7) and (10), proceed with implementation of the planned measures, in accordance with the notification and any other data and information provided to the notified states.

(ii) Any claim to compensation by a notified state which has failed to reply within the period applicable pursuant to paragraph (c) may be

offset by the costs incurred by the notifying state for action undertaken after the expiration of the time for a reply which would not have been undertaken if the notified state had objected within that period.

(g) Consultations and negotiations concerning planned measures

(i) If a communication is made under paragraph (e) that implementation of the planned measures would be inconsistent with the provisions of Article 3 (7) or (10), the notifying state and the state making the communication shall enter into consultations and, if necessary, negotiations with a view to arriving at an equitable resolution of the situation.

(ii) The consultations and negotiations shall be conducted on the basis that each state must in good faith pay reasonable regard to the rights and legitimate interests of the other states.

(iii) During the course of the consultations and negotiations, the notifying state shall, if so required by the notifying state at the time it makes the communication, refrain from implementing or permitting the implementation of the planned measures for a period of six months, unless otherwise agreed.

(h) Procedures in the absence of notification

(i) If a state party has reasonable grounds to believe that another watercourse state is planning measures that may have a significant adverse effect upon it, the former state may request the latter to apply the provisions of paragraph (b). The request shall be accompanied by a documented explanation setting forth its grounds.

(ii) If the state planning the measures finds that it is not under an obligation to provide a notification under paragraph (b), it shall so inform the other state, providing a documented explanation setting forth the reasons for such finding. If this finding does not satisfy the other state, the two states shall, at the request of the other state, promptly enter into consultations and negotiations in the manner provided in sub-paragraphs (i) and (ii) of paragraph (g).

(iii) During the course of the consultations and negotiations, the state planning the measures shall, if so requested by the other state at the time it requests the initiation of consultations and negotiations, refrain from implementing or permitting implementation of those measures for a period of six months unless otherwise agreed.

(i) Urgent implementation of planned measures

(i) In the event that the implementation of planned measures is of the utmost urgency in order to protect the public health, public safety or other equally important interests, the state planning the measures may, subject to paragraph 7 and 10 of article 3 (7) and (10), immediately

proceed to implementation, notwithstanding the provisions of paragraph (d) and sub-paragraph (iii) of paragraph (g).

(ii) In such case, a formal declaration of the urgency of the measures shall be communicated without delay to the other watercourse states referred to in paragraph (b) together with the relevant data and information.

(iii) The state planning the measures shall, at the request of any of the states referred to in paragraph (ii), promptly enter into consultations and negotiations with it in the manner indicated in sub-paragraphs (i) and (ii) of paragraph (g).

3.4.2 Environmental protection and preservation

(a) Protection and preservation of ecosystems

State parties shall, individually and, where appropriate, jointly, protect and preserve the ecosystems of shared watercourses.

(b) Prevention, reduction and control of pollution

i. State parties shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution and environmental degradation of shared watercourses that may cause significant harm to other watercourse states or to their environment, including harm to human health and safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse.

ii. Watercourse states shall take steps to harmonise their policies and legislation in this connection.

iii. State parties shall, at the request of any one or more of them, consult with a view to arriving at mutually agreeable measures and methods to prevent, reduce and control pollution of a shared watercourse, such as:

- setting joint water quality objectives and criteria;

- establishing techniques and practices to address pollution from point and non-point sources;

- establishing lists of substances in the introduction of which, into the waters of a shared watercourse, is to be prohibited, limited, investigated or monitored.

(c) Introduction of alien or new species

State parties shall take all measures necessary to prevent the introduction of species, alien or new, into a shared watercourse which

may have effects detrimental to the ecosystems of the watercourse resulting in significant harm to other watercourse states.

(d) Protection and preservation of the aquatic environment

State parties shall individually and, where appropriate, in co-operation with other states, take all measures with respect to shared watercourses that are necessary to protect and preserve the aquatic environment, including estuaries, taking into account generally accepted international rules and standards.

3.4.3 Management of shared watercourses

(a) Management

Watercourse states shall, at the request of any of them, enter into consultations concerning the management of a shared watercourse, which may include the establishment of a joint management mechanism.

(b) Regulation

(i) Watercourse states shall co-operate, where appropriate, to respond to needs or opportunities for regulation of the flow of the waters of a shared watercourse.

(ii) Unless otherwise agreed, watercourse states shall participate on an equitable and reasonable basis in the construction and maintenance or defrayal of the costs of such regulation works as they may have agreed to undertake.

(c) Installations

(i) Watercourse states shall, within their respective territories, employ their best efforts to maintain and protect installations, facilities and other works related to a shared watercourse.

(ii) Watercourse states shall, at the request of any of them, which has reasonable grounds to believe that it may suffer significant adverse effects, enter into consultations with regards to:

- the safe operation and maintenance of installations, facilities or other works related to a shared watercourse; and

- the protection of installations, facilities or other works from wilful or negligent acts or the forces of nature.

(iii) Shared watercourses and related installations, facilities and other works, shall enjoy the protection accorded by the principles and rules of international law applicable in international and non-international

armed conflict and shall not be used in violation of those principles and rules.

3.4.4 Prevention and mitigation of harmful conditions

(a) State parties shall individually and, where appropriate, jointly take all appropriate measures to prevent or mitigate conditions related to a shared watercourse that may be harmful to other watercourse states, whether resulting from natural causes or human conduct, such as floods, water-borne diseases, siltation, erosion, salt-water intrusion, drought or desertification.

(b) State parties shall require any person intending to use the waters of a shared watercourse within their respective territories, for purposes other than domestic or environmental use, or who intends to discharge any type of waste into such waters, to first obtain a permit, licence or other similar authorisation from the relevant authority within the state concerned. The permit or other similar authorisation shall be granted only after such state has determined that the intended use or discharge will not cause significant harm to the regime of the watercourse.

3.4.5 Emergency situations

State parties shall, without delay, notify other potentially affected states, the SADC Water Sector Co-ordinating Unit and competent international organisations of any emergency situation originating within their respective territories, and promptly supply the necessary information to such states and competent organisations with a view to co-operating in the prevention, mitigation, and elimination, of the harmful effects of the emergency.

4. Role of the Water Sector of SADC

4.1 Goals

The vision of the water sector is:

To attain the sustainable, integrated planning, development, utilisation and management of water resources that contribute to the attainment of SADC's overall objective of an integrated regional economy on the basis of balance, equity and mutual benefit for all member states.

The overall objective is:

To promote co-operation in all water matters in the SADC region for the sustainable and equitable development, utilisation and management of water resources, and contribute towards the uplifting of the quality of life of the people of SADC region.

4.2 Functions of the Water Sector Co-ordinating Unit

The role of the SADC Water Sector Co-ordinating Unit is primarily one of stimulating and facilitating development and co-operation in the region. In order to achieve this, the Water Sector Co-ordinating Unit:

(a) Co-ordinates water resources research and development, including appropriate technological development, data and information collection, processing and dissemination among member States;

(b) Facilitates integrated planning, development, management and utilisation of water resources at both the national and regional levels;

(c) Monitors the implementation of the protocol and assists in resolving potential conflicts on shared water resources;

(d) Facilitates identification and preparation of regional water resources programmes and projects;

(e) Mobilises resources (financial, human and institutional) including the appointment of Technical Assistance and Consultancy services for the implementation of approved regional programmes;

(f) Co-ordinates the implementation, operation and maintenance of regional projects;

(g) Provides advice and guidance on equitable water resources allocation among riparian countries;

(h) Facilitates human resources development, capacity building and institutional strengthening at both national and regional levels;

(i) Promotes joint and cross-border water resources development and investments, and provides guidance on cost-sharing arrangements;

(j) Advises on policy and cross-border water resources development and investments;

(k) Promotes the participation by all relevant stakeholders in water resources development and management at both national and regional levels;

(l) Provides strategic leadership in the development and management of water resources, including the development of appropriate policies and strategies at regional level;

(m) Facilitates the establishment of shared river basin institutions where required and strengthening of their capacities where they do exist.

5. Regional strategic action plan

The Regional Strategic Action Plan (RSAP) is a programme consisting of several regional projects. The United Nations Development Programme (UNDP) funded this programme for the Water Sector to be in a position to hold the first Water Round Table Conference.

UNDP funded the consultants to assist the member states to prepare Country Situation Reports and to come up with the projects that they wanted. The Water Sector Co-ordinating Unit engaged a consultant to propose a comprehensive programme, the RSAP. This consultant was funded by the UNDP. There were many projects that the member states submitted to the Water Sector Co-ordinating Unit (WSCU), and the consultant produced a list of 31 priority projects of regional nature. Out of these 31 projects, 10 were fast-tracked to level the playing field for the remaining 21.

UNDP funded the Water Round Table Conference in Geneva, Switzerland, in December 1998. This Round Table Conference was very fruitful, since most of the co-operating partners attended it and showed their interest in the various projects. At the moment, all these projects are in the form of Project Concept Notes (PCNs) for anyone interested to have an understanding of what they are about. The Co-operating Partners in collaboration with the Water Sector prepared these PCNs. Some of the PCNs are in a process where terms of references are being prepared in order to come up with fully-fledged project proposals.

Overview of Experiences in the Limpopo River Basin

Thomas Schild
Team Leader, German Agency for Technical Co-operation (GTZ), Windhoek, Namibia

Abstract

The paper presents a summary of the findings of a German mission to four countries of Southern Africa, in which many people at different levels were asked to give their views about water issues in two trans-national river basins, the Limpopo and the Orange-Senqu. The principal common factors in people's responses are identified. Various sources and types of inequity are described. In conclusion, it is found that external assistance could be especially useful in areas of information and communication, and in organisational development for river-basin management.

1. Context

A mission by a project appraisal team of the German Agency for Technical Co-operation (GTZ) was carried out in September 2000, for the support of regional water management in the SADC (Southern African Development Community) region. The team talked to stakeholders of the Limpopo and the Orange-Senqu river basins.

The mission had the following major tasks;

- Map the scene;
- Capture the expectations and issues of concern of the stakeholders with regard to the establishment of river basin commissions;
- Identify possible areas for technical co-operation;
- Make preparations for the planning workshop.

2. Procedures

Between 14 and 29 September 2000, the group visited Zimbabwe, Mozambique, Botswana and South Africa and held discussions with relevant government institutions, parastatals and donor organisations involved in water resources management of the Limpopo and, where applicable, of the Orange/Senqu. Other resource persons, such as representatives of water users' organisations, researchers, non-governmental organisations (NGOs) and consultants were met. Similar talks will be held in Namibia in October 2000.

3. Purpose of the presentation

The purpose of this presentation is to address the first two major tasks. Emphasis is laid on the presentation of voices captured from stakeholders in the Limpopo basin. The audience is asked to respond.

4. General observations

The mission recorded the following general observations:

- A broad consensus exists about the principles of common management of shared watercourses.
- There is a high degree of solidarity among the riparian states.
- The authorities acknowledge that in future regional prerogatives will be given higher priorities than national interests.
- It is expected that the creation of river basin commissions will enhance further co-operation and contribute to avoiding conflicts.
- There is a felt need to build up trust and confidence amongst the institutions involved in the water sector of the riparian countries.
- In spite of their different historic backgrounds, and socio-economic and political conditions, the riparian states share a common vision with regard to the development of their national water sectors.

5. Mapping the scene

5.1 Problems in the catchment areas

In all the riparian countries visited by the mission, the contacted institutions and resource persons mentioned problems that reflected their specific interest in sharing the water resources. Nevertheless, there was a great similarity among the issues raised.

The natural conditions found in the shared river basin and the capacity imbalances with regard to technical and managerial issues lead to stresses, which cause particular impacts. The main items in each of these categories are shown in Table 1.

5.2 Stresses in the catchment areas

The following stresses were mentioned:

- low flow or dry rivers during long drought seasons
- unexpected high floods in the lower parts of the basins
- increasing water pollution

Table 1: Capacity imbalances in the riparian countries

Natural conditions	Technical problems	Managerial problems
High temporal and spatial variation of rainfall	Uneven standards of infrastructure	Unequal economic standards
Areas affected by saline groundwater	Different degrees of exploitation (development) of the water resource potential	Unequal negotiation skills
Variation of climate from humid to arid	Unequal potential for water use	Lack of early warning system (quantity and quality)
Unequal physical potential for water use (hydrological, morphological)	Water use without considering trans-boundary impacts (dams, intakes, outlets)	Deficiency of exchange of data and information between member states, e.g. gauges, water resources development
		Unequal water resources management capacity access to data monitoring capacity (quantity, quality)
		No common management of dams (flood protection, drought prevention)

5.3 Impacts

Informants mentioned the following impacts of water, on the people and on their environment:

- negative impacts on the environment, especially in those parts of the rivers, which become dry during some time of the year and on the ecosystems of the estuaries (affecting clam and prawn cultures) through salt-water intrusion
- further degradation of biodiversity
- flood damages with high destructive power causing high costs to the economy
- reduced potential for economic development
- unequal access to water resources for
  - human consumption
  - irrigation

- animal production
- industrial development

6. Voices from stakeholders

This section presents some quotations from the people who provided information to the mission. These individual statements seem to capture some more general views.

6.1 Statements recorded

"On the South African side, 64 commercial farmers are drawing water from the river. On our side there are only 6 commercial farmers left, all not paying to the council anymore, and thousands of people who hope for water for income generation projects.

"We don't really know what to do. We want to talk to the other water users in South Africa and Mozambique and raise our concern."

Chairperson, Lower Mzingwani Catchment Council, Beitbridge, Zimbabwe

"If no mechanism exists, you are thrown into the conflict, and guess who wins? The one who flexes the muscles best."

CEO, Water Utilities Corporation, Gaborone, Botswana

"We seriously fear for our ecosystem downstream. Our coastal resources, our clams and prawns, are threatened, if the river does not flow."

Executive Director, Environmental Working Group, Maputo, Mozambique

"In spite of our different historic, socio-economic and technical background, we all share a common vision with regard to the management of shared watercourses."

Chief Engineer, Department of Water Affairs and Forestry, Pretoria, South Africa

6.2 Main issues addressed

The voices quoted above address the following main issues:

- Obvious imbalances of water use
- Need for communication and conflict management
- Threats
- Goodwill declarations

6.3 National voices

A not too serious attempt is made to frame the voices heard in the four riparian countries into national categories.

Botswana seems to be relaxed about the issue and interested to participate.

Zimbabwe is rather concerned and poses questions.

Mozambique seems to be a bit alarmed and does not want to lose out.

South Africa is self-confident and hopeful that things turn out well.

7. Areas of intervention

In the discussions held the following activities were identified, which could be carried out by GTZ:

- To act as an honest broker between member states
- To facilitate access to international experience
- To provide specific expertise on selected subjects
- To support the assessment of existing reports, studies and data
- To help to identify gaps and deficiencies in the existing reports, studies and data and define areas for further activities
- To assist in capturing of data, processing of data and their dissemination
- To provide equipment for improvement of the database
- To help to improve negotiation skills
- To assist in the establishment of dispute settlement mechanisms
- To act as a catalyst for the organisational development of the commission

- To give managerial support to the secretariats of the commissions
- To assist in co-ordinating and streamlining technical and administrative processes

We, at GTZ, feel that external assistance could focus on the following points, among others:

- Support for the organisational development of the river-basin organisation
- Strengthening communication routes
- Facilitating access to information

Section F

Reports of working groups

During the Workshop, the participants divided on three occasions into smaller working groups, to discuss and report on key aspects of management of water resources in river basins

This section presents the reports of these working groups

The first set of reports discusses issues that can arise during the initiation of river-basin management
The second set discusses the operational phase, and the methods of implementing river-basin management
The third set of reports focuses on issues of special concern, and on the role of river-basin management in addressing these issues: cost-effectiveness in management, poverty alleviation and agricultural growth, and incentives for responding to water scarcity by improving efficiency of water uses

Group Work 1: The Start-up Phase of River-Basin Management

Wednesday 18 October

In these sessions the workshop broke into four groups, each of which was asked to address an aspect of the initiation of river-basin management, and to present a report.

The topics assigned to the four groups were:

Group 1 **Enabling Conditions**

Group 2 **Identifying Stakeholders**

Group 3 **Constraints**

Group 4 **Start-up Processes**

Group report 1.1: Enabling conditions

This group considered two questions:

1. What conditions indicate the need for river-basin management?
2. What characteristics will make the introduction of river-basin management more likely to be successful?

Prior conditions

The group said that the key pre-condition for river-basin management was scarcity of water. Scarcity could have various dimensions: it could be global (affecting users of all kinds) or it could be sectoral. It could be actual, or projected for the future. It could be due to insufficiency of water quantity, or it could be due to reduction of water quality, making some part of the resources unusable.

The key word is scarcity, which leads to the demand and need for basin management.

Causes of scarcity include:

- Hydrological changes
- Pollution coming from anthropologic activities
- Resource capture
- Flooding

The impacts of scarcity include:

- Increasing levels of conflict
  - Social
  - Economic
  - Environmental
- Growing insecurity of supply
- Complaints and social unrest

The group then considered the processes that may occur in response to scarcity. First, who acts?

There are different sets of people involved, some of which take actions, and some which generate the pressure for actions. The direct actors include:

- politicians;
- industries;
- local communities;
- technical managers.

while the pressure for management change comes from:

- society in general;
- downstream countries or downstream users of water;
- researchers;
- non-governmental organisations;
- international standards;
- donors.

The group noted the role sometimes of a "trigger event," such as a drought or flood, in bringing the pressures and the actors together to "kick-start" the process of establishing a river-basin management system.

They also observed that the impetus for river-basin management sometimes comes from top downwards, but may also come from bottom upwards, in which case it may be possible to build on existing organisations as the starting point.

Not every river basin needs a river-basin organisation. In assessing the need, we should think of the functions that need to be performed, and what means are required for performing them adequately, rather than thinking of the organisation first. There may be a fashion for river-basin management; this could seem to give rise to a need.

The group noted two basic shifts or changes that are generally needed, if it is clear that river-basin management should be established:

Firstly, a paradigm shift, from sectoral, fragmented management to integrated management;

and secondly, a boundary shift, from management within local administrative units to management within basin boundaries.

Success factors

The group then turned to their second issue, the characteristics that are associated with success in the introduction of river-basin management. Their response to this was in the form of some checklists:

Political factors:	Governance
	Rule of law
	Legislation
	Political will
	Participation by all interested parties
	Awareness
	Champions of reform
	Social pressure

Social factors:	Perception of water as an economic good
	Awareness of the need for integrated water resources management
	Social acceptance
	Adaptive capacity
	Good practices in the management of public funds
Financial factors:	Money available
	High cost of non-participation
Processes:	Full stakeholder representation
	Successful models
	Culture of subsidiarity
	Real issues that require top level action
	Trigger events
	Hydraulic bureaucracy committed and convinced
	Human resources
Information factors:	Data available and uncontested
	Transparency

Group report 1.2: Identifying stakeholders

Group 1.2 focussed on two critical questions:

1. Who are the stakeholders in the start-up phase in river-basin management?

2. How can they be reached and involved?

Identifying Stakeholders.

The group began by discussing the notion of stakeholders. In a broad sense, anyone who benefits from the river basin and who plays a role in the management can be called a stakeholder. But such a conception is unclear and does not help in clarifying who are the stakeholders. It was therefore agreed that although everyone in the river basin could practically be a stakeholder, it is necessary to come up with some categories. The notion of using the physical boundary of the river basin in identifying stakeholders was rejected by the group, because there are some complex issues involved; for example, the impact of the river basin on neighbouring states, provinces or even countries which are not geographically covered by the river basin.

The group dwelt on possible ways of categorising the stakeholders, for example according to:

1) aims and issues;

2) functions; for example, users, providers, regulators, managers.

3) status; for example, public entities such as administrators or politicians, or private such as commercial enterprises, non-governmental organisations or traditional leaders.

Finally, the group decided to classify the stakeholders in river-basin management according to their aims and issues or concerns. Accordingly, the following categories were identified:

1) Poverty alleviation: Stakeholders include rural/urban communities, subsistence farmers, deprived groups and other interest groups whose aim is to alleviate poverty, such as churches and non-governmental organisations. This could also include government ministries and public bodies.

2) Wealth creation: This would cover those whose primary objective is to make profit, for example, commercial entities and industries, including power plants.

3) Recreation: All those interested in using river-basin management for recreational purposes, fishing and boating.

4) Regulation: This would include groups of people whose aim is to regulate the river basin such as government agencies, community structures, municipalities, traditional leaders and chiefs.

The above sets of stakeholders could, at any time, play different roles, for example, as managers, service providers, regulators, mediators in case of conflicts, as well as supporters or advocates.

Reaching and involving Stakeholders:

Having identified the stakeholders, the next task is to involve them in river-basin management. To do so, it is necessary to know and define the river basin first, and then the following steps could be followed:

1. Inventory collection

   Guided by these questions:

   "Who are they?"

   "Where in the river basin are they located?"

   "What are their aims and objectives?"

   "What roles and functions can they assume in the river-basin management?"

   Make an inventory of a wide range of groups of stakeholders within the river basin. This could be done by doing a survey or by checking secondary sources of data. In this regard, the support and assistance of non-governmental organisations, research institutions and government agencies can be sought.

2. Conduct a stakeholders' forum.

   The aim would be to promote joint efforts in river-basin management, to motivate people to get involved in the river-basin management. This forum could also be the venue for clarifying issues, airing concerns and "worries", settling conflicts of interest, etc.

3. Organise stakeholders with the aim of building capacity. Some ideas in this regard are:

   - Personal contacts: need to speak to stakeholders to know their concerns;
   - Participatory approach;
   - Learn to speak their language;
   - Actively involve women and other deprived groups;
   - Use different kinds of media such as the radio, TV, print, drama, etc;
   - Conduct workshops;
   - Community meetings.

An important guiding principle when involving stakeholders is to make sure that representation in the river-basin management organisation is from the bottom up. This, however, does not exclude the possibility of promoting participation through laws and regulations.

Group report 1.3: Constraints

The group addressed the following tasks:

1. Identify possible constraints in establishing river-basin management
2. Identify priorities among this set of constraints

Pre-conditions

Questions emerged immediately concerning whether there should be a river-basin organisation at all, because there may be no infrastructure or supply facilities or there may be a small level of use. In some cases, it may not make sense to set up an organisation such as a river-basin organisation. [See also the report of Group 1.1 on enabling conditions]

Constraints

In no specific order, clusters of constraints were identified as follows:

Legal Constraints

In some countries, existing legislation related to water and its uses might be fragmented, contradictory or conflicting with each other.

There is also lack of enabling legislation for a river-basin organisation in many countries.

Institutions

Existing institutions may be ineffective and thus represent a constraint to managing a basin.

Lack of human resources is another constraint.

Lack of administrative will and inertia can also act as an impediment.

Political Constraints

Water has to be on the national agenda, in order to set up a river-basin organisation and give it the resources to do its job.

If this is not the case, then popular pressure must be brought to bear on politicians. Without political commitment, the river-basin management concept cannot materialise.

Information

There needs to be hydrological data, and data of various kinds (political, socio-economic, financial, legal, environmental and cultural) must be available, transparent

and accessible. In many cases these data are not available, or not accessible by stakeholders other than the implementing agencies.

Stakeholders

It is important for stakeholders to participate in decision-making and management of the use of the river basin. However, most of them lack awareness of issues.

The willingness and capacity of each stakeholder to participate also varies and may represent serious impediments.

A large number of diverse interests can present problems for stakeholder participation.

Stakeholders also vary in their power and influence.

Strategy

There must be an effective strategy to launch the river-basin management concept.

Financial

Finance can be a big constraint in establishing river-basin management. The perennial question was asked: where will the money come from?

Priorities

The group opted to describe a process rather than setting priorities, preferring to turn the constraints into positive statements concerning what was necessary. There was discussion about designing a matrix of how constraints interacted with each other, but no consensus was reached.

The process begins only when the basic pre-conditions of need for this type of management exist. There must be political will, and a strategy.

When these basic conditions exist, then the legal, institutional and financial constraints must be overcome.

Stakeholders need to be involved all through the process and information must be available at various points along the way.

Group report 1.4: Start-up processes

The question put to this group was:

What are appropriate processes and procedures in establishing new river-basin organisations?

Processes

Each group member wrote down the five processes he or she thought were the most relevant in creating a river-basin organisation. Eighty-nine cards were produced (some wrote more than five), and then cards were clustered into groups, each group defining a specific compound or complex process, that generally involves several sub-processes, or approaches or mechanisms.

The ten clusters were:

Process 1 Identify the need

The need for a river-basin organisation has to be established as a first part of the process. The group agreed that a preliminary information assessment was necessary to support the possibility of creating a river-basin organisation. Certain data would already be collected; a baseline assessment of technical aspects and information available would be needed.

Process 2 Gain political support / commitment

Having political support from the earliest stages will prove crucial for sustainable implementation of a river-basin organisation. Furthermore, political support is obligatory for a healthy and fruitful environment within which a river-basin organisation can develop and become useful.

Process 3 Gain stakeholder participation

Stakeholder participation as a process supports many other processes needed to create and maintain a river-basin organisation. The main discussion centred around whether the political support should exist before stakeholder participation, or should political support rather be the result of stakeholders' original interest to participate.

Process 4 Identification of need (bottom up)

As well as the initial need-identification process mentioned above (*Process 1),* it is necessary to identify whether the major stakeholders groups felt a need. This affects the process of establishing the river-basin organisation.

Process 5 Establish a policy framework

It is necessary to establish proper legal frameworks for river-basin management, and for the duties and responsibilities of the river-basin organisation.

Process 6 Consensus-building and conflict management

These are key roles of the river-basin organisation.

Process 7 Establish financial arrangements

Proper arrangements are needed for financing the river-basin organisation. Examples of problems with river-basin organisations, where financing arrangements had not been satisfactory, were discussed.

Process 8 Develop human resources

Training and capacity-building are key components of river-basin management, especially if these processes and organisations are relatively new.

Process 9 Identify functions, structure and implementation arrangements

The functions, structures and implementation arrangements for the river-basin organisation and for associated agencies and stakeholders in river-basin management, should be defined. The duties and responsibilities of each stakeholder need to be delineated and the communication pathways identified.

Process 10 Identify who drives the process

It is crucial to identify who is driving the creation of the river-basin management approach and the formation of a river-basin organisation. The process is more likely to succeed if it is an internal process (as in the case of Mexico), rather than an external process driven by donors or funding agencies (such as the World Bank).

Procedure

Having identified these ten sets of processes, the group made several conclusions and recommendations about the procedure to be followed:

- River-basin organisations have processes that might occur in stages.
- The chronological order in which processes appear, or should be addressed, is different from case to case.
- Could we be generic on sequencing these processes.
- Policy definitions come first; legal framework definitions and decisions come later.
- Assessment of technical aspects is mandatory.
- Technical aspects represent a continuous process. The same goes for information of any kind: demography, economy, social structures, institutional arrangements, etc.

- Awareness and involvement are not the same. Awareness is a necessary condition to obtain public participation.
- There is no way to advance realistically in the long run without political support. Probably, it is an indispensable component in the earlier stages as well.
- Implementation approaches are many; they can be roughly classified into: top-down, bottom-up or mixed approaches.
- Some river-basin organisations are born by a decree or by a political decision at executive levels.
- Some river-basin organisations are born of demands derived from severe problems: water scarcity and/or water quality degradation.
- Some others are born almost simultaneously by political decisions that correspond to severe problems and social demands.
- Inertia has to be overcome. Overcoming old structures is essential, when opposition emerges from those strongholds. Resistance to change is a common factor, and should be taken into consideration within the processes that will facilitate a river-basin organisation to be born.
- Conflict management is a paramount engine that drives river-basin organisations' activities.
- A question to be answered continuously is: What are the specific information needs, and how can they be satisfied in a cost-efficient manner?
- Why should we change, is it necessary?
- How to operate and manage a river-basin organisation efficiently and sustainably?
- How much power should a river-basin organisation have: is it a nominal monitoring and evaluation body reporting to others, or do we want it to possess decision-making capabilities?
- Knowing who will drive the process of creating and establishing a river-basin organisation is crucial.
- Do not attempt to drive a river-basin organisation externally. Experiences in this direction have been ill-fated.

Group Work 2: The Operational Phase of River-Basin Management

Thursday 19 October

In these sessions the workshop again was divided into four groups.
Each group was asked to address an aspect of operational management in river basins.
The groups were asked to address four factors, in each of their reports: these factors were information, management processes, resources, and allocation.

The topics assigned to the four groups were:

Group 1 **Governance**

Group 2 **Finance**

Group 3 **Laws and Institutions**

Group 4 **Managing Water**

Group report 2.1: Governance

The group defined governance as a mechanism, arrangement or process by which an organisation or a social system regulates or controls itself. Amongst the first things discussed was: how do we tell good governance from bad? Four distinguishing characteristics of good governance were identified:

- accountability
- transparency
- credibility, and
- representativeness.

Basin Management Strategy:

What strategies and structures might be useful to promote and ensure good river-basin governance? Several themes were identified on ideal strategies for basin governance:

- Over-arching policy environment:

  This will be reflected in

  (a) a clear statement of water policy;

  (b) enabling legal and regulatory framework;

  (c) clear delineation of the roles of government and other players or stakeholders;

- Transparency:

  This will be obtained through

  (a) information network;

  (b) strong emphasis on communication;

  (c) wide sharing of information about stakeholders and their outstanding concerns;

- Subsidiarity:

  (a) sharing of responsibilities;

  (b) minimal government role;

  (c) privatise all functions that are amenable to privatisation;

- Participatory approach:

  (a) bottom-up approach;

(b) strong emphasis on public involvement at all stages;

(c) accent on empowering the stakeholders;

(d) balancing competing interests, especially of the weak and the powerful, with a view to ensuring fairness and equity;

- A system of checks and balances should be instituted at all levels; and
- The river-basin management strategy with most likelihood for success will be building creatively upon opportunities offered by the unique political culture of the country rather than foisting a model strategy in all contexts.

Structure for river-basin management

Several structures were identified at different levels. Three over-riding aspects were that:

- As far as possible, the government should focus on playing the role of facilitation and regulation effectively, while depending upon private sector or users' organisations for service delivery;
- The river-basin management structure should be culture-appropriate;
- The structures at policymaking levels should be underpinned by intermediary organisations, such as private service-providers, users' organisations, and stakeholder forums, which can mediate between the river-basin management and the ultimate water users.

Given these over-riding considerations, the structures and mechanisms identified for river-basin management were:

- A basin-level governing and co-ordinating body or mechanism: to be designed so as

  (a) to ensure representation to the widest range of "conflict drivers" specific to each basin; and

  (b) to ensure optimal balance of power amongst competing interests and stakeholder groups;

- Technical support structures or mechanisms:

  to ensure steady supply of high-quality expert input into the process of river-basin management;

- Structures for stakeholder participation:

  to operationalise effectively both and subsidiarity and participation.

- Structures for control and accountability:

  these should include monitoring for generating and disseminating information on a wide range of variables as well as periodic social, environmental and policy audit of the river-basin management process.

- Structures and mechanisms for conflict mitigation and resolution:

  in order to support effective basin governance, given that conflict mitigation is one of the primary governance tasks.

Over-arching principles

The group proposed the following seven over-arching principles that might be useful to any country embarking upon a new strategy of river-basin management.

1. Participation:

   Continuing emphasis on stakeholder participation at all levels is the cornerstone of a good river-basin management strategy.

2. Role Clarity:

   Early in the process, the river-basin management strategy should produce a high level of clarity about the roles to be played by the government and other actors, regardless of the scale of role envisaged for the government.

3. Subsidiarity:

   A river-basin management strategy with a high chance of success entails government delegating and sharing responsibilities for specific roles, tasks and functions to other organisations.

4. Culture-appropriateness:

   The river-basin management strategy and structures should be designed to suit the political culture of the target country or region.

5. Transparency, credibility and legitimacy:

   River-basin management strategies and structures succeed only to the extent that they command credibility and legitimacy through sustaining high levels of transparency in decision-making and implementation.

6. Checks and Balances:

   Effective checks and balances at different levels are the hallmark of an effective river-basin management regime; and

7. Equity and Fairness:

   A river-basin management strategy will attract broad participation from all stakeholder groups only if it successfully fights the pressures from powerful and influential groups from the mainstream and engages weaker groups in the society in evolving ways to address their priorities and concerns.

The group considered also that the following three issues deserved more discussion:

- Trans-boundary basins which pose complex issue of hydro-politics and diplomacy; these need a totally different approach and strategy;
- Ways to integrate water management in a broader strategy of integrated natural resource and environment management as a second-generation issue; and
- Redefining the relationship between the state and the water users.

Group report 2.2: Finance

This group selected three questions for discussion:

1. What principles should guide the mobilisation of funds?
2. How should costs of river-basin management be allocated to the stakeholders?
3. What mechanisms can be identified to control the cost?

Mobilisation

Prior to answering the question, agreement had to be obtained about the functions of the river-basin organisation so that the purpose of fund mobilisation could be defined. A set of functions can be:

- allocation
- monitoring
- regulation
- planning
- operation
- social capacity-building

The extent and intensity of the various functions differs according to the organisational model. Four models were considered by the group as reference:

- Basin Authority: example, Brantas, Indonesia
- Diffuse authority: example, Central Valley, California
- Council-directed agency: example, France
- Co-ordinating Council

All these models need money for their operations. Mobilisation of funds is necessary for two types of processes:

- seeking loans for investments and development
- seeking funds to recover the cost of operations and investments

Principles that should guide the cost recovery are:

- users and beneficiaries should contribute;
- the contribution should be based on objectively measurable parameters (discharge, area concentrations, etc.);

- payments should be related to the level and reliability of service provision;
- polluters pay in proportion to their pollution;
- differential unit prices should enable allocation to and use by financially marginal but socially important uses and users;
- cross subsidies within the tariff structures of the basin should cover the costs of differential unit pricing;
- payment should give the payer a say in the decision-making process. The extent of this say should be arranged through agreed regulations;
- scarcity pricing could be introduced for groundwater management;
- the charges should be educational, collectable and predictable.

Allocation of costs

First, a list is made of stakeholders who can or should contribute:

- environment (user is not the payer);
- smallholder irrigated agriculture;
- large-scale irrigated agriculture;
- rain-fed agriculture;
- manufacturing industry;
- domestic water supply—urban, rural;
- hydropower;
- forestry;
- tourism;
- fishery;
- navigation.

Different mechanisms can be applied

- direct payment;
- direct tax system (especially environment and small farmers);
- additional charges to be added on service bills and forwarded to river-basin organisation;
- land-tax (though not very educational).

Mechanisms for cost control

The group made the following list of cost-control policies

- External audit;
- Payers' control through budget approval;
- Functions on as-needed basis;
- Benchmarking services, costs and internal processes;
- Financial autonomy;
- Run on sound business principles.

Group report 2.3: Laws and institutions

The group posed for itself the following question:

How should laws and institutions be designed, in order to maximise voluntary compliance in river-basin management?

The group addressed first the law and then discussed institutions. Remarks for law seem valid for institutions as well.

Meanings: Law—policy— regulation—informal rules

There are various forms and levels of regulation, for example, laws passing through the parliaments, or through lower levels; by-laws and regulations, or informal rules. Water policy made by a minister may have legal status as well.

Law is pluralistic; it is wider than just state law, and encompasses customary, traditional, local, religious and other forms or sources.

Motivation to formulate new law

There are three main "triggers" for formulation of new law:

- Scarcity of water and problems in allocation among multiple users.

  This is a sensitive issue. For example, the Ministerial Declaration during the World Water Forum did not accept the concept of sharing water. Sharing is accepted at the small, local scale, but the larger the scale, the more delicate. Current laws still emphasise the appropriation aspect; heterogeneity in society is still weakly addressed. It is very rare, probably only in South Africa, that protection of water users who suffered from racial and gender discrimination in the past is an explicit goal in allocation law. However, implementation in South Africa will be a tough next step; the negotiations during compulsory licensing especially fit those who are already organised. None of the Latin American initiatives for legal reform had this goal. The Indonesian case also calls for recognition of the water rights of (poor) former users, and legal measures to prevent expropriation.

- Environment issues, like pollution or preventive measures to protect the environment.

  This was a common reason in the past two or three decades.

- Gaps, inconsistencies, or overlaps in existing legislation.

  Some countries still do not have a water law, but refer to water in a fragmented way in other laws, such as laws on land use. South Africa had the advantage of being able to start from scratch in formulating a

new law. Brazil now also has opted for a comprehensive new water law.

There are also cases, like Turkey, in which it may be counter-productive to touch upon water legislation now. In other situations it is just not needed to change law.

New law should build upon felt needs and thus gain legitimacy and compliance. It should *prevent* conflicts. There should also be court institutions where complaints and disagreement can be expressed. One should be able to enforce new law; otherwise it does not make much sense.

The process of law design

There is experience in the appropriate process for law formulation, e.g. starting with general principles, white papers, refinement etc.

Steps include the following:

- Any new formulation should start with a thorough inventory of existing laws and institutions, including customary law and other legal systems. It is crucial that this information on institutions and laws is also widely made accessible, besides all technical data. Databases on institutions need to be built up.
- Public participation and capacity building are needed. Networking also between non-governmental institutions is to be encouraged. Leadership needs to be identified and built. Existing local institutions, such as traditional men and women leaders, are to be pro-actively tapped and brought into the process. Drafts of legislation are to be widely discussed for public reactions. Lawyers are instrumental and most effective in the final stages, when the purposes of the new law, in all their technical and hydrological complexities, have clearly crystallised.

The 'product'

Governmental institutions and non-governmental organisations and civil society institutions co-exist in river-basin management. All are needed for river-basin management. Internal (hierarchical) relations between government institutions should be clarified. Representation from the proliferation of public organisations is important. Purposive efforts are needed to include groups who tend to fall outside the existing networks and contacts, and to address their specific interests.

The character of the basin-level institution can vary as widely as from a body with legal authority, if not state powers, as South Africa is pioneering, to a facilitating agency aiming at consensus building or co-ordination. It also depends upon the varying relations between basin-management law and institutions versus national water law.

The resulting basin law and institutions depend upon many parameters that largely vary between countries, but also between sites within the same basin. As a follow-

up to the workshop, the International Water Management Institute could do a comparative and benchmarking study of existing basin-level institutions.

Finances and other resources

There should be provisions for financial and other resources of river-basin management institution, modest as they may be.

Group report 2.4: Managing water

This group decided to focus its discussion on the case of river-basins that are at or near "closure" (meaning that the available water resources of a normal year are fully committed for uses). They identified three specific challenges in this situation.

1. What measures can be adopted when a river basin is approaching closure, or has gone beyond closure, or experiences periodic water shortages?

2. What criteria can or should be used for selection and implementation of these measures?

3. What data and other information are needed to manage the process?

The group noted that it was difficult to analyse these questions in general terms it would be better to look at individual case studies and draw out generic lessons from them.

The first requirement is a database, which helps to define the scale of scarcity. Further data-collection may be needed to understand the situation fully. Factors in planning for these data needs can include:

- type and quantity of data;
- frequency of collection;
- users and uses of water;
- groundwater and environmental variables;
- drainage outflows.

The data must be converted into performance indicators, regularly recalculated, in order that managers can understand the situation.

The root causes of basin closure or scarcity must be understood. Categories of differing kinds of scarcity could include:

- physical water scarcity;
- economic water scarcity;
- new demands (new uses, or new users);
- problems of quality, as well as quantity;
- short-term and long-term scarcity.

People should be told about the problem at an early stage. Information about it should be disseminated at an early stage, and discussion should be promoted about proposed and possible measures, among users, local authorities, and other

stakeholders. Criteria will be needed for selection of intervention measures. This is a key but difficult process. Possible basis for these criteria include:

- prioritising uses;
- degrees of urgency;
- stakeholders' support;
- costs (implementation cost, and benefits foregone);
- sustainability of the solution;
- external obligations;
- adequacy of resources.

The measures chosen will usually be site specific, and will usually aim at a mixture of supply management and demand management. Management of supply and demand needs a variety of approaches, which the group clustered under the following five sets:

Technical measures:

- develop alternative sources of supply;
- augment supply;
- additional infrastructure for harnessing resources;
- identify opportunities for water saving;
- promote crops that need less water.

Social measures:

- involve all key participants.

Policy measures

- define and implement supporting legislation;
- identify and classify priorities;
- develop inter-departmental co-operation;
- institute regulations and control measures on the use of the river;
- formulate zoning plans.

Financial measures

- restructure tariffs (for example, tiered structure, with differential rates);
- develop incentives for water saving.

Information measures

- inform people about the nature of the closure (quantity, quality, etc);
- hold meetings with all interest groups;
- build public awareness;
- inform people of the possible consequences and impacts of proposed measures.

A critical issue is the question of resources for implementing these management policies and procedures. Concern was expressed that, in some developing countries, there are significant constraints that would inhibit these procedures. Can management influence these resource constraints? There must be a political will to address the problem, and the management strategy must be designed to match available resources, especially human and financial resources.

Group Work 3: Management Strategies

Friday 20 October

For the third and final round of group work, the participants again formed four groups. Each group was asked to formulate recommendations on appropriate management strategies for achieving certain specified goals.
Two of the groups were asked to address the same topic, in view of this topic's importance to many developing countries.

The goals assigned to the four groups were:

Group 1 **Cost-Effective River-Basin Management**

Groups 2 and 3 **Poverty Alleviation and Agricultural Growth**

Group 4 **Incentives for Efficient use of Water**

Groups were invited to address the strategic issues at three practical levels:
What needs to be done?
By whom? And
how?

Group report 3.1: Cost-effective models of river-basin management

Cost-effectiveness concerns both benefits and costs. The idea is to try and identify some cost-saving measures, while achieving benefits. The group developed a process by which these cost-effective solutions may be found, and gave some ideas on how costs could be saved. The process described summarises much of the discussion during the workshop.

River-basin management does not necessarily mean one organisation managing the river. This was brought out in the German and Californian cases. Some management models listed by the group were:

- Information sharing: different groups linked directly to a co-ordinating body, whose role is to ensure flows of information among them;
- Linked model: existing structures (organisations) are linked together with some kind of co-ordinating body, which in this case participates in the formulation of policy and decision-making;
- Directive model: a unified structure, carrying out many aspects of basin management.

Three essential features of river-basin management are:

- it is based on hydrologic boundaries,
- it is cross-sectoral in nature,
- it aims at broad inclusion of stakeholders.

It is cost-effective to focus on one, or a small number, of principal functions. Typically in water-stressed basins, with agricultural uses dominating, we would select between:

- allocation,
- pollution, or
- flood control.

Concerning stakeholders' participation, it was observed in the European example, that many stakeholders did not know about river basin management organisations, and this was not necessarily bad. In this case, local-government structures were used for representation. In developing countries, these means of representation may not be effective, so other means of stakeholder participation were necessary.

If there is a certain limited amount of money, where should it be spent? The group listed in order of importance:

- Stakeholder forum
- Data collection

- Communication infrastructure
- Further problem identification

Principal steps for start-up:

- Establishment of a stakeholder forum to guide the processes. This group would be instrumental in figuring out how to allocate water, and how to spend funds to accomplish this task.
- Identification and description of problems.
- Data collection.
- Communication infrastructure.

The above steps would have the following two important outcomes:

- Shared vision and
- Quick pay-off action—the idea is to try to show some kind of benefit quickly, to gain acceptance.

Principal steps in the operational phase:

- Stakeholder forum

  This would stay in place to guide the process

- Data collection and monitoring

  In perhaps a more extensive way than during the start up phase

- Actions taken on primary problem(s)
- Strengthen and formalise linkages
- Planning

  This would include supply and demand projections, and plans on how to manage future supply and demand.

- Resource mobilisation.

  For all steps one should look at most cost-effective means.

Stakeholder representation in governance.

In this case, the main idea to save costs was to use existing structures to quickly and cheaply get stakeholder representation. These structures could include:

- Government representation

- Traditional leaders
- Existing associations of users
- Co-operatives
- Non-governmental organisations
- Others

There are various concerns about using existing structures for river basin management. There can be conflicts of interest, or using these structures may perpetuate social imbalances.

Everyone should have the possibility of giving an opinion, and a chance to join the discussion, but the power of decision-making may not be given to everyone.

An idea of merit is to use opinion polls. Some stakeholders would be used to set a direction, and then opinion polls would be used to verify the direction taken.

Technically, there are now many cheap means of communications, such as cell phones. Care should be taken that poor people have access to these technologies too.

Group report 3.2: Poverty alleviation and agricultural growth

The task of this group was to make recommendations about strategies of river-basin management, for achieving the twin goals of poverty alleviation and agricultural growth. [See also the report of Group 3.3, who addressed the same subjects.]

Summary of Recommendations

1 As water emerges as an economic good, under integrated river-basin management, developing country river-basin management regimes can use water allocation and pricing mechanisms to generate resources for supporting small-holder communities and other poorer groups. Economically dynamic sectors—such as commercial farming, mining, electricity companies, and industry in general—which use water intensively in wealth creation, should contribute a development levy, which would be used to create social infrastructure for poor communities.

2 Planned investment should be directed to capacity-building and human-resource development initiatives in poor rural communities, formal education, vocational training, public health, water supply and sanitation, and other such social overhead capital.

3 While poorly designed subsidies can be dysfunctional or counter-productive, carefully designed "smart" subsidies can provide powerful incentives. For example, in societies that lay great emphasis on privatisation of service provision, dispersed poor communities may prove costly to serve, and therefore, it may take generations before they become viable demand systems for privately delivered services. In such situations, smart subsidies can create the required incentives for private service-providers to serve dispersed poor communities.

4 Critical to making smallholder farming communities in underdeveloped river-basins viable are value-added farming and marketing. Poor rural communities tend to be short on capital but long on family labour and care. If these are supported to switch from field crops to high-value crops, their livelihoods can be stabilised even if their holdings are tiny. However, this necessitates support in terms of money, management, and marketing. If the communities are organised and provided with resource support, their livelihoods can be improved.

5 New institutional models need to be forged to link poor smallholder communities with more dynamic sectors of the economy. In countries like South Africa, there exists enormous scope for a mutually gainful collaboration between smallholder farming communities and large commercial farmers. These, however, need to be actively catalysed and promoted through innovative approaches by the government.

Group report 3.3: Poverty alleviation and agricultural growth

This group addressed the question of strategic recommendations towards the goals of poverty alleviation and agricultural growth. [See also the report of Group 3.2, who addressed the same subjects.]

The physical unit of analysis is the river basin. Water is the primary focus of the strategic actions to be considered.

Definition of the target group

The group spent some time in defining who "the poor" are, and whether they should discuss the two issues, poverty alleviation and agricultural growth, together or separately. The target groups were defined as: small farmers, landless people, urban poor (unemployed, piece workers, etc.). The group also decided to discuss actions for poverty alleviation independent of agricultural growth. They felt that most actions for poverty alleviation would fit agricultural growth as well.

Need

The group considered that one should not go for river-basin management unless it is necessary. Money for river-basin management could be spent for poverty alleviation. If it is needed, basin management must be based on real basin issues and not go beyond those limits.

Empowerment

All poor groups need to be empowered. Their dignity and confidence must be built among themselves. Various self-help organisations should be promoted. These must represent their interests and ideas in decision-making processes.

Income generation

Income-generating activities, especially individual entrepreneurs, must be developed, targeted to the poor, and water-sustainable. Crop diversification should be introduced and should be based on economic, ecological and social comparative advantage.

Infrastructure

There are two kinds of infrastructure, hardware and software. The hardware includes roads, water-delivery systems, health centres, sanitation facilities, market places and facilities, while the software includes education, access to credit, information, extension services, and development of new markets (locally for consumers, and externally for farm producers).

Capacity-building

This is meant for both parties, the agency staff and the water users. The agency managers must have right understanding of poverty (through training and exposure) and they must be able to perform new, facilitating roles, not the leading roles any more. The users must also understand the water issues in the basin. Appropriate water uses for different purposes must be taught to users.

Policy and institutions

Land reform is needed, to improve the management of resources and equity issues. Access to water should be linked with access to land to allow growth of agricultural activity (not rights only, but service provision simultaneously). Other water policies needed include water pricing that takes cognisance of socio-economic circumstances and security of water allocation for small-scale farmers.

Incentives and catalysts

Watershed management must be promoted that takes cognisance of the ecological limits for development towards poverty alleviation. Other incentives and targeted subsidies may be needed at the beginning, to help the poor people to survive.

Due to time constraints, the group could not address the questions "by whom" and "how."

Group report 3.4: Incentives for efficient use of water

The group proposed sets of mechanisms, first for overall management, and then for specific stakeholders and users of water.

Broad mechanisms might include:

- Water trading among users, within social, ecological and physical constraints;
- Scarcity pricing and water economics (costs and cost pricing) within emerging economies, especially in poor sub-regions and communities;
- Tax incentives and fiscal instruments, in general designed to trigger efficiency in water use;
- Social shaming and rewarding;
- Information, education and research;
- A clear recognition that water is a social, environmental and economic good.

It is better to target major items, not to waste effort on smaller matters that will produce small gains.

Ideally the mechanisms should result in low pollution levels and water use efficiency.

For specific stakeholders, the group proposed:

Regulatory Authority, or River Basin Authority

- International pressure can lead to changes in behaviour (e.g. Turkey and the EU). There are also a series of international forums or international normative order (agenda 21, etc)
- Price signals, tax mechanisms, water trading and the establishment and maintenance of water rights.
- Service priorities and policy guidelines shape efficiency.

Water Supply and Sanitation

Objectives: Good clean water leads to poverty alleviation and health benefits.

- There are social and cultural aspects that enter this issue. Public consciousness has to be raised. The price of water or tariff structures can be used to ensure that a lifeline supply is available and thereafter the price increases.

- Adoption of water re-use technologies seems sporadic or restricted to developed countries.
- There is a role for regulation, metering and benchmarking in this industry.
- There is considerable room for carrots and sticks for efficient water use.
- Water Audit Exercises such as targeting the youth (20–20 Vision).

Irrigation service providers, commercial farmers, small-scale farmers

Objectives: Soil conservation, water efficiency

- This topic has a two-fold analysis: the first one is related to poverty and farmers whose production is for survival or self-consumption in a water scarcity context; the second part of such analysis includes commercial farmers and enterprises for whom incentives and efficiency adopt a different meaning.
- The mechanisms will be different even though all are involved in agriculture. The capacity of human resources is different.
- With the small-scale farmers, many of the incentives may be non-monetary. Access to credit (maybe even bartering), forward trading of crops, and access to markets can lead to higher farm income and then farmers can invest in simple technologies that save water. It may be necessary to develop proxies when water metering is impractical.
- With large-scale farming, tax mechanisms and volumetric charges can be effective means.
- Guaranteed crop prices may be useful for providing incentives to save water for small farmers.
- Promote efficient farm storage, switching of different agricultural crops.

Hydro-power, industrial use and mines

Objectives: Low pollution levels, flood reduction, soil conservation, and water-use efficiency

- Benchmarking, self-monitoring and social shaming.
- Creative use of tax mechanisms and, in a broader sense, fiscal incentives per se.
- May be some room for leveraging clean up and water-use efficiency along watercourses.

Fisheries and forestry

Objectives: Flood reduction, soil conservation and positive social reactions

- Water-efficient species can be introduced.
- Water-price elasticities are radically different from those of other sectors.

Environment

- The environment is often low on the priority list; thus, incentives that address this topic in terms of efficient water use are scarce in the realm of countries and regions where poverty and water scarcity prevail.
- Environmental benefits are often unevenly distributed: the poor bear the burden with health problems and environmental degradation (mosquitoes) and, in contrast, recreation and tourism for the rich, for whom in emerging countries few incentive mechanisms have been implemented to contribute for poor people to have a better environment within the water resources realm.

Other mechanisms

Offsets

- The concept itself deals with the commitment of certain high-value economic uses of water that should when entering as users clean up not only their environmental impacts but contribute to cleaning up those pre-existing. Offsets represent a creative incentive mechanism for certain uses like industry, hydropower generation and mining.

Water pricing should take into account

- price elasticity
- scarcity
- differential tariff and water pricing structures
- measuring: volumetric or proxies
- practical realities

Water policy

- a general water policy
- policy guidelines

- water-trading regulations
- water is an economic good, as well as a social and environmental good

Annex

List of Participants

List of Participants

Name	Position	Organisation	Address	E-mail
Abernethy, Charles L.	Consultant on Irrigation & Water Management		5 Havelock Road, Colombo 5, Sri Lanka	abernethy@itmin.com
Alpaslan, M. Necdet	Director	Centre for Environmental Research & Development (CEVMER)	Dokuz Eylul University, Kaynaklar Campus, Buca, 35160 Izmir, Turkey	nalpaslan@ izmir.eng.deu.edu.tr necdet.alpaslan@dev.edu.tr
Bandaragoda, D. J.	Senior Management Specialist	International Water Management Institute	127 Sunil Mawatha, Pelawatte, Colombo, Sri Lanka	d.j.bandaragoda@cgiar.org
Burger, Jaco	Estate Engineer	Schoeman Agricultural Farm	P. O Box 3, Marble Hall 0450, South Africa	-
Burton, Martin	Director	Itad-Water Ltd	Lion House, Ditchling Common, Hassocks, West Sussex, England	martin.burton@itad.com
Bybordi, Mohammed	Senior Advisor	Ministry of Agriculture	22 Sahra Street, Agabozorghi Ave, Elahieh, Tehran, Iran	m-bybordi@areeoor.ir
Chavula, Geoffrey	Lecturer	University of Malawi	The Polytechnic, P Bag 303, Blantyre 3, Malawi	gchavula@yahoo.com

Name	Position	Organisation	Address	E-mail
Collado, Manuel L.	Regional Irrigation Director	Region 3, National Irrigation Administration	Tambubong, San Rafael, Bulacan, The Philippines	nia.reg.3@bulacan.net.ph
De Lange, Mama	Smallholder Irrigation Specialist	International Water Management Institute, Africa Office	P Bag X813, Silvertown 0127, Pretoria, South Africa	marna@global.co.za
Fourie, Charles	Managing Director	ECOSAT (Holdings), Environmental & Resource Managers	Unison House, 190 Smit Str, P.O. Box 73286, Fairland 2030, South Africa	charles@ecosat.co.za
Frenken, Karen	Water Resources Management Officer	FAO	P.O. Box 3730, Harare, Zimbabwe	karen.frenken@fao.org
Hai, Pham Ngoc	Head	Faculty of Irrigation & Land Reclamation, Hanoi Water Resources University	175 Tây Son, Dong Da, Hanoi, Vietnam	
Hassan, R.M.	Professor	Department of Agricultural Economics, University of Pretoria	Hatfield, Pretoria, South Africa	rhassan@postino.up.ac.za

Name	Position	Organisation	Address	E-mail
Hattingh, Louis C.	Water Resources Planner	Department of Water Affairs & Forestry	P. Bag X313, Pretoria 0001, South Africa	halh@icon.co.za
Hatton MacDonald, Darla	Senior Research Scientist	Commonwealth Scientific & Industrial Research Organisation	PMB 2, Glen Osmond, Australia	darla.hatton_macdonald@ adl.clw.csiro.au
Heim, Franz	Head, Water Policy &Water Management	Food & Agriculture Development Centre, DSE	D-82336 Feldafing, Germany	f.heim@dse.de
Helmi	Research Staff/ Lecturer	Centre for Irrigation, Land & Water Resources & Development Studies, Andalas University	JL. Belanti Indah IV / No.8, Padang 25137, Indonesia	helmi@indosat.net.id
Hollaender, Robert		National & International Water Policy Division, Ministry for Environment	P.O Box 120629, 53048 Bonn, Germany	hollaender.robert@bmu.de
Istijono, Bambang	Chief Officer	Water Resources Services, West Sumatera Province	Jalan Arau 86, Padang, Indonesia	
Kalludzu, E.L Herbert	Special Advisor to the Minister	Ministry of Water Development	P Bag 390, Lilongwe, Malawi	water@malawi.net
Karodia, Haroon	Director, Catchment Management	Department of Water Affairs & Forestry	P Bag X313, Pretoria 0001, South Africa	karodiah@dwaf.pmv.gov.za

Name	Position	Organisation	Address	E-mail
Kokwe, Misael	Co-ordinator, Ecosystems Programme	Regional Office for Southern Africa, IUCN	Box 745, 6 Lanark Road, Belgravia, Harare Zimbabwe	mak@iucn.org.zw
Lange-Tagaza, Norma	Consultant	Interconsult	Dill Str. 50, D-67549 Worms, Germany	norma.lange-tagaza@ t-online.de
Ledwaba, Refilwe	Extension Officer	Africare South Africa	P. Bag X8613, Groblersdal 0470, South Africa	refilwedwaba@hotmail.com
Levite, Hervé	Researcher	International Water Management Institute, Africa Office	P Bag X813, Silvertown 0127, Pretoria, South Africa	h.levite@cgiar.org
Ligthelm, M.E.	Deputy Director, Water Quality Management	Department of Water Affairs & Forestry	P Bag X11259, Nelspruit 1200, South Africa	ligthelmm@dwaf.mpu.gov.za
Maaren, Hugo	Research Manager	Water Research Commission	P.O. Box 824, Pretoria 0001, South Africa	hugo@wrc.org.za
Maartens, Wynand	Chief Engineer	Lesotho Highlands Water Commission	P Bag A100, Maseru, Lesotho	wm.iptc@iesoff.co.za

Name	Position	Organisation	Address	E-mail
Masiyandima, Mutsa	Post-doctoral fellow	International Water Management Institute, Africa Office	P Bag X813, Silvertown 0127, Pretoria, South Africa	m.masiyadima@cgiar.org
Matoase, Selloane	Development Specialist	Lesotho Highlands Water Commission	P.O. Box A 156, Maseru, Lesotho	seloanem.jptc@lesoff.co.za
Merrey, Douglas	Director for Africa	International Water Management Institute, Africa Office	P Bag X813, Silvertown 0127, Pretoria, South Africa	d.merrey@cgiar.org
Mestre, Eduardo	Permanent Technical Secretary	Latin American Network of River Basin Organisations	215 F Street, Washington, DC, USA ; *and* 211 Plates Ave, Carretas, Querétaro 76050, Mexico	emestre@att.net.mx tulipe@infosel.net.mx
Mkhizwe, Siphiwe	Director, International Relations	National Department of Agriculture	P Bag X250, Pretoria 0001, South Africa	dir@nda.agric.za
Mokuoane, Edward M.	Senior Engineer	Water Sector Co-ordinating Unit, Southern African Development Community	P Bag A 440, Maseru 100, Lesotho	sadcwscu@lesoff.co.za

Name	Position	Organisation	Address	E-mail
Molden, David	Research Leader, Irrigation & Water Resources Programme	International Water Management Institute	P.O. Box 2075, Colombo, Sri Lanka	d.molden@cgiar.org
Mollel, N. M.	Professor & Acting Dean	Faculty of Agriculture, University of the North	P Bag X1106, Sovenga 0727, South Africa	molleln@unin.unorth.ac.za
Mongkolnchaiarunya, Jitti	Co-ordinator, CUC.UEM Yala Project	School of Environment, Resources & Development	Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand	jitti_m@yahoo.com
Moroasui, Pearl	Rural Sociologist	Africare – South Africa	P Bag X8613, Groblersdal 0470, Mpumalanga, South Africa	refilweledwaba@hotmail.com
Motanya, Limpho	Principal Technical Officer	Department of Water Affairs	P.O. Box 772, Maseru, Lesotho	wrd@ilesotho.com
Mugabo, Leopold	Head of Water Department	Electrogaz	B. P. 537, Kigali, Rwanda	
Muller, Mike	Director General	Department of Water Affairs & Forestry	P Bag X313, Pretoria 0001, South Africa	MikeMuller@dwaf.pwv.gov.za

Name	Position	Organisation	Address	E-mail
Mulwafu, Wapulumuka	Lecturer/Principal Investigator	Basin Water Resources Management Project	University of Malawi, Chancellor College, P.O. Box 280, Zomba, Malawi	wmulwafu@ chirunga.sdnp.org.mw
Murray, Sharon	Water Resources Advisor	U.S. Agency for International Development	Ronald Reagan Building 3.08, 1300 Pennsylvania Avenue, N.W., Washington, D.C, 20523, USA	smurray@usaid.gov
Mwaka, Dr. Beason	Principal Engineer, Water Utilisation	Department of Water Affairs & Forestry	P Bag X313, Pretoria 0001, South Africa	mwakab@dwaf.pwv.gov.za
Mwangi, Josephine	Agricultural Economist	African Development. Bank	B.P.V 316, Abidjan, Côte d'Ivoire	j.mwangi@afdb.org
Nduli, Njabulo	Programme Manager, Sustainable Resource Use & Management	National Department of Agriculture	P Bag X250, Dirk Uys Building, Pretoria 0001, South Africa	cdsrum@nda.agric.za
Niyangoda, S.M.S.B.	Secretary	Ministry of Mahaweli Development	500 T.B.Jaya Mawatha, Colombo, Sri Lanka	dev123@setnet.lk

Name	Position	Organisation	Address	E-mail
Nkeramihigo, Jean Pierre	Head of Treatment Plant	Electrogaz	B.P. 537, Kigali, Rwanda	nkerajp@yahoo.fr
Nthathakane, Peter N.	Chief Technical Officer	Department of Water Affairs & Forestry	P.O. Box 772, Maseru 100, Lesotho	wrd@ilesotho.com
Ntshangase, Karim	Marketing Director	ECO SAT Holdings Ltd, Environmental & Resource Managers	Unison House, 190 Smit Str, P.O. Box 73286, Fairland 2030, South Africa	karim@ecosat.co.za
Özgöbek, Hikmet	Regional Director (Region 2)	State Hydraulic Works (DSI)	35100 Bornova-izmir, Turkey	dsi2bölge@superonline.com
Perret, S.R.	Associate Professor/Researcher	Departmentt. of Agricultural Economics	University of Pretoria Pretoria 0002, South Africa	sperret@nsnper1.up.ac.za
Rodkin, Hayley	Communication Development & Environmental Education	Department of Water Affairs & Forestry	P Bag X313, Pretoria 0001, South Africa	qtp@dwaf.pwv.gov.za
Ruiters, Cornelius	Director, Social & Ecological Services	Department of Water Affairs & Forestry	P Bag X313, Pretoria 0001, South Africa	deo@dwaf.pwv.gov.za

Name	Position	Organisation	Address	E-mail
Salemi, Hamid Reza	Member of Scientific Board	Esfahan Agricultural Research Centre	Khorsand Alley 15, Hooshmand st., Soroush ave., 81997 Isfahan, Iran	agresor@cc.iut.ac.ir
Sally, Hilmy	Irrigation & Water Management Specialist	International Water Management Institute	P.O. Box 2075, Colombo, Sri Lanka	h.sally@cgiar.org
Samad, Madar	Research Associate	International Water Management Institute	P.O. Box 2075, Colombo, Sri Lanka	m.samad@cgiar.org
Samarasinghe, S. A. P.	Director	Irrigation Management Division	P.O. Box 1138, Colombo 7, Sri Lanka	lakruwan@pan.lk
Sandoval-Minero, Ricardo	Executive Secretary	Guanajuato State Water Commission	Autopista Guanajuato-Silao KM 1, CP36251 Guanajuato, Mexico	rsandova@guanajuato.gob.mx rsandovalm@infosel.com
Schild, Thomas	Team leader	GTZ (German Agency for Technical Co-operation)	88 John-Meinert st, Windhoek, Namibia	gtzswam@iafrica.com.na
Schreiner, Barbara	Chief Director, Water Use and Conservation	Department of Water Affairs and Forestry	P Bag X313, Pretoria 0001, South Africa	Bschreiner@dwaf.pwv.gov.za
Shah, Tushaar	Research Leader	International Water Management Institute	P. Box 2075, Colombo, Sri Lanka	t.shah@cgiar.org

Name	Position	Organisation	Address	E-mail
Sharma, Khem Raj	Chief, Research Development & Co-ordination of Water Management	Department of Irrigation	P.O Box 8975 EPC 1115, Kathmandu, Nepal	krsharma@email.com (h) ofwm@wlink.com.np (w)
Smallwood, Andrew J.	Senior Engineering Advisor	Department for International Development (United Kingdom), Eastern Africa Office	P.O Box 30465, Nairobi, Kenya	aj-smallwood@dfid.gov.uk
Stalzer, Wolfgang	General Director	Ministry of Agriculture, Forestry, Environment & Water Management	Stubenring 1, A-1010 Vienna, Austria	wolfgang.stalzer@bmlf.gv.at
Stimie, Chris	Manager, Rural Engineering	Institute for Agricultural Engineering	P Bag X519, Silverton 0127, South Africa	cmstimie@ing1.agric
Svendsen, Mark	Consultant in Water Resource Management		24144 Price Creek Road, Philomath, Oregon 97370, USA	msvendsen@compuserve.com
Tardieu, Henri	Director General	Compagnie d'amenagement des Coteaux de Gascogne (CACG)	P Bag 449, 65004 Tarbes, France	h.tardieu@cacg.fr
Tej, Bahadur K. C	Professor of Soil Science	Institute of Agriculture & Animal Science, Tribhuvan University	Rampur Campus, Rampur, Chitwan, Nepal	chitwan@mos.com.np

Name	Position	Organisation	Address	E-mail
Tunha, Washington	Principal Engineer	Department of Water Affairs and Forestry	P. Bag X9506, Pietersburg 0700, South Africa	tunhaw@dwaf-ptg.pwv.gov.za
Turton, A.R.	Head, African Water Issues Research Unit	University of Pretoria	Pretoria 0002, South Africa	awiru@postino.up.ac.za (w) art@icon.co.za
Undan, Rodolfo C.	President	Central Luzon State University	Muñoz, Nueva Ecija, Philippines	rmundan@mozcom.com clsu@mozcom.com
Uskay, Savas	Head, Operation & Maintenance Department	State Hydraulic Works (DSI)	Genel Mudurlugu, Yucetepe, Ankara, Turkey	savasu@dsi.gov.tr
Usman, Rusfandi	President Director	Jasa Tirta Public Corporation	Jalan Surabaya 2A, Malang 65115, Indonesia	pjt@malang.wasantara.net.id
van Hofwegen, Paul	Senior Lecturer	International Institute for Hydraulic & Environmental Engineering	Westvest 7, P.O. Box 3015, 2601 DA Delft, The Netherlands	hof@ihe.nl
van Koppen, Barbara	Poverty and Gender Specialist	International Water Management Institute, Africa Office	P Bag X813, Silvertown 0127, Pretoria, South Africa	b.vankoppen@cgiar.org

Name	Position	Organisation	Address	E-mail
Volz, Hans-Albert		German Embassy	P.O. Box 2023, Pretoria 0001, South Africa	germanembassypretoria@ gonet.co.za
Wang Aiguo	Division Chief	Dept. of Planning, Ministry of Water Resources	No. 2, Lane 2, Baiguang Rd., Xuanwu District, Beijing 100053, China	agwang@mwr.gov.cn wangiu@iwhr.com
Wester, Flip	Visiting Researcher	Irrigation & Water Engineering Group, Wageningen University	Nobelweg 96, 6706 GE, Wageningen, The Netherlands	flip.wester@xs4all.nl
Weston, Derek	Assistant Director	Directorate: Catchment Management, DWAF	P Bag X313, Pretoria 0001, South Africa	westond@dwaf.pwv.gov.za
Wolff, Peter	Consultant		Heiligenstaedter Weg 5, D37213 Witzenhausen, Germany	wolff-witzenhausen@ t-online.de