International Workshop on
River Basin Management - Proceedings
International Workshop on River Basin Management

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Proceedings

Editor E. Mostert

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Prof. ir. R. Brouwer
Director RBA Centre

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Introduction

River basin management is one of the biggest challenges of the 21st century. River basins sustain ecosystems, are the paramount source of water for households, agriculture and industry, and fulfil many non-consumptive uses. Yet:

- Some 1.2 billion people are still without safe drinking water
- Some 3 billion are without sanitation, which threatens public health and water quality
- Between 1950 and 1995 per capita water availability has dropped by 38% (developed countries) to 70% (developing countries with an arid climate)
- Many ecosystems are being destroyed
- Floods occur more often and cause more damage
- Many conflicts occur between upstream and downstream uses and between different types of water use

Moreover, due to population growth and overexploitation, the demands made on river basins are increasing and the basins’ capacity to meet these demands is decreasing. Consequently, if nothing is done, the problems will only get worse.

From 27-29 October 1999 the International Workshop on River Basin Management was held in The Hague. The main objective of the workshop was to contribute to the preparations of the Ministerial Conference that will be held in The Hague on 21-22 March 2000, parallel to the Second World Water Forum. As river basin management will be a key issue at this conference, it was considered opportune to bring together experts from all over the world to discuss their experiences with river basin management and develop a set of recommendations and guidelines. The workshop was organised by the RBA Centre of the Delft University of Technology in co-operation with IHE Delft (International Institute for Infrastructural Hydraulics and Environmental Engineering), WL|Delft Hydraulics and the GLODIS-Institute of the Erasmus University Rotterdam.


This report constitutes the proceedings of the workshop. It contains the opening addresses, the Recommendations and Guidelines, all keynote papers and most other written contributions. The annexes contain the list of participants, the workshop programme and the composition of the organising committee. The brochure Towards Sustainable River Basin Management is published separately by the Ministry of Housing, Spatial Planning and the Environment.
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Words of Welcome by Mr. K. Zoeteman

Deputy Director-General for Environment, Ministry of Housing, Spatial Planning and the Environment, The Netherlands.

Ladies, Gentlemen,

I am very pleased to welcome you to The Netherlands and to this International Workshop on River Basin Management organised by the Delft University of Technology and sponsored by the Dutch Ministry of the Environment and the Dutch Ministry of Water Management.

"Everyday, 230,000 people join the human race. Each and every one of them will depend on water to live. Competition for fresh water is becoming more intense ....".

This quote from the draft version of the report that the World Commission on Water for the 21st Century is preparing, clearly sets the stage for the issue of water management in our world. On the threshold of the 2nd. millennium we have not yet succeeded in managing this basic condition for life on earth in a sustainable way. On the contrary, hundreds of millions of people do not have access to safe drinking water and proper sanitation facilities. In many parts of the world, ecosystems have been damaged and people face serious flooding, droughts or polluted waters. Progress with water management is being made in some parts of the world, but overall economic developments and population growth will further increase pressures on water resources.

Since the 1977 Conference in Mar del Plata, water management has been on the agenda of the international community regularly, and policies and projects have been developed and implemented. Nevertheless, they fell short of expectations as was stated by the UN General Assembly in its Rio +5 evaluation.

The Dutch government attaches high importance to international co-operation in the environmental field. It has promoted sustainable water management in the past, and will continue to do so. In 1994, we organized in Noordwijk, about 20 kilometres from here, a Ministerial Conference on Drinking Water and Environmental Sanitation. Coming year, from 17 to 22 March 2000, the Dutch government will be hosting again a large international meeting: the Second World Water Forum and Ministerial Conference. On the agenda will be (1) the ‘Long Term Vision on Water, Life and the Environment in the 21st century’, prepared by the World Commission on Water, chaired by mr. Serageldin, vice-president of the World bank; and (2) the ‘Framework for Action’, which is an action programme, based on the Vision, and proposed by the Global Water Partnership. We hope that the Ministerial Conference will provide political commitment to these activities, and that it will give a push to concrete projects and actions on-the-ground. This means that in addition to a political declaration by ministers, Dutch government would like to see concrete results and follow-up coming out of this conference. In this respect, we expect a lot from your contributions during this workshop.

Over the last years, two key concepts in water management have gained ground internationally: the concept of ‘integrated management’, and the concept of ‘river basin management’. ‘Integrated management’ refers to an approach that takes into account all relevant stakeholders, all functions, and all aspects of water, including quantity and quality issues, with the aim to manage water resources in a sustainable way. ‘River basin
management' refers to the watersystem or geographical scale that is considered the most relevant for sustainable water management. It is obvious that when you put these two concepts at the heart of managing water resources, 'the old technical fix', - meaning that water problems can be solved by engineers -, cannot hold. However, most politicians and the general public are not yet convinced of this; most people think that water management is a technical matter that can be solved by engineers.

Integrated management approaches at river basin level already received attention in the 1992 Dublin and Rio meetings, and for instance in 1994 in the Noordwijk Conference. Since then, in several parts of the world, further practical experience has been gained with river basin commissions or authorities. Integrated river basin management is expected to be emphasised again as an important instrument in the Long Term Vision, and at the Forum and Conference coming year. However, as there is internationally no shortage of principles and good intentions, we would like to try to come up this time with a set of concrete recommendations based on best management practices for river basins that could be useful for water management in different parts of the world.

Your contribution in this workshop in developing such a set of recommendations is much needed and appreciated. How the set of recommendations will be dealt with during the Conference is not yet clear; the set could be a contribution to a ministerial discussion on integrated river basin management. In the final declaration of the Conference, ministers might underline the useful application of these recommendations.

Let me finish by hoping that this workshop will be of interest to you for exchanging views with participants, and for contributing directly to the preparation of the global Conference coming year. I wish you a very creative, and fruitful workshop and an enjoyable stay in The Netherlands.

Thank you.
Words of Welcome by Ir. L.H. Keijts

Deputy Director-General for Public Works and Water Management, Ministry of Transport, Public Works and Water Management, The Netherlands

Ladies, Gentlemen,

On behalf of the Netherlands Ministry of Transport, Public Works and Water Management, I fully associate myself with the warm words of welcome expressed just now by our chairman and by my colleague Kees Zoeteman.

The Netherlands have a long standing reputation in the field of water management, situated as we are in a deltaic region. Four international rivers are discharging their waters through this country into the North Sea via an intricate system of river arms and estuaries. And the Dutch did everything to make the system even more complex by shaping an original marshy landscape into a geometrical patchwork of polders and canals with a very high productivity rate of crops and cattle; actually, about two-thirds of our territory are floodable area, half of which is situated below sea-level; and precisely in that part of the country, our major mainports are located: the Port of Rotterdam - the largest in the world - and Amsterdam Airport - the fourth of Europe. During the next century, the possible rise of the sea-level promises to be matched by the gradual subsidence of our soil, especially at the lower western edge of the country, and by increased rainfall. So much for the long-term vulnerability of the Netherlands.

Due to centuries of being busy with our water systems in order to protect our land against flooding, to improve our agricultural yields and to increase the capacity for constructing in our urban areas, there hardly any unspoilt piece of land left. Even most of our nature areas are artificial, human-made parks. Twenty-two years ago, we seriously considered turning our major rivers and canals into an integrated system which could be directed in whatever direction we pleased. But we soon realised that rationalising our water systems to such an extent might turn these systems against ourselves. The delicate balance between existing uses and the aquatic ecosystem might be gravely upset.

The awareness of these risks only increased with some major accidents with far-reaching consequences. In the first place, the Sandoz blaze. In November 1986, a stock of hazardous chemicals took fire in Basel, Switzerland, alongside the Rhine, and the water used for extinguishing the fire flowed freely into the river, which turned ecologically dead at a length of 200 km. This calamity set the Rhine countries into motion and triggered the competent ministers of the riparian States to accept a set of ambitious objectives such as “to get the salmon back in the year 2000”. Soon, when elaborating a programme of actions for attaining these objectives, the administrations involved found out that they needed more than just emission reductions: the salmon, which had become extinct for quite a while, needs living rivers for its living. So we decided to set up nature rehabilitation projects: constructing ladders for migratory fish in order to circumvent sluices and weirs; reintroducing meandering floodplains; creating spawning and resting areas. We integrated water quantity and water quality management. And indeed, now we are approaching the year 2000, the signs are promising that the objective will be met.

Then, in 1993 and 1995, we were alarmed by extremely high water levels in the Rhine and Meuse, our two largest rivers. In 1995, we had to evacuate 250.000 persons, more than
of our population, because the dikes protecting our lands against flooding were on the verge of collapsing. This event gave a fierce blow to our self-confidence. It made us realise that by forcing our rivers into a strait-jacket by constructing dikes and by canalising the rivers for navigation purposes, we only increased the pressure on the water, and thus we only made our land more vulnerable. Meanwhile, canalisation works upstream and a huge increase of urban run-off decreased the volume of water staying within the catchment area, and thereby reduced the overall capacity of waters ready for human use. So we decided to integrate water management and spatial planning, by making the water system approach a guiding principle of our spatial policies. And this not only at national scale, but at the scale of the Rhine and Meuse river basins as well.

In the institutional sphere, we extended the scope of the International Commission for the Protection of the Rhine, up to then limited to water quality aspects, to related fields as flood control, ecosystem preservation and groundwater management. As far as the Meuse is concerned, we are aiming in the same direction, but circumstances are different. Anyway, the EU water framework Directive expected for adoption next year will mean a significant boost for a harmonized approach for river basin management all over Europe. At the same time, I would like to point out that no river basin is the same, even if the same partners are involved, as we have seen in the case of the rivers Scheldt and Meuse. If we put the emphasis of strategic water management at the river basin level, we also should respect the need of every river basin to shape their structures, their procedures and their culture according to the prevailing circumstances. A tailor-made approach, so to say, will be required.

I look forward with great interest to the results of this workshop, and I hope these will inspire the World Water Conference of The Hague to give significant support to the concept of integrated water management at river basin scale. A concept that has proven its worth in this very region. And I wish you a most pleasant stay in our water-rich country!

Thank you.
Honoured participants, Ladies, Gentlemen,

I am very honoured to be able to welcome you to this International Workshop on River Basin Management, organised by the RBA Centre for Research on River Basin Administration, Analysis and Management of the Delft University of Technology. However, were it not for the generous support of the Dutch Ministry of Transport, Public Works and Water Management, we would not be here at all! Their support made this workshop possible and I would like to gratefully acknowledge this. Many thanks!

River basin management has become a challenge nowadays and will be one of the biggest challenges for the 21st century. To my firm belief, effective river basin management is quintessential to prevent the destruction of ecosystems, the occurrence of disastrous floods and possibly even "water wars". This holds equally for developing as well as developed countries; for humid as well as for arid regions. Every effort should be made to avert the looming water crisis. We therefore welcome the initiative to organise the 2nd World Water Forum and the Ministerial Conference next year in March, here in The Hague. We see it as very appropriate that the Forum and Conference will be held in The Netherlands, a country with a centuries old water tradition, which evolved from "fighting water" via "coping with water" to "living with water".

The Delft University of Technology is of course not a river basin manager and we therefore cannot contribute directly to the solution of the pending water crisis. Indirectly, however, we can play a significant role, because we educate engineers who will later be active in river basin management, both in The Netherlands and abroad. The Dutch are well-known to work world-wide.

River basin managers of the future will have to be well-trained in topics such as hydrology and hydraulic engineering, topics that have been taught at our University since its establishment more than 150 years ago. But in addition, the future river basin managers need to understand the broader issues involved in river basin management and have a sound understanding of environmental issues, decision-making processes and the involvement of stakeholders and international water law. To provide our students with this knowledge, we also offer courses on topics such as ecology, integrated water resources management and water law.

In research we play a constructive role as well. Obviously, I should mention here the name of the RBA Centre. However, the University can fulfil its role in research and education only if it stays in close contact with important stakeholders from outside; to wit water managers and NGOs active in river basin management, both in The Netherlands, in other European countries and on other continents. Their input has to ensure that we address the most pressing issues in a realistic way. We are therefore very interested in your views on the major issues in river basin management and the best way to address them. We can use your input to further improve our education and research.
Perhaps river basin management really boils down on two things: an open dialogue and cooperation. In national river basins an open dialogue is necessary between the water managers at different policy levels; between water managers and water users; between water managers and land-use planners; and between government, farmers, industry, NGOs and citizens. And this dialogue will only be successful when supported by a firm intention to co-operate with the parties concerned. In international river basins – which cover some 45% of the earth's surface and nearly 100% of The Netherlands – this dialogue and co-operation is needed on an international level as well.

Co-operation is also needed in education and research, and for that matter even in the organisation of workshops. This workshop, for example, is organised in close co-operation with Delft Hydraulics, IHE-Delft and the Erasmus University, Rotterdam, which we gratefully thank for their collaboration. Concerning research, different departments of the Delft University co-operate in the interdisciplinary RBA Centre. Externally, we co-operate with other technological institutes in the "Delft Cluster", in "The Netherlands Water Partnership" and in several European research projects. International water resources management is but one of the topics addressed by the Delft Cluster fundamental research programme. The Netherlands Water Partnership unites the Dutch water expertise and aims to harmonise the activities and initiatives of the Dutch water sector overseas. And last but not least, the Delft University co-operates with many different water managers both in The Netherlands and abroad. This workshop is just one example.

Coming to the end of my welcome address, I realise that I may have spoken too much about the University and too little about river basin management. You will certainly make up for that in the course of the following days. Wholeheartedly I wish you a successful workshop and a pleasant stay in The Netherlands. And thanks again to our sponsors who made this all possible.

Thank you for your attention.
Recommendations and Guidelines on Sustainable River Basin Management

Key Message

Sustainable river basin management requires proper study, sound understanding and effective management of water systems and their internal relations (groundwater, surface water and return water; quantity and quality; biotic components; upstream and downstream). The water systems should be studied and managed as part of the broader environment and in relation to socio-economic demands and potentials, acknowledging the political and cultural context. The water itself should be seen as a social, environmental, and economic resource, and each of these three aspects must be represented in the political discourse. This discourse should reflect the interests of local communities and peoples, their livelihoods and their water environments. Users and managers at all levels must be allowed to have an input.

The aim of sustainable river basin management is to ensure the sustained multi-functional use of the basin. Basic water needs of peoples and ecosystems should be fulfilled first. Essential ecological and physical processes should be protected. Moreover, the effects on the receiving water bodies (seas, lakes, deltas, coastal zones) should be paid full attention.

The following points need to be stressed as crucial for sustainable river basin management:

General
- Leadership and political commitment
- Local empowerment and effective public and stakeholder participation in decision-making
- Decision-making at the lowest appropriate level
- Transparent processes
- Commitment to long-term capacity building, also by external support agencies
- Recognition of the role of social policy and economic incentives in managing water demand
- Financing of river basin management
- Maintenance (as much as possible) of the dynamics of the hydrological system; floods not only cause suffering, but also provide life
- Learning from previous experiences (e.g through Twinning)

Institutions
- Institutions that reflect local conditions, provide a framework for conflict avoidance and management, and are responsive to changing needs
- Flexible water rights responsive to changing (national and international) circumstances
- Clear mandate and sufficient resources for international river basin organisations
- National and international agencies with operational tasks should be accountable to the public and all stakeholders, have sufficient financial and legislative means, and work on the basis of a plan
- Consider ratification and implementation of the UN Watercourses Convention as a means to support river basin management
Planning and implementation
• Basin-wide planning
• Realistic plans, based on the best available knowledge and adaptive to new knowledge, with sufficient political support and financial means for implementation
• Needs (re)assessment and demand management
• Water markets only when several conditions are met

Monitoring and evaluation
• Accessible data, analytical tools and information
• Regular evaluations
• Compliance monitoring
Preamble

We, the participants in the International Workshop on River Basin Management, held in The Hague, 27-29 October 1999, professionals affiliated with international organisations, river basin commissions, national and sub-national governments, national hydrological services, non-governmental organisations and academic institutions from all regions of the world, participating in our personal capacity as experts;

Considering that river basins sustain natural ecosystems, are the paramount source of water, and fulfil non-consumptive, as well as consumptive uses;

Considering also, that in many river basins pressures on the environment, including the marine environment, have reached levels surpassing those that may be sustainable; that vulnerability from extreme natural events has increased; that conflicts between different water uses and between upstream and downstream uses are increasing; and that the capacity of many basins to meet the growing social demands, including basic human needs such as drinking water, is decreasing rapidly;

Recognising that effective river basin management that meets the needs of the present without compromising the ability of future generations to meet their own needs, is a prerequisite for sustainable development, including the social, environmental and economic dimensions;

Recognising furthermore, that effective, sustainable river basin management requires cooperation and political commitment, both within countries, within international basins, and at the global level;

Recognising moreover, that since the United Nations Water Conference in Mar del Plata in 1977, many initiatives have been taken and many international policy documents have been issued to promote sustainable river basin management, such as, the Dublin Statement on Water and Sustainable Development (1992), the Rio Declaration on Environment and Development (1992), Agenda 21, Chapter 18 on freshwater (1992), and the work of the UN Commission on Sustainable Development;

Recognising also, that the UN Convention on the Law of Non-navigational Uses of International Watercourses, which was adopted in 1997 but has not yet entered into force, contains many elements of relevance for river basin management;

Recognising in addition, that the concepts, principles and rules contained in the different international documents, while most relevant to river basin management, require specification and in many basins still await ratification and/or implementation and/or compliance monitoring;

Having discussed the issue how river basins can be managed in a sustainable way, on the basis of discussion papers, keynote presentations of a generic nature (on river basin management in general, on capacity building and the role of international donors, and on the Vision process and the Framework for Action), and keynote presentations on the management of individual basins (the Danube, Yellow River, Incomati, São Francisco and Colorado basin);
Recommendations and Guidelines on Sustainable River Basin Management

Have formulated the following "Recommendations and Guidelines on Sustainable River Basin Management" and a "Key message", and address them to:

- The Ministerial Conference, to be held on 21-22 March 2000 in The Hague in conjunction with the Second World Water Forum;
- The World Commission on Water in the 21st Century, which is preparing the World Water Vision for 2025, initiated by the World Water Council and including the Sector Consultation "Water in Rivers";
- The Global Water Partnership, which is preparing the Framework for Action for implementing the Vision;
- All other national and international governmental and non-governmental actors playing a role, directly or indirectly, in river basin management, such as the UN family of organisations, international banks and donors, national and international river basin organisations, the International Network for River Basin Organisations, national and sub-national governments in charge of (parts of) river basin management, water users associations, environmental NGOs, farmers, industry, consumers, consultants, trainers, teachers and academics.

I General

Leadership
1. River basin management is often characterised by parochial interests and intractable problems. To achieve progress, leadership and political commitment are essential.

Learning from experience
2. River basin managers can and should learn from each other's experiences, successes and failures. (cf. recommendation 29 and 30)

Public participation
3. Public participation and empowerment are necessary conditions for achieving sustainable development. To ensure effective public participation, independent of the goodwill of the authorities, rights of access to information, active participation in decision-making processes, and access to justice need to be legally established. Resources should be made available for the implementation of the outcomes of the public participation process.
4. Effective approaches and methods for public participation need to be devised that can be applied in different cultures and may help to overcome reluctance on the part of the authorities.
5. Since some issues in international river basins can be handled best at the international basin level, public participation should be provided for also at that level. This will contribute to a more integrated management of international river basins.

The importance of water
6. Water should be seen as a social, environmental and economic resource. The importance of safe drinking water supply and sanitation, the role of water for subsistence farmers and fishermen, and the significance for the different ecosystems should be recognised. Moreover, water plays a key role in many economic processes. Water has a high value, even if it is politically difficult to reflect this value in water transactions.
II Institutions

II.a General

Criteria
7. The institutional structure for river basin management should facilitate the necessary coordination within the water management sector and between the water management sector and other sectors such as land-use and environment in order to achieve sustainable water use and maintain the balance of the river system.
8. The institutional structure should also be a means of empowerment. All stakeholders should be able to play an active role in river basin management, including economic interest groups, local communities, environmental NGOs and women.
9. Policy formulation, mediatory, regulatory and other management tasks should be well-defined, clearly allocated and made transparent.

General government and river basin commissions for strategic tasks
10. Strategic tasks with many interfaces between sectors should be the primary responsibility of general (national, regional and local) government, and not of a specific functional institution.
11. River basin authorities with autonomous decision-making powers may be a good option for operational tasks with a narrow scope.
12. River basin commissions should be established for river basins crossing administrative boundaries in order to provide the necessary intergovernmental co-ordination and offer a platform for negotiation.

Decentralisation advisable and usually feasible
13. Decentralisation should be pursued as much as possible in order to bring river basin management as close as possible to the individual citizens and facilitate local variation in response to differing local conditions and preferences.
14. Decentralisation is also possible in case of tasks with a supra-local scope if the decentralised governments concerned co-operate (e.g. in a river basin commission) or if they are supervised by a higher-level government body.
15. The decentralisation process should be transparent, phased and planned.

Capacity building
16. The capacity of all institutions needs to be maintained and/or developed by means of short-term and long-term programmes (including postgraduate education and curricula development).

Local institutions
17. Traditional regimes and institutions should be recognised and integrated in river basin management.

Private sector participation and corporate management
18. There may be a distinct role for private entities (publicly or privately owned) in the provision of water services and water management. Private ownership of water infrastructure is a controversial issue that needs to be carefully explored.
Recommendations and Guidelines on Sustainable River Basin Management

19. Water rights should be flexible and responsive to changing circumstances at both the national and the international level.

II.b The management of international river basins

International co-operation: content and development

20. Mutual understanding and trust and shared information are the basis for international co-operation.
21. Technical co-operation involving the collection and dissemination of information promotes the acceptance of this information by all basin states and stimulates mutual understanding and trust. In times of international conflicts at least technical co-operation should be maintained.
22. Several mechanisms could be used to overcome conflicting (upstream-downstream) interests. Contentious international issues could be linked with other issues (“issue linkage”). Moreover, countries may accept less favourable agreements in the expectation that other countries will do the same in the future (“diffuse reciprocity”). In some cases financial compensation from the benefiting country to the country having to incur costs could be justified, provided the polluter-pays principle is respected.
23. River basin treaties and other forms of international co-operation should reflect the relevant principles of international law, primarily the principles of equitable and reasonable use, the obligation not to cause significant harm, and the duty to notify and exchange information.

International river basin commissions usually advisable

24. International river basin commissions can perform many useful functions in the management of international basins, such as co-ordination of research and monitoring, co-ordination of river basin management between the participating basin states, planning, compliance monitoring and conflict resolution. International river basin commissions are almost indispensable for international basins located in more than two states, and advisable for many basins located in two states. States sharing several international waters may also establish joint boundary water commissions.

International river basin authorities can be practical

25. International river basin authorities with decision-making and enforcement powers may be a good option for specific operational tasks, such as the restoration of water quality, shipping and the joint operation and management of infrastructure.

Watercourses convention

26. Ratification of the 1997 UN Watercourses Convention should be considered as an instrument to facilitate river basin management. In addition, principles with respect to limiting transboundary impacts (1992 UNECE Helsinki Transboundary Watercourses Convention), encouraging public participation (1998 Aarhus Convention), and water and health (1999 Protocol on Water and Health) may supplement the principles in the 1997 UN Watercourses Convention.

Interdisciplinary forum to develop principles and standards

27. A global multilateral interdisciplinary forum should be established to develop general principles and minimum standards for the sustainable management of international river basins. All relevant actors, including states, international organisations and non-state
actors, such as NGOs and other interest groups, should be enabled to participate in the discussions. The aim of the forum should be to exchange and share experiences and ideas on the management of international river basins.

**International donors and banks can play positive role**

28. The lending operations and programmes of international donors and banks should reflect the principles and considerations expressed in this document. Donors and recipient countries should co-ordinate funding programmes in order to ensure a coherent approach and long-term solutions.

**Co-operation and twinning important for strengthening river basin management**

29. Co-operation and mutual support between river basin organisations are important means of strengthening river basin management. Twinning of river basin organisations is an important form of such co-operation. It should aim at mutual learning and capacity building with respect to operational management, planning, institutions, mediation and analytical support.

30. Such co-operation is most effective if the partners are both national or both international organisations. Moreover, the partners should be comparable with respects to some, but not all of the following groups of parameters:
   a. The tasks and competencies of the river basin organisations and their internal structure
   b. The size and hydrology of the basins and the level of environmental pressure
   c. The socio-economic and cultural context

**III Policy and Planning**

**Function, scope and limitations of planning**

31. Planning (the formulation of plans and policies) is an important and often indispensable means to support and improve operational management. Planning has four related functions:
   a. To assess the current situation (including the identification of conflicts and priorities), formulate visions, set goals and targets, and thus orient operational management
   b. To provide a framework for organising policy relevant research and public participation
   c. To increase the legitimacy, public acceptance of, or even support for operational management
   d. To facilitate the interaction and discussion among managers and stakeholders, offer a common point of reference (the plan or policy), and thus provide co-ordination

32. Planning should involve, in a systems framework, all phenomena, institutions and issues that affect the allocation and protection of inland waters. It should not result in negative effects on other natural resources and should consider linkages to plans for biodiversity management, coastal protection, ocean health, and human health and well being.

33. Planning should be focussed and coherent and be in proportion to the resources available for implementation. Planning should be rooted in the real problems to be solved and be realistic.

34. Planning systems should be evaluated to check whether they serve their purpose; planning systems should not be taken for granted.

35. Given the differences in problem situations and cultures, planning systems should reflect the local situation.
Sectoral and intersectoral strategic plans
36. For international river basins and national basins located in several jurisdictions, strategic water management plans should be prepared that preferably cover the complete basin. The main function should be to co-ordinate water management between the different jurisdictions and offer a framework for negotiation. The planning process should be open to linkage with issues outside of the water sector, since this may result in win-win solutions for upstream-downstream conflicts, which otherwise would have a win-lose character.

37. For river basins falling within one jurisdiction, strategic river basin management plans should be prepared that are intersectoral in character. In such basins intersectoral planning offers good opportunities for intersectoral co-ordination.

38. Strategic (water management or intersectoral) plans should typically include or reflect, inter alia:
   a. Institutional arrangements
   b. Capacity building policy
   c. Public participation
   d. Transparency of decision making
   e. Legitimacy
   f. Structural and non-structural measures
   g. Economic aspects and efficiency
   h. Compliance

Operational plans
39. The operational manager should be committed to and hence be involved in (or even better, responsible for) operational planning. Depending on the institutional structure, the geographical scope of operational plans could or could not coincide with river basins or subbasins.

40. Operational plans should be realistic and consider the management capacity (finances, personnel, legal resources, etc.) that is or can be made available for the planning period. If necessary, the proposed measures should be adjusted accordingly, and shortcomings in the management capacity should be indicated.

Planning processes
41. To improve the quality and practicability of the planning exercise, planning processes should be participatory and involve all interested parties, preferably directly.

IV Operational management
Key role of operational management
42. The only form of river basin management that directly affects the river basin and its users is operational management (the application of regulatory, economic and communicative policy instruments and concrete activities such as infrastructure management). Consequently, it should play a pivotal role in any river basin management strategy. Planning, policies, analytical tools and institutional systems play an essential role as deciders and facilitators. They can improve operational management, promote a basin-wide, intersectoral long-term approach, and in this way further the sustained multi-functional use of the basins concerned.
Effective and accountable operational management
43. National and international agencies charged to execute operational decisions should be accountable to all stakeholders (including the public) through appropriate governance. They should work on the basis of a plan and be equipped with the necessary financial and legislative means.

Flood and Drought Management
44. Floods not only cause suffering but also support life. Flood management should not be based solely on building dykes and dams. It needs to be based on strategies that use both structural and non-structural methods. The strategy should balance all interests involved and be based on an integrated assessment, of the environmental, economic and human costs and benefits of these alternatives, including their potential contribution to drought mitigation and including the possibilities that they offer for nature.

Pollution control
45. The ultimate goal of pollution control is to close substance cycles and in this way prevent pollution. A mix of instruments for regulation and compliance can be used to move into this direction and solve urgent pollution problems: waste control, process and emission standards, and a water quality approach. The exact mix should reflect inter alia the local management capacity and the availability of water quality data and other data.

Communicative instruments complement to regulation
46. Communicative instruments for operational management, such as voluntary agreements, can help to improve the implementation of river basin plans and policies, but they only work in relation to (pending) regulation and compliance mechanisms.

Water markets under conditions
47. Tradable water rights can be an important tool for river basin management, but they are only effective if a number of conditions are met:
   a. The basic water demands of citizens and ecosystems are safeguarded
   b. The rights should be defined and agreed upon
   c. Utilisation of the rights should be physically possible
   d. Monopolies can be prevented
   e. For international river basins: an international agreement to that extent has been concluded.
48. Tradable emission rights are often not feasible because of the large number of different pollutants – many of which will only be emitted by one or few polluters in a sub-basin – and in case of diffuse pollution.

Charges
49. Charges are effective and efficient means to finance river basin management (cost recovery) and reduce water use and pollution if the basic water needs of the poor are safeguarded, e.g. by means of block tariffs.

V Monitoring and Evaluation

The need for data and information
50. Effective river basin management requires sound data, information and knowledge, including both data on surface and groundwater (quantity and quality) and social and
Recommendations and Guidelines on Sustainable River Basin Management

economic data. Collection and processing of relevant data, easy accessibility and broad dissemination are eminent tasks of river basin management.

51. To increase policy relevance, data should be aggregated into meaningful information, for example in the form of indicators and systems for benchmarking.

52. Compliance monitoring (reporting, reviewing and evaluating) is very important for promoting the implementation of plans.

International impact assessment

53. Within international river basins the social, economic, regulatory and environmental consequences of planned developments for other countries should be evaluated.

Harmonisation of monitoring and analysis methods

54. Monitoring and analysis methods should be harmonised nationally and, in case of international basins, internationally.

Exchange and dissemination of data and knowledge

55. The unrestricted exchange of data and knowledge is a prerequisite of efficient management and co-operation in both national and international river basins. Monitoring data collected with public funds should be publicly available and easily accessible, nationally and internationally.

A comprehensive analytical model

56. To support river basin management, a new analytical model should be developed that can aggregate socio-economic, political, institutional and technological potentials and hydrological constraints. This model should furthermore be capable of evaluating the actual management capacity.

Requirements for analytical methods

57. To support strategic planning, methods for analytical support should be developed that:
   a. cover the whole basin and all significant impacts;
   b. specifically consider the socio-economic processes that affect the basin;
   c. predict the socio-economic effects of alternative strategies; and
   d. present the issues in such a way that people can understand them.

58. Methods for analytical support should furthermore reflect the fact that policy analysis can never rely on quantitative information only. Moreover, these methods should be transparent and flexible, promote policy learning by all actors, and facilitate negotiation processes. Appropriate methods may include argumentative policy analysis and role-playing supported by a computer model of the natural system and the socio-economic effects.

Decentralised information systems

59. There is a large role for appropriate decentralised information systems and networks that can promote interaction among sectors, provide a basis for consistent technical studies, help communication with the public, and stimulate participation.

VI Implementing Sustainable River Basin Management

60. To implement the general principles contained in these Recommendations and Guidelines, promote policy learning and continuously improve river basin management, States
should specify the principles for their country and their basins, following a cyclic policy development approach. Such an approach would include the following steps:

1. Assessment of institutions, needs and resources
2. Planning
3. Implementation
4. Compliance monitoring
5. Evaluation
KEYNOTE PAPERS

River Basin Management and Planning  
*E. Mostert, E. van Beek, N.W.M. Bouman, E. Hey, H.H.G. Savenije, W.A.H. Thissen*

Problems in the management of International River Basins - the Case of the Incomati  
*Álvaro Carmo Vaz*

Basin Management of the Yellow River  
*Wenxue Li*

Management of International River Basins; The Case of the Danube River  
*László Kardoss*

The São Francisco River Basin  
*Rolando Gaal Vadas*

The Colorado River: History and Contemporary Issues of a Complex System  
*Robert W. Johnson*

The Role of River Basin Management in the Vision Process and Framework for Action up to Now  
*Tony Allan, Khalid Motadullah, Alan Hall*

The Role of External Support Agencies (International Donors) in Developing Cooperative Arrangements  
*G.J. Alaerts*
Summary

This paper gives an overview of river basin management (RBM), defined as "the management of water systems as part of the broader natural environment and in relation to their socio-economic environment." It distinguishes four levels in RBM: operational management, planning, institutional structure, and analytical support. Moreover, it identifies a number of crosscutting issues that are important at several levels: public participation, co-operation within international basins, and co-operation between basins (including the role of international donors and banks). Each level and each crosscutting issue is discussed at some length in order to come to an understanding of what RBM really entails and how it can be improved. The purpose of this was to initiate the discussions at the International Workshop on River Basin Management (The Hague, 27-29 October), which have resulted in "Recommendations and Guidelines on Sustainable River Basin Management". However, the paper can also be read simply as an overview of RBM.

1 Introduction

Background

River basins are important management units. They are the natural context in which freshwater occurs, the ultimate source of all water used and the receptor of most waste water. Moreover, they have important non-consumptive uses, such as recreation, nature, shipping and hydropower production.

River basins are being used ever more intensively. In many basins human pressure is reaching the maximum sustainable level or has already surpassed this level. Conflicts between different water uses and between upstream and downstream use are increasing, many basins are overexploited, and the capacity to meet the different social demands is decreasing. To prevent or remedy these problems, an integrated approach to river basin management (RBM) has been called for. Basic elements of such an approach are a basin-wide scope; attention to the different forms (surface and groundwater) and aspects (quantity, quality) of water; attention to the relations between land and water resources; and the integration of natural limitations, social and economic demands, and legal, political and administrative processes (e.g. White 1957, Teclaff 1985, Lundqvist, Lohm and Falkenmark 1985, Newson 1992, Wessel et al. 1999, Dublin principles: ACC/ISGWR 1992, Agenda 21: UNCED 1992).

Integrated RBM will play a significant role in the Long Term Vision for Water, Life and the Environment of the World Water Council and the Framework for Action of the Global Water Partnership, which are presently being developed. The former will describe the desired future scenario for 2025, while the latter will provide a "route map" of how to get there. Both
will be presented at the 2nd World Water Forum, which will be held from 17-22 March 2000 in The Hague (The Netherlands).

In conjunction with the World Water Forum a Ministerial Conference will be held which is to provide the political commitment to the Vision and the Framework. To support the preparations for this conference, the RBA Centre of the Delft University of Technology has organised a workshop at the request of and sponsored by the Dutch government, in cooperation with IHE Delft, Delft Hydraulics and the Gldis Institute of the Faculty of Law of the Erasmus University (Rotterdam). The workshop has resulted in “Recommendations and Guidelines on Sustainable River Basin Management”, which are addressed to the participants in the Ministerial Conference, to be held on 21-22 March 2000 in The Hague in conjunction with the Second World Water Forum, and to all others playing a role in RBM.

Purpose and structure of paper

The purpose of this paper is twofold. First, it provides an overview of RBM and the general principles to be applied, irrespective of the different hydrological, economic, social and political conditions. Second, this paper raises several specific issues that are encountered when trying to implement these principles in practice. In this way it tried to stimulate the discussion that ultimately resulted in the “Recommendations and Guidelines”.

The paper first delineates the concept of RBM, discusses its aim and describes the different levels in RBM (§ 2). Subsequently, the different levels are discussed in more detail under four headings:
- Operational management (§ 3)
- Institutional structure (§ 4)
- Planning (§ 5)
- Analytical support (§ 6).

Following, three topics are discussed that play a role at the different levels:
- The management of international river basins (§ 7)
- Co-operation between basins (§ 8)
- Public participation (§ 9)

The final section discusses how RBM as outlined in this paper could be put into practice (§ 10). The annex recapitulates the different issues encountered in the form of statements for discussion.

The term “river basin management” appeals to many persons, but its appeal is not universal. Nationals from some countries often argue that there is no river basin management in their country. What they really mean is that no river basin organisations and no integrated, basin-wide planning exist in their planning. However, this paper does not treat river basin organisations and planning as synonymous with RBM, but rather as a means to implement RBM, together with for instance informal co-operation.

A second line of argument against the term RBM is that often areas other than the river basin are important and that therefore integrated water resources management (IWRM) is a better term. In fact, as used in this paper, RBM is almost synonymous with IWRM. However, the term RBM emphasises the relation between water and land resources and the geographical and often international dimension (upstream-downstream). Moreover, the term RBM does not imply that all management should take place at the basin level (see above), or that river basins are closed systems or the only relevant geographical areas. It does imply, however, that river basins are important units that should be managed carefully, for the benefit of present and future generations.

Box 1: Why talk about river basin management?
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**Box 1: Why talk about river basin management?**
River Basin Management and Planning

2 What is river basin management?

Water and its environment
Fundamental to river basin management (RBM) is the river basin itself. A river basin can be defined as the geographical area determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus (cf. art. II of the Helsinki rules). Strong relations exist between groundwater and surface water in the basin, between water quantity and quality and between land and water, upstream and downstream. These interrelations turn river basins from a geographical area into a coherent system (cf. Lundqvist, Lohm and Falkenmark 1985, Newson 1992).

River basins are open systems with sometimes ill-defined boundaries. Rivers may have a shared delta, watershed limits in flatland areas are either vague or man-made (and alterable), and watershed limits often do not correspond exactly with aquifer limits. Moreover, river basins interact continuously with the atmosphere (precipitation and evaporation, airborne pollution) and the receiving waters (seas and sometimes lakes). Furthermore, the uses made of river basins often transcend river basin boundaries (e.g. interbasin water transfers).

Despite their open and sometimes ill-defined character, river basins are very important systems. They fulfil many important functions, such as water supply for households, industry and agriculture, navigation, fishing, recreation, and “living space”. Economic and social development and even life itself cannot be sustained without sufficient water at the right time and place and of the right quality. Moreover, water has shaped and continues to shape the environment in which we live. It erodes mountain areas, transports sediment and creates delta areas. It can cause floods and is essential for nature.

River basin management (RBM) is about all these things. It is much broader than traditional water management and includes significant parts of land-use planning, agricultural policy and erosion control, environmental management and other policy areas. It covers all human activities that use or affect freshwater 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.

Aim
Following the logic of sustainable development, the aim of RBM can be formulated as ensuring the multifunctional use of rivers and their basins for the present and future generations. Since the capacity of river basins to accommodate different uses is always limited, priorities have to be set. Humanitarian considerations dictate that first the basic human needs have to be safeguarded: water supply for drinking and basic hygiene. Moreover, nature, which cannot represent itself, should be given a full place in RBM. Apart from that, priorities should depend on the natural, social and economic conditions in the pertinent basin and the values and interests of its population.

An outline of RBM
To come to grips with RBM, it is useful to distinguish four different levels: operational management, planning, analytical support and the institutional framework. Only operational management affects river basins directly (see figure 1). Planning (used here in a generic sense as including policy formulation) is a means to improve and support operational management. Analytical tools support both planning and operational management. All three take place in

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5 Cf. the famous definition of sustainability in the Brundtland report: “development which meets the needs of the present without compromising the ability of future generations to meet their own needs.” (WCED 1987: 43)
and are influenced by the legal and institutional framework, which is therefore the fourth level in RBM. The following sections provide more details.

Figure 1: Levels in river basin management (feedback mechanisms not indicated)

3 Operational management

RBM can affect river basins in different ways. It may interfere directly in the river basin by means of river regulation, constructing and operating water supply infrastructure, reforestation projects, etc. RBM may also address the behaviour of the different users or managers by explicitly forbidding or allowing certain activities (regulation), by offering economic (dis)incentives and by providing information. Different resources are necessary to apply these instruments, such as money, personnel, legal resources, appropriate policy directives and data.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>CHARACTERISTICS</th>
<th>INSTRUMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete activities</td>
<td>Direct interference by the managers in the river basin</td>
<td>- Structural flood protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- River regulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Water supply and sanitation infrastructure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reforestation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Etc.</td>
</tr>
<tr>
<td>Regulation</td>
<td>Influencing other managers or users by means of forbidding activities or explicitly allowing them</td>
<td>- Standard setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Permitting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Compliance monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sanctioning</td>
</tr>
<tr>
<td>Economic instruments</td>
<td>Influencing other managers or users by means of financial (dis)incentives; market mechanisms</td>
<td>- Charges (taxes, levies etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Subsidies (financial contributions etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tradable water use and pollution rights</td>
</tr>
<tr>
<td>Communication and awareness raising</td>
<td>Influencing other managers or users by providing information</td>
<td>- Public information</td>
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<tr>
<td></td>
<td></td>
<td>- Non-binding plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Voluntary agreements</td>
</tr>
<tr>
<td>Financing</td>
<td>Supporting the previous instruments by providing the necessary finances</td>
<td>- Charges (taxes, levies etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- General taxes</td>
</tr>
<tr>
<td>Capacity building</td>
<td>Supporting the previous instruments by providing the other necessary resources (personnel, legal competencies, policy directives)</td>
<td>- Staff training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Legislation</td>
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<tr>
<td></td>
<td></td>
<td>- Planning</td>
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<tr>
<td></td>
<td></td>
<td>- Etc.</td>
</tr>
</tbody>
</table>

Table 1: Types of operational RBM instruments
Table 1 gives an overview of the different types of operational RBM instruments. Any effective RBM system will require a mix of instruments. However, there is no unanimity as to which instruments should be chosen. A number of current issues are discussed below.

New infrastructure?
Modern RBM is unthinkable without infrastructure for water supply and flood protection. Yet, infrastructure is also very expensive, and someone has to bear the cost, also in case of subsidies. Moreover, infrastructure often reduces the “resilience” (adaptability) of river basins and can have negative environmental effects. Non-structural measures can offer an alternative. In water supply, they include water re-use, water saving, water pricing, educational activities and locating water-intensive activities in water-rich areas (“demand management”: e.g. Merrett 1997). In flood protection, non-structural measures include land-use planning (e.g. not building up flood-prone areas) and insurance.

<table>
<thead>
<tr>
<th>APPROACH</th>
<th>DESCRIPTION</th>
<th>STRENGTH</th>
<th>WEAKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product policy</td>
<td>- Explicit forbidding or allowing the use of specific products&lt;br&gt;- Quality standards for products</td>
<td>- Administrative costs and demands and enforcement can be low (depending on product)&lt;br&gt;- Appropriate for diffuse pollution (e.g. pesticides)</td>
<td>- Production process often more important than product</td>
</tr>
<tr>
<td>Process standards</td>
<td>- Prescribing specific processes&lt;br&gt;- Standards concerning the environmental performance of production processes</td>
<td>- Standards concerning environmental performance are steps towards ultimate aim of closing substance cycles</td>
<td>- Administrative costs and demands on capacity of managers are high&lt;br&gt;- Prescribing specific processes may hinder the application of cleaner technologies</td>
</tr>
<tr>
<td>Uniform emission standards</td>
<td>- Emission standards applying to all emissions in a certain area (usually country)</td>
<td>- Solution for reducing emissions of dangerous substances quickly to zero</td>
<td>- Too strict in some cases, too lenient in others&lt;br&gt;- May promote end-of-pipe solutions</td>
</tr>
<tr>
<td>Water quality Approach</td>
<td>- Emission standards, usually set in a permit, that reflect the quality of the receiving water in relation to the prevalent quality standard</td>
<td>- Most efficient: pollution reduction efforts concentrated where need is largest</td>
<td>- Difficult to link emissions to water quality: many data needed (water quality, emissions, transport and persistence, dilution, etc.) and good models&lt;br&gt;- Administrative costs and demands on capacity of managers are high&lt;br&gt;- Not appropriate for pollutants accumulating in the environment; difficult to deal with synergetic effects&lt;br&gt;- Unequal treatment of polluters in different basins and between different parts of the basin (upstream-downstream, tributaries)&lt;br&gt;- Difficult to ensure minimum level of pollution control</td>
</tr>
</tbody>
</table>

Table 2: Regulatory approaches to pollution control
Pollution control
In a sustainable world RBM will not have to deal with pollution control. The use of non-renewable resources will be minimised and substance cycles will be closed (cf. Goodland 1994), resulting in zero or close to zero emissions. The main issue is how to approach the ideal and how to solve urgent pollution problems. Apart from economic and communicative instruments, discussed below, four approaches could be followed: product policy, process standards, uniform emission standards and a water quality approach. Table 2 compares the strengths and weaknesses of the different regulatory approaches.

There is no universally best approach: it depends on factors such as the urgency of pollution problems, the substance concerned, the pollution source, the capacity of the managers, etc. In practice the different approaches are often combined, e.g. minimum uniform emission standards combined with more stringent pollution controls if the water quality so requires (e.g. Rees and Zabel 1998, Commission 1997).

Voluntary agreements and other communicative instruments
A big problem in all regulatory instruments is enforcement. Personnel and equipment are often insufficient for frequent monitoring, sometimes the different bodies responsible for enforcement do not cooperate effectively, and political forces and lobbying may prevent strict sanctioning.

Voluntary agreements and other communicative instruments can offer a partial solution. They are based on the cooperation of the water users or polluters: the latter are not forced but persuaded to do or not to do something. This makes control and enforcement less problematic. Moreover, since they are not legally binding, users and polluters may be willing to agree on quite ambitious goals. However, they will not commit themselves voluntarily to anything that goes against their interest, unless there are some specific incentives – such as regulation if no agreement is reached. Moreover, voluntary agreements require a high degree of organisation of the different user groups. Finally, it should be clear what happens if individual users or whole user groups do not comply with a voluntary agreement. Regulatory instruments remain therefore necessary, and work needs to be done on improving enforcement (Mostert 1999).

Market mechanisms
Another issue relates to the potentials and limitations of market mechanisms. Market mechanisms are often seen as very efficient. Tradable emission rights would ensure that pollution is reduced where the costs are lowest, and tradable water use rights would ensure that water is used where the benefits are highest. Yet, in the case of water use rights the basic water needs of the poor should be safeguarded and speculation and monopoly formation should be prevented. Tradable emission rights are often not feasible because of the large number of different pollutants, many of which will only be emitted by one or few polluters in a subbasin, and in case of diffuse pollution. Finally, monitoring and control of actual water use and pollution is as important as in a purely regulatory approach.

Charging and full cost recovery
The final operational issue discussed is charging. Charging can serve several purposes: costs recovery from water services provided (water supply and waste-water treatment), revenue raising and reducing water use and pollution. Whenever charges are based on actual water use/pollution, it will always reduce water use/pollution to a certain extent. The size of the effect depends on the price elasticity (the sensitivity of water use/pollution to the costs of the user/polluter), which is generally low in the case of drinking water use and high in the case of irrigated agriculture (the major water user in many countries).
Charges that reflect the full economic and environmental costs of water use and pollution are economically efficient since they confront the water user/polluter with the real costs and promote an integral assessment of the costs and benefits. Moreover, they solve the financing problems of the providers of the water service concerned. Yet, there are some potential complications. First, water should not become too expensive for the poor to meet their basic needs. Second, high charges can make irrigated agriculture unprofitable, resulting in a drop in production. This will cause an often welcome drop in water use, but the effects on the rural communities can be quite substantial, especially if there is no alternative source of income. Related to this point, very high charges and especially rapid increases may decrease the willingness to pay and may result in massive political opposition. Finally, reductions in water use and pollution may in the short term create excess capacity, raising the unit cost (see also the discussion on privatisation in section 4).

Water rights
An alternative approach to operational RBM is a discussion in terms of water rights. Two types of water rights should be distinguished: ownership rights and the right to use water (Caponera 1992). Water bodies can be government-owned, they can be privately owned, they can be the property of a whole community (res communis omnium), or they can be seen as something that cannot be owned by anyone (res nullius). The ownership status depends on the national legal system (Roman law countries, common law countries, Arab countries, etc.) and the type of water body (navigable or non-navigable river, ponds, groundwater, water in containers).

Use rights do not always follow automatically from ownership rights. In the case of government ownership, water use rights are generally granted by a government body by means of permits, concessions, etc. Private ownership, however, does not necessarily mean that the private owner can use the water as he pleases: apart from his duty not to encroach upon the rights of others, his ownership right might be limited by the government and permits may be needed for specific uses. If the water is seen as the property of a whole community or as incapable of being owned by anyone, water use is often regulated by the government. However, in many places local communities of users have their own institutions to manage water use ("common property management": see the next section). Specific problems may occur in the case of transboundary waters (see section 7).

The major issues concerning water rights relate to their flexibility. In the case of privately owned waters these issues include the extent to which the ownership right can be limited; whether water use can be charged; and whether – if necessary and with due compensation – the water can be expropriated. In the case of water use rights major issues are whether these rights are granted for a specific period or in perpetuity and under which conditions they can be revised. A relatively high degree of flexibility – combined with respect for existing rights and if necessary compensation – seems essential for effective RBM in a changing world.

4 Institutional structure
The instruments for operational management are not applied in a vacuum but in an institutional structure. Institutional structures consist of three levels of formal and informal working rules. Operational rules provide a framework for operational management. Examples are statutory emission standards and policy directives. Collective choice rules deal with how operational rules should be developed. Examples include permitting and planning procedures. Constitutional rules determine who is entitled to make collective choice rules. They set up the organisational structure for RBM and allocate tasks and competencies (cf. Ostrom 1990).
This section discusses the constitutional level and present three basic models for RBM. Moreover, three issues deserving special attention are discussed: decentralisation, privatisation, and local institutions as an alternative to RBM by government and privatisation.

**Three models**

Roughly speaking, three different models exist for RBM (Mostert 1998a). In the *hydrological model* the organisational structure for water management is based on hydrological boundaries. In its extreme form all water management is in the hands of a single entity: the “river basin authority.” The *administrative model* is in many respects the opposite of the hydrological model. In this model water management is the responsibility of provinces, municipalities and other bodies not based on hydrological boundaries. The *co-ordinated model* falls somewhere between the hydrological and the administrative model. In this model water management is not performed by river basin authorities, but there are river basin commissions with a co-ordinating task.

Each model has advantages and disadvantages. In the hydrological model administrative coincide with hydrological boundaries and there is the least chance of upstream-downstream conflicts. However, since river basin authorities usually deal with water management only, this model may isolate water management from other relevant policy sectors, and intersectoral co-ordination may become a problem. Moreover, in countries with decentralised water management the adoption of this model would imply centralisation, and in international river basins it would imply the establishment of a supranational authority. Consequently, river basin authorities are often only an option for smaller national basins and for operational, not politically sensitive tasks with a narrow scope, such as buoying.

In the administrative model water management, land-use planning and other relevant policy sectors can be kept together (but are not necessarily kept together). A major disadvantage is the serious risk of upstream-downstream conflicts and the lack of a platform to discuss these problems. In the co-ordinated model such platforms exist: river basin commissions. The different bodies participating in these commissions could each individually ensure co-ordination between water management and other policy sectors, and together, in the commission, they could co-ordinate their water management.

*Infrastructure vs. regulation, financing and empowerment*

Additional conclusions can be drawn if we distinguish between the different tasks in RBM. First, it may not be advisable to combine the responsibility for constructing and operating infrastructure with regulatory responsibilities if this means that managers have to control their own operations (the “poacher and gamekeeper” problem). This can only work well if the managers themselves are controlled strictly.

Second, tasks, competencies and financing should go hand in hand. Without sufficient competencies and financing, managers cannot perform their tasks properly. Either their competencies and financing should increase or – if that is not possible – their tasks have to be redefined.

Third, the institutional structure for RBM is also a means of empowerment: it gives or denies legal rights and influences the balance of power between the different parties involved. For RBM to be effective and equitable, it is important that the different water users, local communities, women and environmental NGOs (non-governmental organisations) can participate actively in RBM.

*Decentralisation*

This last point brings us to the issue of decentralisation. Several good reasons can be given for decentralisation. It is democratic to bring government as close as possible to individual
River Basin Management and Planning

citizens and allows for local variation in response to local circumstances and preferences (cf. the notion of "subsidiarity": Brinkhorst 1992, Leenknecht and Bekkers 1993, Kraemer 1998a). Moreover, decentralised government tends to be less bureaucratic – simply because of its size – and better informed about local circumstances.

Decentralisation is also possible for tasks with a supralocal character, provided the decentralised governments co-operate with each other or are supervised by a higher level government. Supervision may also improve enforcement of regulations in case the decentralised governments have too close relations with the persons and organisations they regulate. Decentralisation is not possible for tasks such as establishing the institutional structure and formulating policies that apply to a country as a whole. However, decentralised governments should be involved because of their superior information on local conditions and because of their (usually) closer contacts with the population. Decentralisation may also not be possible if the decentralised governments lack the necessary management capacity. Solutions could include local capacity building and advisory services by specialised central governments.

Privatisation

Privatisation could be another solution for the shortcomings of large bureaucracies. Privatisation is only possible for specific services such as the construction and operation of water supply and waste-water treatment infrastructure – not for regulatory functions and policy making. Different forms exist. A very common form is contracting out specific activities such as construction, billing, and laboratory services. Privatisation may also imply that private firms get a contract to operate and/or maintain the infrastructure for a specific water service. The infrastructure remains in the hands of government, and after expiration of the contract another firm may be contracted. The opposite also occurs: government is responsible for operation and maintenance, but for budgetary reasons it does not own the infrastructure but rents it from a private firm. Finally, private firms may own, operate and maintain the infrastructure (cf. Kraemer 1998b).

The private provision of services can be efficient. Private companies have a strong incentive to minimise costs in order to stay in business and raise profits. However, many water services are a “natural monopoly”: the necessary infrastructure is so expensive that there can be only one provider. To prevent misuse of this monopoly, a well-functioning economic regulator controlling prices and the quality of the service is necessary. Moreover, the environmental performance of the service provider should be assessed and regulated since its prime motive will be cost minimisation, not environment improvement. In case competition is possible (e.g. competition for a government contract), anti-cartel rules and strict procedures for awarding contracts may be necessary.

A midway option between the public and private provision of water services is the provision by publicly owned private companies. These are not dependent on the government budget, can apply commercial double-entry bookkeeping, and can take out the necessary loans. In theory they can function as efficiently as private firms. Since their shareholders are public authorities, the incentive to misuse their monopoly position and save on environmental measures may be smaller. The incentive to minimise costs may also be smaller, but benchmarking of a complete sector may provide an additional incentive. Finally, publicly owned private companies could be used as a “milk cow”, providing the shareholders with financial resources without having to increase taxes.

The third alternative: local institutions

Last but not least, the importance of local institutions for managing river basins should be mentioned. River basins and river-related infrastructure provide several goods and services to
society. Unless there are means to exclude potential beneficiaries from these goods and services, they will have a temptation to “free-ride”. They may not contribute to the development or upkeep of the resource and may not limit the use they make of the resource, since they benefit anyway. The result is an overexploited resource in bad shape, providing less or no goods and services, to the detriment of all (“Common pool resources” and “public goods”: Ostrom 1990).

To solve the free-rider problem, two solutions are often proposed: government intervention (government provision or regulation), or privatisation of the resource and its use. As may be clear from the foregoing discussion, these solutions are not always feasible or effective. Yet, there is also a third alternative. There are many examples of beneficiaries organising themselves for developing or managing the resource concerned and preventing over-exploitation. Based on their intimate knowledge of the resource, they may devise rules to limit use and may set up self-financing systems, self-monitoring systems and conflict-resolution procedures. The results are local institutions that are neither totally public nor private but have a mixed character (Ostrom 1990, cf. Kraemer 1997, cf. Barraqué 1998).

5 Plans and policies

Whereas operational RBM constitutes the core of RBM, plans and policies have an important supportive role to play. As important as the plans and policies themselves is the way in which they are prepared, the “planning process” (used here in a generic sense as including policy formulation).

Functions of plans and policies

Plans and policies can support operational RBM in several ways. Planning helps to assess the present situation in the basin, the situation desired, the gap between the two, and means to bridge the gap. It helps to orient operational management and set priorities.

Second, it is often not possible or effective to do policy analysis and organise public participation for each individual operational decision. In these cases planning may offer a framework and focus (cf. Faludi 1987).

Third, open and participatory planning processes may result in more public support or acceptance of the resulting plan/policy and (by extension) operational management.

Fourth, plans and planning may have a co-ordinating effect. Planning processes can bring the different river basin managers into discussion with each other and the resulting plans and policies can act as common focal points.

The planning process

Planning requires extensive technical and scientific information, but it can never be purely technical or scientific (cf. Parker and Penning-Rowsell 1980). The following steps could be followed:

1. Identification of the need for planning, possibly involving some preliminary research
2. Analysis of the institutional framework for RBM and identification of the different operational decisions that can be taken, the bodies responsible for these decisions, and their management capacity
3. Identification of the other stakeholders and their main interests
4. Preparation of a process design, describing the scope of the planning exercise; the different phases; the different groups to be involved in each phase and the means to do so; the necessary research in each phase; and the project organisation
5. Implementation of the process design, resulting in the adoption of a plan

After a while the plan and its implementation can be evaluated, and the process can start again. Yet, there may also be a need for iteration earlier in the process. For instance, in step 4 the scope of the planning exercise may be broadened, which may necessitate a more extensive analysis of the institutional framework and may bring more stakeholders into the picture (steps 2 and 3).

In step 5 goals, targets and measures are proposed. To be adopted and later on implemented, they should reflect the major constraints – legal, political, administrative, technical. However, planning may also result in initiatives to stretch too restrictive constraints (cf. Majone 1989).

Planning systems

Plans and policies relevant to RBM can differ on many dimensions: policy sectors, geographical scope, etc. (Table 3). What types of plans are needed in a specific situation depends on a number of factors, such as the most important policy issues; whether the river basins are located in one, two, or more jurisdictions; the funds that can reasonably be spent on planning, etc. These factors differ from country to country and from basin to basin, but still some general guidelines can be given.

<table>
<thead>
<tr>
<th>Strategic vs. operational character</th>
<th>Setting aims and goals (<em>policy plans, policies</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Setting short or medium-term targets, strategies and/or specific guidelines for operational management (<em>operational plans, strategies</em>)</td>
</tr>
<tr>
<td></td>
<td>Setting prioritising and/or specifying, scheduling and financing operational activities (<em>programmes</em>)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy scope</th>
<th>Only surface or groundwater, quantity or quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Only some uses (e.g. hydropower)</td>
</tr>
<tr>
<td></td>
<td>All water, all uses</td>
</tr>
<tr>
<td></td>
<td>Water and land</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Geographical scope</th>
<th>Whole basin</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Subbasin(s)</td>
</tr>
<tr>
<td></td>
<td>Part(s) of (sub) basin(s)</td>
</tr>
<tr>
<td></td>
<td>Administrative area</td>
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<td></td>
<td>National/international</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Character</th>
<th>Purely informative, politically binding or legally binding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validity</td>
<td>Short, medium, long-term</td>
</tr>
<tr>
<td>Time horizon</td>
<td>Short, medium, long-term</td>
</tr>
<tr>
<td>Detail</td>
<td>Global plan, detailed plan</td>
</tr>
<tr>
<td>Planning process</td>
<td>Top-down closed planning</td>
</tr>
<tr>
<td></td>
<td>Top-down participatory planning</td>
</tr>
<tr>
<td></td>
<td>Bottom-up planning</td>
</tr>
</tbody>
</table>

Table 3: Types of plans and policies relevant to river basin management

In section 2 RBM was described as the management of water systems as part of the broader natural environment and in relation to their socio-economic environment. Consequently, river basin planning should ensure the consideration of the different interrelations within water systems (surface and groundwater quantity and quality), the interrelations between water systems and land, and the interrelations between complete river basins and their socio-economic environment. This does not mean that each individual plan should have such a broad scope. Rather, we should think in terms of planning systems: sets of interrelated types of planning, consisting of strategic and operational plans. The more strategic a plan is, the more important it is that it covers complete river basins and all relevant
policy sectors. Operational plans have to go more into detail and usually cover only one policy sector or part of a sector. Moreover, they could cover areas different from the river basin, provided they are firmly set in a more integrated framework and provided all the necessary co-ordination with other operational plans takes place.

The types of plans needed depend on the need for the different functions that plans can perform. For instance, if in a specific basin there is one very urgent, very obvious issue, such as pollution of drinking water sources, there may be no need for integrated strategic planning that provides a complete integrated description of the basin and sets long-term goals. The resources could much better be used for making and implementing an operational plan that sets concrete targets, proposes operational measures, and creates the necessary support.

Generally speaking, the number of plans should be kept low, especially in countries and basins with a low management capacity. If too much planning is going on at the same time, too few resources may be available for each planning exercise, co-ordination between the plans can become problematic and transparency for the citizen is reduced. Moreover, resources that are spent on planning cannot be spent on operational management.

6 Analytical support

River basin management is a complex task. Therefore, tools that help to assess the present situation and assist the development and evaluation of solutions may be important. Two types of support can be distinguished: support of operational management and support of strategic policy making and planning. A second distinction is between (support) systems for monitoring, data collection and processing, oriented towards making facts and figures about the “as is” situation available; and tools or systems to support decision-making with a view to the future, typically oriented to the ‘ex ante’ identification, analysis and evaluation of alternative allocations, policies or plans. These distinctions are not absolute. Operational management and strategic policy-making interact, and data collection and ex ante analysis support each other.

The development of information and computer technology over the last thirty years has enabled the design and application of a wide array of systems and tools for supporting water managers. Most efforts in the field have so far concentrated on the technical and physical aspects of the (physical) river system itself. Little attention has been paid to the development of systems and tools covering relevant aspects and processes in the river basin as a whole. This can be explained by the fact that broader notions of integrated water are relatively recent, and by the complexity of monitoring and analysing the interaction between natural and socio-economic systems at the scale of a river basin.

Analytical support for operational management: main challenges

At the level of operational management many analytical tools have become available. In most river basins ambient monitoring is carried out on a routine basis and the results are stored in databases. A major challenge is the homogenisation of the monitoring and analysis methods used by the different institutes, especially in international basins. A second challenge is to make the information available to anybody involved or interested. Developments in database technology, often in combination with Internet applications, can provide powerful tools for data retrieval. The application of such technical possibilities is, however, often severely constrained by institutional/political reasons, especially in the field of water quality monitoring.

A more advanced type of operational support is to combine on-line monitoring with computer models in order to predict future conditions of the system. Examples are Early Warning Systems, both for water quantity issues (floods, droughts) and for water quality
issues (accidental spills). Flood Early Warning Systems are already installed in many major basins in the world.

An even more advanced form of support is the automation of infrastructure operation, such as weirs, pumps, sluices, etc. In most cases such tools do not replace human operators: the tools provide the necessary information, but the operators decide. This information is generated using monitoring data, often combined with computer models that describe the behaviour of the natural system (water levels, discharges, etc.). The main challenge is to develop support systems that describe not only the natural system, but also the use functions related to this system, thus enabling a weighing of all aspects involved.

The ultimate form of automation is systems that actually take and implement decisions. For simple systems, such as switching pumps on or off in response to the water level, this is straightforward and beyond discussion. However, the operation of major infrastructure, such as storm-surge barriers, is increasingly fully automated as well, thus eliminating the risk of human errors.

**Analytical support and the strategic level: new directions**

At the level of strategic planning and policy-making, most efforts so far are related to the development of specific tools for specific problems in specific river basins. Examples include the analysis of options for managing and clean-up of heavy metal pollution in the Danube and the analysis of the origins, transport and impacts of Nitrogen and Phosphorus from agriculture in the Rhine basin. The challenges of developing more generic and comprehensive tools at the river basin level are enormous. Generally, there is a lack of data and theories to fully describe the complex processes taking place in the river system and the interaction with the socio-economic system. In addition, at the level of a basin, a large number of processes and aspects are relevant, making it difficult – if not impossible – to include all in a single model or tool. Yet, given the crucial importance and complexity of management at the basin level, it is of utmost importance that investments are made in the further development of analytical approaches and associated tools. We limit ourselves here to indicating a number of directions for development and improvement.

First, analytic tools for supporting integrated management at the river basin level should describe not only the different aspects (quantity and quality) of the physical system, but also the interactions with the socio-economic system. They should incorporate the possibilities to affect socio-economic processes and assess the impacts of alternative policies on the relevant socio-economic sectors. The few attempts so far at developing such tools generally focus on one or a few aspects only. The development of integrated (assessment) tools covering all relevant impacts (ecological, hydraulic, economic, social) on the basis of a model of the system as a whole is hampered by complexity and lack of knowledge of all interactions and processes. Yet, attempts should be made to develop integrated analyses of the interaction of key water management issues at the river basin level. Such tools will inevitably be highly aggregated and should be based on underlying scientific knowledge.

Second, as many processes and implementation aspects have a regional rather than a basin-wide character, tools should facilitate the linkage of (aggregated) strategies at the basin level and strategies at the regional and local levels. Thus, the challenge is not to develop one tool at the basin level, but rather to develop a family of tools operating at different geographical scales and levels aggregation, linked to each other for overall consistency.

Third, RBM is in essence a mixed process of learning and negotiation. Tools may be developed that address this mixed character more explicitly and support the negotiation more directly. Such tools or models would not only describe the costs and benefits of specific actions to the various actors involved, but would also help to explore the possibilities for exchanges between actors, to assess the need to involve other actors in the process, and
possibly to identify potential linkages to other issues that would turn a win-lose situation into a win-win situation. Linkages may particularly be necessary in river basin situations with their typical upstream-downstream relations.

Fourth, support systems and tools should be developed that are better tuned to the dynamic and increasingly participatory nature of policy processes. Present analytic models are often highly complex and hard to communicate to non-specialists, if at all. For interactive learning settings there is a need for more flexible and transparent tools. This too points to the need for a family of tools: detailed analytic tools grounded in existing theory and detailed data, and more aggregate, global meta-tools based on the results of the underlying complex ones.

Fifth, alternatives to the traditional tools based on "objective" system analytical approaches should be explored. One line of exploration is provided by argumentative analysis. This approach acknowledges that in most policy debates it is difficult, if not impossible, to distinguish clearly between "objective" knowledge and subjective judgements. Perceptions of problems and solutions are inevitably affected by differences in worldviews and interests of participants, and arguments put forward in policy debates typically contain a mixture of "objective" facts and subjective viewpoints or perceptions. The argumentative approach to policy analysis concentrates on identifying the argumentation patterns of different actors or actor groups, including their normative viewpoints and assumptions. Identification of and communication about different viewpoints may enhance mutual understanding and eventually the development of shared perceptions. Argumentation analysis may be supported by tools specifically designed to describe, visualise and analyse policy arguments.

Another novel approach is to use gaming as a vehicle for learning. In a policy game participants interact as if they were playing the roles of different parties involved in a real-world issue. Such games can be very instructive to both participants and observers as they include parts of the social and psychological dynamics of real policy processes, which cannot be included in more traditional systems. Policy games are generally supported by computer-based tools that take account of physical and other aspects in the process.

Sixth, rapid developments of information and communication technology offer new opportunities for support of policy processes. Among the most prominent developments are increased facilities for attractive graphical presentations (GIS) and interactive interfaces, allowing use of support tools by a broader group of users, and the development of the Internet. Particularly the Internet provides – in developed economies! – possibilities for communication and input from a much wider audience than hitherto possible, and could develop into the prime medium for public participation. This, however, will require the development of dedicated tools for information provision, user interface and information collection and processing.

7 International River Basins

7.1 The challenge

A special type of RBM is the management of international river basins. International basins are usually larger than national basins and less homogeneous. Natural and socio-economic conditions, culture and language often differ significantly between the different parts of the basin, and consequently upstream-downstream conflicts can occur easily. Most importantly, however, international basins are by definition located in different states. Consequently, international co-operation is needed in order to best manage the basin and prevent or solve upstream-downstream conflicts.
A major problem in the management of international basins is the so-called "lowest common denominator." Few obligations can be imposed on countries without their own consent. Consequently, many international agreements simply reflect the commonalities in the national policies of the states concerned or are very procedural and vague. More ambitious agreements are possible if for instance an issue on which national interests conflict is linked to another issue where the distribution of costs and benefits is the reverse (e.g. pollution reduction in an upstream country and improvement of the shipping channel in the downstream country (cf. Meijerink 1999). These issues can then be solved together, resulting in net benefits for both basin states. Box 2 presents in total nine mechanisms for moving beyond the lowest common denominator, some more advisable than others.

1: **Issue linkage**
Issue linkage implies that a contentious issue on which national interests conflict (e.g. upstream-downstream conflict) is linked to another issue where the distribution of (perceived) costs and benefits is the reverse. Solving such issues simultaneously can result in a net gain for all parties involved, thus overcoming the conflict of interests (LeMarquand 1977, Marty 1997, cf. Meijerink 1999). The second issue might be either an RBM issue or a totally different issue, but the former is usually more effective since on both issues the same parties are involved and costs and benefits fall on the same groups (Golub 1996).

2: **Diffuse reciprocity**
Diffuse reciprocity refers countries accepting less favourable agreements in order to keep good relations and create a "reservoir of goodwill" (cf. LeMarquand 1977) from which they can draw in the future.

3: **Side payments**
Side payments (or “financial compensation”) are payments - directly or through increased subsidies or reduced contributions – in return for a concession (Golub 1996). Side payments will be most effective in cases of agreements affecting the economy or the finances of countries. They will be less effective when deeply held values or basic human needs are involved and can be experienced as bribery (cf. HisschemöUer and Midden 1989 and Zeiss 1991). Moreover, side payments for pollution reduction conflicts with the polluter pays principle.

4: **Large geographical scope**
Strict national environmental standards may limit the competitiveness of industry in a basin, but the effects are much smaller if several countries adopt similar standards for their whole territory.

5: **Appealing goals/mobilising vision**
Ambitious agreements can also be reached if they contain goals or a vision of the future that is attractive for large sections of society in the countries concerned (e.g. “Salmon back in the Rhine, Rhine, etc.”). Such goals and such a vision can act as a form of awareness raising. Moreover, they can implicitly incorporate forms of issue linkage and diffuse reciprocity.

6: **Slack cutting**
Slack cutting occurs when national government bodies use international agreements for introducing a more ambitious policy domestically or for promoting enforcement of existing policies (Golub 1996, cf. Bernauer and Moser 1996).

7: **Intended non-compliance**
Intended non-compliance refers to the fact that countries may be willing to accept ambitious international agreements if they expect that the agreements will not be enforced. Obviously, agreements reached in this way are usually not implemented.

8: **Unforeseen consequences**
Ambitious agreements can also be reached if their consequences are not foreseen. Negotiators might be too confident about their national situation and assume too easily that no adaptation will be necessary. Furthermore, international courts may give unexpectedly strict interpretations to agreements. Finally, the negotiators may be inexperienced or the time to study proposals may simply be lacking, especially in case of last-minute changes.

9: **Majority voting**
In some rare cases, notably within the EU, international agreements are the result of majority voting. In these cases, the more conservative countries can be overruled, at least in theory. However, the more conservative countries can link the issue to an issue where their co-operation is needed, either because unanimity is required for that issue or to obtain a majority.

Box 2: Nine mechanisms for reaching international agreements that go beyond the lowest common denominator (cf. Golub 1996)
The development of international co-operation was the topic of the EU-SADC conference on the management of shared river basins, held in May 1997 in Maseru (Lesotho). One of the conclusions was that technical co-operation (e.g. information exchange, joint monitoring) is the most solid form of co-operation and often the first step towards co-operation on substantive issues and international agreements (Savenije and Van der Zaag 1998). Issues such as (informal) information exchange are often much less controversial than the substantive issues at stake. Starting with technical issues may therefore make it easier to develop mutual trust and explore possible areas of agreement (cf. Brehmer 1989, Vlek and Cvetkovich 1989; cf. Mostert 1998b, cf. Académie de l'Eau 1998). Technical co-operation may even continue in times of conflict, to be broadened to non-technical issues as soon as relations have returned to normal.

7.2 Overview of international conferences relevant to freshwater resources

For almost three decades the international community has been concerned with freshwater problems. To gain insight into the point that we have reached now, the present section gives a brief overview of the main international conferences relevant to freshwater. In addition, recent developments in the context of the Commission for Sustainable Development (CSD) are mentioned (Table 4, see page 41).

Overview
The first (global) UN conference on the environment was held in 1972 in Stockholm, but freshwater was not a specific issue on the agenda. The first conference that did pay specific attention to freshwater issues was the global freshwater conference in 1977 in Mar del Plata. This conference established that people have a right to water for their basic needs, which was repeated often in later conferences. Development matters and environmental issues were not yet approached in an integrated manner. For the period 1981 - 1990 an International Decade on water supply and sanitation was established, with the aim of achieving access to clean drinking water and sanitation for all people by the year 1990.

Although the programmes of the Decade reach a large number of people in developing countries, the aim is by far not realised. The Conference on water and sanitation in 1990 (New Delhi) concluded, among other things, that to solve the problems a reduction in the costs and the mobilisation of additional funds are needed.

In 1992 important steps were taken in the area of freshwater management with the international conference on water and the environment (Dublin) and the UN Conference on Environment and Development (Rio de Janeiro). The need for an integrated approach to the management of water resources was emphasised that links social and economic development and the protection of natural ecosystems. Also the participation by users/the public, planners and policy-makers at all levels of government was emphasised. Moreover, the role of women in water management is underlined. Furthermore, the principle that water should be considered as a social and economic good was established. These principles reoccur in most later conferences and declarations.

Two years after the Rio Conference, The Netherlands organised a conference on the improvement of access to safe drinking water and sanitation (Noordwijk 1994). Furthermore, in 1997, the progress made in implementing Agenda 21 was evaluated by the United Nations General Assembly (UNGASS). Governments were called upon to place freshwater problems high on the political agenda and to start a dialogue on the necessary actions and measures for implementation under the auspices of the Commission for Sustainable Development (CSD).
<table>
<thead>
<tr>
<th>NAME OF THE CONFERENCE</th>
<th>PLACE, DATE</th>
<th>NEW ELEMENTS / EMPHASIS</th>
</tr>
</thead>
</table>
• Water is a side issue |
| United Nations Water Conference | Mar del Plata, 1977 | • First global conference on freshwater  
• Emphasis on development, agriculture drinking water and sanitation |
| Global Consultation on Safe Water and Sanitation for the 1990s | New Delhi, 1990 | • Drinking water and sanitation  
• Attention to financing, integrated management of water resources, institutional aspects and role of women |
| International Conference on Water and the Environment | Dublin, 1992 | • Preparation of the Rio Conference  
• Sustainability is a key issue  
• Four principles: freshwater is a finite and vulnerable resource, participatory approach, the role of women, water as an economic and social good |
| United Nations Conference on Environment and Development | Rio de Janeiro, 1992 | • The Dublin principles are reconfirmed  
• Protection of ecosystems  
• Need for integrated planning and management on the river basin scale is emphasised  
• Development of strategies and action programmes for transboundary waters  
• Improved co-ordination between global organisations and programmes. |
| Ministerial Conference on Drinking Water and Environmental Sanitation | Noordwijk, 1994 | • Drinking water and sanitation  
• Partnerships between stakeholders  
• Change behaviour patterns  
• Technical innovations |
| United Nations General Assembly Special Session | New York, 1997 | • Evaluation of the implementation of Agenda 21  
• River basin management  
• Information management  
• Emphasised the need for concrete actions and (financial) commitment of states  
• Decided to hold a dialogue under auspices of the CSD |
| Expert Meeting on Strategic Approaches to Freshwater Management | Harare, January 1998 | • Advice of the inter-sessional ad hoc working group of the CSD and CSD VI  
• International co-operation  
• Mainly a repetition / rehearsing of already formulated/adopted principles |
| Ad hoc Inter-sessional Working Group on Strategic Approaches to Freshwater Management | New York, February 1998 | • Specific attention to information on policy, institutions, capacity building, participation, technology transfer and co-operation in research, financial resources and mechanisms |
| Cooperation for Transboundary Water Management | Petersburg (Bonn), March 1998 | • Transboundary water management  
• Emphasis on regional co-operation, river basin organisations, political commitment, and mutual trust. |
| International Conference on Water and Sustainable Development | Paris, March 1998 | • Little news on principles and points of departure  
• Decided on the development of an “agreed statement of principles”  
• “Programme of priority actions” |
| Commission on Sustainable Development, Sixth Session | New York, April/May 1998 | • Governments are encouraged to co-operate on transboundary water resources and set up river basin institutions.  
• Governments may report to the CSD on a voluntary basis  
• The importance of UN organisations is underlined, including the need for a more transparent way of working and more co-ordination within the UN |

Table 4: International conferences relevant to freshwater
In preparation of the Sixth session of the CSD (April/May 1998) two important expert meetings took place (Harare and Petersburg), as well as an inter-sessional working group of the CSD on strategic approaches for freshwater and an international conference on water and sustainable development in Paris. Taking account of the results of these meetings, CSD VI concluded among other things that lacunas for integrated water management should be filled; that states should co-operate concerning their international watercourses; and that they should set up institutions at the river basin level for the implementation of water management programmes. In addition, governments were encouraged to organise international meetings to solve problems, to set priorities for action, to exchange experiences, and to facilitate progress in the implementation. States were invited to inform the CSD about the conclusions of such meetings.

**Agenda 21**

Most noteworthy among these conferences is probably the UN Conference on Environment and Development, where, among other things, the Rio Declaration and Agenda 21 were adopted. Agenda 21 provides a programme of action for attaining sustainable development, while the Rio Declaration sets out the principles on which such action is to be based. Chapter 18 of Agenda 21, entitled “Protection of the quality and supply of freshwater resources: Application of integrated approaches to the development, management and use of water resources,” contains three main objectives. First, access should be ensured for all people to safe and sufficient water supplies, or at least water supplies to meet the basic drinking and food-growing requirements. Second, public participation and management at the lowest appropriate level should be enhanced. Third, integrated development and management of water resources should be attained.

**7.3 The Watercourses Convention and alternatives**

**International basins and the global level**

Considering all initiatives that are being or have been taken, and considering furthermore the fact that international river basins constitute some 47% of the earth’s land area (nearly 60% for Africa and Latin America, all excluding Antarctica; Biswas 1991 and Brans et al. 1997), one might be inclined to conclude that the objectives and actions to be taken for managing international river basins are now agreed upon and clearly defined. Moreover, one might suppose that such agreement would be reflected in recent international treaties. However, while important steps towards the codification and development of international water management law have been taken, they have mainly taken place at the regional level and — in some cases — at the river basin level.

At the global level the normative system for the management of international river basins focuses on the discretion of states and their sovereignty, rather than on their particular responsibilities in the process towards attaining sustainable water management. This focus also found its way into Chapter 18 of Agenda 21, which in paragraph 18.4 provides as follows: “Transboundary water resources and their use are of great importance to riparian States. In this connection, cooperation among those States may be desirable in conformity with existing agreements and/or relevant arrangements, taking into account the interests of all riparian States.” (emphasis added by authors) Chapter 18 thus only half-heartedly concedes the point that the objectives it seeks to promote should, let alone shall, be implemented by states with respect to international river basins.

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6 Par. 18.47 and Parts E and F
7 Subsidiarity, e.g. par. 18(9)(c), 18.12(i), (m) and (m), 18.54 and 18.72
8 Par. 18.3 and 18.9
**The Watercourses Convention**

The only global legally binding instrument that focuses on the management of international river basins moreover revolves around protecting the discretion of states. The Convention on the Law of the Non-Navigational Uses of International Watercourses (Watercourses Convention) was adopted by the United Nations Assembly on 21 May 1997 and has not yet come into force. It is the culmination of a period of over 20 years of deliberations in the International Law Commission of the United Nations. The Watercourses Convention, while attesting to the relevance of co-operative action among riparian states, does not require that states conclude agreements in conformity with certain minimum standards for purposes of managing international river basins that flow through their territory. Instead, it leaves the conclusion of such agreements to the discretion of states. The Watercourses Convention also does not make securing access for all people to safe and sufficient water supplies a main goal. Instead, it ultimately includes this goal among a long list of goals that may be pursued by states in managing an international river basin, and in doing so, makes this goal subject to the balancing of interests, which is the main concern of many of its provisions. The Watercourses Convention, furthermore, does not provide instruments that may serve to enhance public participation and subsidiarity. Instead, it focuses on state actors and their discretion.

Much of the Watercourses Convention can be explained by the nature of the negotiating process that started over twenty years ago and by the cautious role of states in that process. What remains, however, is a multilateral regime for the management of international river basins that has limited normative content (for further details: Hey 1995, 1998; Nollkaemper 1996).²

**A flexible regional framework**

Developments within the United Nations Economic Commission for Europe (UNECE) and at the level of particular river basins are more positive. The ECE 1992 Convention on the Protection and Use of Transboundary Watercourses and International Watercourses and International Lakes as well as, for example, developments with respect to the Great Lakes and the river Rhine have provided a basis for establishing flexible frameworks based on sound principles that allow for the development of sustainable river basin management in a participatory context.

Assuming that the interests of individuals, groups within countries and the international community at large supersede the interests of individual states and of the riparian states bordering on a single river, it is high time that a flexible framework be developed at the international level. Such a framework could provide the basis for the development of relevant rules that bind states in their actions vis-à-vis the wider interests involved in international river basin management. Instruments that provide such a framework have been adopted for other policy areas. Relevant examples are in the area of climate change the 1992 United Nations Framework Convention on Climate Change and its 1997 Kyoto Protocol; in the area of the protection of biological diversity the 1992 Convention on Biological Diversity; in the area of ozone depletion the 1985 Convention on the Protection of the Ozone Layer and its 1987 Montreal Protocol; and in the area of fish stocks the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to Straddling Fish Stocks and Highly Migratory Fish Stocks. These agreements, to a lesser or greater extent, provide the basic principles and minimum standards that states are to implement in their mutual relations and a framework within which these principles can be

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² It should be noted that other assessments of the Watercourses Convention are possible as well. In many river basins no treaties have been concluded at all, which places the downstream countries in a difficult position. In these basins ratification and subsequent entry into force of the convention could promote a more equitable use of the water.
further developed into rules and regulations, where appropriate at the regional level, as e.g. in international fisheries.

An approach as advocated here may give rise to a "significant degree of indeterminacy of the normative landscape" (Handl 1990). However, it is less likely to result in treaties that are devoid of normative content, as the Watercourses Convention. Instead, it is likely to foster continuous interactions between developments in technology, policy and law (Gehring 1990), which eventually may result in enhanced normative content of the regime (for further information on this approach, see Brunnée and Toop 1994, 1997).

**Compliance regimes**

Part and parcel of the development advocated here is the inclusion of what are generally called compliance regimes. Such regimes aim to establish non-confrontational mechanisms in which parties assess each other's performance under a given treaty and measures to remedy a situation of non-compliance, both "carrots" and "sticks". Compliance regimes have now been included or are being developed in most multilateral environmental agreements (Goote 1999). Even the Watercourses Convention contains a procedure that could fulfil part of the role of such a mechanism: the independent fact-finding commission (art. 33).

The procedure related to the independent fact-finding commission essentially entails the following. At the request of a state party to the Watercourses Convention a fact-finding commission may be installed, if six months after a request for negotiations the parties to a dispute have not been able to resolve their dispute. The fact-finding commission is to make recommendations for the equitable solution of the dispute. While these recommendations are not binding in law, the parties to the dispute are to consider them in good faith. Such a procedure remains short of the compliance regimes included in multilateral environmental agreements in that it does not provide an automatic peer review system. It may, however, provide a mechanism through which the normative content of the international regime for river basin management may be enhanced. Preferably a new framework mechanism should be established in which states and other relevant actors, such as international organisations and NGOs, could continue the multilateral dialogue on the management of international river basins. The past and present dialogue on sustainable water management, as it is taking place under the auspices of the UNECE and the European Union, may provide a valuable model for further developments at the international level.

**7.4 International river basin organisations**

A major aspect of many river basin treaties is the establishment of a river basin organisation. In section 4 two types of national river basin organisations were discussed: river basin commissions with a primarily co-ordinating task and river basin authorities with decision-making and policing powers. The same type of organisations can be found in international basins.

The importance of international river basin commissions has been widely recognised (e.g. Petersburg declaration and Dieperink 1997). River basin commissions may co-ordinate monitoring and research efforts, add legitimacy to the monitoring and research results and in this way provide a common, generally agreed upon factual basis for management. They furthermore offer the basin states a platform for co-ordinating their policy and management. River basin commissions can also prepare RBM plans and programmes, but after adoption by the Commission they still have to be adopted by the basin countries or a "Ministers Conference". River basin commissions may also oversee the implementation of the plans, programmes, but implementation remains the responsibility of the basin countries. Finally, river basin commissions can play a significant role in resolving river-related international
conflicts. They constitute a relatively informal forum for discussion, may help in selecting fact finders and arbitrators, or may even do fact-finding or act as arbitrators themselves.

River basin commissions can be organised in different ways, but always there is a plenary commission, usually consisting of national representatives and meeting once or twice a year. The work of the plenary commission can be supported by working groups, project groups and/or expert groups. Moreover, the commission may have an independent secretariat, in charge of preparing the meetings, publishing annual reports, giving information to the public, etc. Alternatively, the secretarial function can be performed by one of the states concerned or may alternate between the member states.

River basin authorities have decision-making and policing powers. They can independently adopt plans, programmes and bylaws and implement them or enforce their implementation. International river basin authorities usually have a limited scope. They usually do not deal with policy issues, but with specific operational tasks, such as constructing and managing joint infrastructure and enforcing shipping regulations. The structure of river basin authorities can be the same as that of river basin commissions, with a plenary commission, subgroups and a secretariat.

8 Interbasin co-operation

A last issue concerning river basin management is co-operation between river basins, both as a form of development co-operation and co-operation between comparable partners. In this respect three issues deserve attention: the role of international donors and banks in river basin management, technology transfer, and twinning.

8.1 International donors and banks

International donors and banks can significantly support RBM by means of the projects and programmes they finance. In the past development assistance and lending operations focused mainly on constructing water supply infrastructure (dams, wells), without much attention being given to water quality and other environmental issues, to operation and maintenance, nor even to the economic costs of the infrastructure. Increasingly, however, such issues do get attention.

An example of this tendency is the World Bank's policy with respect to water resources management. In 1993, after extensive discussions, the Bank issued its policy paper on the topic (World Bank 1993). At the core of the World Bank's approach is "the adoption of a comprehensive policy framework and the treatment of water as an economic good, combined with decentralized management and delivery structures, greater reliance on pricing, and fuller participation by stakeholders" (World Bank 1993). Already before 1993, however, several operational directives were issued for the World bank's operations, such as on Environmental Policy for Dam and Reservoir Projects (OD 4.00), Environmental Assessment (OD 4.01), Involuntary Resettlement (OD 4.30) and Projects on International Waterways (OD 7.50).

The World Bank's policy is strongly rooted in economic theory. Its aim is to alleviate poverty, its major strategy is to improve the efficiency of water use by means of economic incentives. Ideally, water users should be charged for the opportunity cost of water use (the value of the next best alternative use), but at least for the costs of providing the services. For the poor lower charges could be used, but the economic viability of providing the services should not be undermined. Because of the limited financial and administrative resources, government should decentralise responsibilities, including financing, as much as possible, and involve users as much as possible. If necessary, the management capacity of the decentralised governments should be improved. Moreover, to promote efficiency, government departments
dealing with the provision of water services should be privatised or become financially autonomous, and the use of management contracts is to be promoted. National government should develop a comprehensive analytical framework for water resources management – partly based on analyses at the river basin level – and set up a strong legal and regulatory framework for dealing with the pricing, monopoly organisations, and other aspects of water management. Preservation of the environment and the resource base is essential (World Bank 1993; with more emphasis on capacity building: Le Moigne et al. 1994).

The possibilities of international banks and donors to improve RBM are limited. For example, it has happened that the World Bank has refused loans for projects for social or environmental reasons, but the projects were implemented with purely national means. Still international donors and banks can make a difference. They should only finance projects that reflect the principle of sustainable development – however difficult it may be to specify this principle and make it operational. Moreover, their supportive programmes can promote capacity building, policy changes and institutional development.

8.2 Technology and knowledge transfer and research co-operation

Technology and knowledge transfer and research co-operation received ample attention at the 6th session of the UN Commission on Sustainable Development, established to monitor overall implementation of the Earth Summit agreements (Rio de Janeiro 1992) by Governments, businesses, non-governmental organisations and others. New knowledge and technologies can contribute significantly to improvements in RBM. New technologies in fact increase the goods and services river basins can provide to society, but never indefinitely. Therefore, the use made of river basins should be regulated. Knowledge may contribute in two ways. First, it lies at the base of the technology development, and second, knowledge on RBM can help in regulating the use made of river basins.

The issues involved in technology and knowledge transfer and research co-operation are as diverse as the types of technologies and knowledge. The types include fundamental knowledge on institutions, policy processes and natural processes; more applied knowledge on river basin institutions and planning processes and on natural processes within river basins; knowledge concerning the different uses of river basins (agriculture, drinking water, etc.); industrial technologies reducing water use and pollution; irrigation techniques; new types of crops using less water, etc. The issues involved include the following:

- Needs assessment for different types of countries/basins ("appropriate technology") vs. a supply-side orientation
- Production of knowledge and technologies; financing
- Dissemination of knowledge and technologies; information technology
- Prohibitive fees for developing countries for using new technologies
- Development of local capacity; research co-operation (South-North, North-North, South-South).

The solution to these issues is in theory simple. Knowledge and technology transfer should respond to the needs in the receiving country/basin. All available knowledge and technologies should be disseminated freely, using information technology and other appropriate means, in order to derive the greatest benefit from them and prevent duplication. Research and development should focus on the biggest, most significant gaps in knowledge. Some degree of – open – competition between the providers is beneficial to the quality and cost efficiency of the services provided, but the providers should also co-operate when necessary. Moreover, they should co-operate with the clients and increase their clients’ expertise rather than just sell their services, produce reports, and leave.
This is the ideal, but in practice commercial/institutional/national/political interests can stand in the way. For instance, technology transfer is sometimes inspired more by the interests of the providers of a specific technology than by the needs of the recipient. Given the reality of these interests, the main issue is how the ideal can be brought nearer; what types of programmes and projects would be most useful; and what each one’s role should be. One possible form is twinning.

8.3 Twinning of river basin organisations

Twinning is another word for a long-lasting co-operative relation between two river basin organisations, involving the exchange of information and experiences. Typical twinning activities are short visits including site visits and presentations, and long-term staff exchange. The aim is mutual learning with respect to the operational, policy and institutional aspects of RBM. Twinning may also be a framework for development assistance and for specific projects.

Twinning of municipalities is quite common, but there are also some experiences with twinning between waterboards and between provinces. Twinning usually has positive effects on the persons directly involved. A major issue is how twinning programmes can be designed to maximise the benefits for RBM more generally. Another issue is which river basin organisations can best enter into a Twinning relation. In which respects could the basins and the organisations concerned differ, and in which respects should they be similar (area basin, human pressure, internal structure organisation, etc.)?

Twinning may become an important topic at the Ministerial Conference in March next year. Therefore, it is important that the workshop recommendations cover the issue of Twinning in some detail.

9 Public participation

Views on public participation and issues

Public participation (PP) plays an essential role in planning and policy-making. PP can be seen as a legal right of individuals and social groups, often resulting in procedural requirements for decision-making. PP can also be seen as a means for empowering individuals and groups and developing local communities. Finally, PP can be seen as a means of improving the quality and effectiveness of decision-making (see UNESCO/IHP 1999).

All three views are equally valid and complement each other. Public participation as a legal right is based on the notion that individuals and groups affected by decisions should have the opportunity to express their views and become involved in decision-making. Often three “pillars” of PP are identified (e.g. the Aarhus Convention: UNECE 1999; Rio Declaration: UNCED 1992): access to information, involvement in the decision-making process (e.g. possibility to comment), and access to justice (right of legal review and redress). The danger of a purely legal approach to PP is that it may become nothing more than an administrative requirement. Moreover, litigation is often time-consuming and expensive. However, given the reluctance of many managers to organise public participation, legal requirements are often indispensable in order to get anything started. Moreover, while litigation as such is usually not desirable, the right of individuals and groups to litigate may promote that managers take the comments received during public participation seriously and that PP becomes something more than only an administrative requirement.

Public participation as a means of community development is closely related to decentralisation and the development of common property management institutions (cf. Barraqué 1999). The aim is to increase the capacity of local communities to become
meaningfully involved in management and ultimately to manage as much as possible on their own. This corresponds to the notion of "direct democracy", in which individuals as citizens and members of a polity become personally and directly involved in government (as opposed to the traditional notion of parliamentary democracy, in which public participation is basically limited to elections). Means to promote community development include financial support for local groups and institutional changes such as decentralisation.

PP as a means to improve the quality and efficiency of decision-making is the most common view on PP (e.g. Institute for Participatory Management and Planning 1990). It makes clear that PP can also have benefits for the managers who take the decisions. The public can come up with information that would otherwise not be available and with innovative solutions. Moreover, the public's involvement in the decision-making process can enhance the legitimacy of the process and the acceptance by the public of the resulting decisions. In this way costly and time-consuming litigation can be prevented.

PP is easier said than done. If PP is to realise its potential, a number of issues will have to be addressed. These are discussed in Box 3.

**Timing**

PP should be organised early enough to influence decisions, but not too early because the different plans and ideas should be specific enough to interest the public. A solution could be to organise PP in different phases and target different segments of the public: in early phases (semi-) professional NGOs, and in a later phase the local population and individuals.

**Methods**

Different methods are appropriate for different target groups. For instance, information meetings for semi-professional NGOs should differ quite a lot from information meetings for local communities. Moreover, the type of issue at stake (complex or not, controversial or not) and the specific culture are important. For instance, in a culture where consulting the public is seen as a sign of weakness on the side of the leaders, the usual "Western" methods of PP could be a kind of political suicide and other methods have to be devised (development of common property management?). Whenever the specific methods chosen allow for large numbers of participants, the public should be able to select itself for participation – after it got sufficient information in an appropriate form.

**Follow-up**

If the decision-makers do not take the results of public participation seriously, the result could be not more legitimacy and acceptance, but less. In this respect a legal-administrative approach to PP could be useful, viz. a legal requirement to publish and react to the comments received in combination with access to justice.

**PP in international basins**

In international basins reluctance on the part of the authorities to organise effective public participation at the international basin level tends to be quite high: it can be seen as complicating international negotiations. Moreover, reaching the public is more difficult than in smaller national basins.

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**Box 3: Major issues in public participation**

**International level**

Governments increasingly endorse the view that the public is to be involved in the environmental decision-making process. This is expressed in international policy documents such as the Rio Declaration and Agenda 21, and more specifically for the field of freshwater resources management also in the Dublin Statement on Water and Sustainable Development and the Noordwijk Political Statement and Action Plan on drinking water and sanitation 10 (cf. § 7.2).

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10 See e.g. Section III of Agenda 21: "Strengthening the role of major groups", in particularly Chapter 27 (strengthening the role of non-governmental organisations: partners for sustainable development). Chapter 18 on freshwater resources mentions as one of the activities to improve integrated water resources management "the
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Rio Principle 10 reads: “Environmental issues are best handled with the participation of all concerned citizens, at the relevant level [...].” (emphasis added). The Principle does not say how one should establish the “relevant level”: it may be the local, the national, the international (intergovernmental) or the river basin level. For international rivers it could be argued that in addition to public participation at the lower levels, public participation at the international level (the level of the riparian states) is needed. If there are only the possibilities for public participation at the national level, the interests of the stakeholders are to be balanced at this level. However, conflicting interests are often located in different basin countries, e.g. a drinking water company using surface water may be located in a downstream country, and an industrial plant discharging waste water may be located in an upstream country. Therefore, public participation at the international (basin) level may contribute to a more integrated management of a river basin.

Also in international environmental legal instruments, public participation increasingly receives attention (Ebbesson 1998). In the UNECE region, several conventions have been adopted which are relevant to public participation in river basin management. The recently adopted UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus, 25 June 1998) is the first general convention that guarantees the rights of access to information, public participation in decision-making, and access to justice in environmental matters. Access to the Aarhus Convention is also open to states outside the UNECE region. The Aarhus Convention is primarily directed at the national level, but it also provides that each party is to promote the application of the principles of the convention in international environmental decision-making processes and within the framework of international organisations in matters relating to the environment. It is not exactly clear what is meant by “principles”, but one may conclude that parties to the Aarhus Convention are to pursue the main obligations in international environmental management, including the management of international river basins.

The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention: Helsinki, 17 March 1992) provides that riparian parties are to ensure that information is made available to the public on the conditions of transboundary waters and on measures (and their effectiveness) taken or planned to be taken for the prevention, control and reduction of transboundary impact. The UNECE Protocol on Water and Health to the Water Convention (London, 17 June 1999) provides that parties to the Protocol are to make practical provisions for public participation in the development of water management plans, and are to ensure that due account is taken of public participation.

Also international legal instruments on specific rivers and lakes increasingly provide for a role of the public in the decision-making process. For many international basins, a river basin commission has been established where important decisions are taken (see § 7.4). Concerning the first pillar of public participation – access to information – river basin commissions often distinguish between different types of information. Possible categories are: 1) official (approved) information, including established international agreements, action plans and programmes; 2) working documents and drafts; and 3) financial and personnel information. Official information is often actively disseminated or can be obtained upon request (passive openness). The other types of information are usually more difficult to obtain. The use of the development of public participatory techniques and their implementation in decision-making, particularly the enhancement of the role of women in water resources planning and management” (par. 18.12 (n)).

Art. 3 par. 7.

Art. 16

Internet has proved to be a valuable tool for making information widely accessible. Many river commissions have already a Home page where the information approved can be viewed. Furthermore, river commissions publish information leaflets, and send out press communications on specific issues. Whenever information is available upon request, usually some restrictions are made, such as the common provision that disclosure must not harm international relations.

When the international legal regime for a basin does not provide for access to information, the public depends exclusively on the specific national legal systems for access. In these cases it is important that such information is accessible on a non-discriminatory basis and without having to state an interest.

The second pillar - public participation - appears in different forms for international rivers. Examples are the consultation of the public on a (draft) river basin action plan, a role for the public in monitoring conditions of waters (e.g. through the submission of data), the possibility to report to the commission on specific matters concerning the river basin, and even public involvement in the negotiation of international agreements.

A number of river basin commissions have made the meetings of their plenary body and/or subsidiary bodies more open. In most cases the general public cannot participate in the meetings, but sometimes NGOs can get observer status. Their admittance is usually made dependent on specific criteria of recognition, such as the international character of the NGO concerned (international objectives and goals and international membership). Pragmatic modalities are found in those situations where public participation is not formally, or insufficiently provided for. Such modalities include 1) representatives of NGOs as members or experts in the national delegation; 2) participation of NGOs in national preparatory meetings for the plenary meetings of the joint body and/or its subsidiary bodies; and 3) special consultative meetings with NGOs organised by the river commission. Moreover, several river basin commissions invite NGO members as experts to their meetings. Participation as an observer or expert in meetings of the commission automatically involves access to information which otherwise might not have been disclosed.

Provisions on access to justice in international environmental treaties - the third pillar - are not only scarce; they predominantly refer to a national legal system. Often they do not provide minimum rights, but set out the non-discrimination principle (citizens from other states are to be given equal access to an administrative or judicial review procedure in accordance with the national legal system).

10 How to put RBM into practice?

In the preceding sections much has been said about RBM and about how RBM can best ensure the multifunctional use of the river basin for present and future generations. This paper certainly has not resolved all contentious issues definitively, but it may have helped the discussions in the International Workshop on River Basin Management, which eventually led to the adoption of “Recommendations and Guidelines on Sustainable River Basin Management.” (cf. § 1)

Yet, it is one thing to know how river basins should be managed, it is another to actually implement this type of RBM. RBM involves conflicting interests and is therefore ultimately a political process (besides all the other things it is). The main question that concerns us here is how and what type of recommendations can influence this political process best.

Criteria for recommendations
First, recommendations will be more influential if they reflect and refer to principles generally agreed upon. However, this is in itself not enough. General principles are open to different
interpretations, and many statements of principles have only been agreed upon because they have no direct consequences in practice. In other words, many general principles have not been internalised.

Second, recommendation will be more convincing if they are not merely normative ("shall", "should"), but also give a rationale ("in order to"). This rationale should refer to truly generally agreed upon principles, or more profanely, it should appeal to the largest possible number of parties involved in RBM; there should be something in it for everybody. As a set, the recommendations should explicitly point the way to a future that is desirable for all, they should be "Visionary." If no future can be described that is attractive for all, then perhaps a future could be described that is unattractive for all or even catastrophic, and the recommendations could show how to avoid this future.

Third, recommendations will be more influential if they are "realistic". They do not have to be politically feasible in the short term – they can also try to make the unfeasible feasible – but they should start from political realities. Recommendations should show how the practice can be improved rather than just paint an ideal. They should integrate Vision and politics, dream and reality.

Fourth, recommendations will be more influential if they reflect the differing hydrological, socio-economic and cultural contexts and are technically/scientifically sound. They should either be truly generally applicable, or clearly distinguish between different contexts.

Fifth, recommendations will be more influential if they are formulated succinctly and at least one step more concrete than the existing international declarations. They should preferably not contain phrases such as "as appropriate" or "in some countries/basins" but instead indicate when and in which type of countries and basins something is appropriate.

Finally, recommendations should not merely promote a specific national system of RBM. Not only would this conflict with the fourth and possibly the third criterion, but this would also create a lot of unnecessary opposition from countries whose RBM system has not been selected as the "model."

The CIP Approach to river basin management

These are the six criteria for recommendations. The "Recommendations and Guidelines" formulated in the workshop meet these criteria to some extent, but not fully. However, even if they did meet the criteria fully, they could still have little influence. To be influential, they should be communicated to as many parties involved in RBM as possible, in a timely fashion (that is, very soon, and certainly before the conference in March). Moreover, a "Cyclical Implementation Programme", with different feedbacks, could be recommended for states in order to implement the general principles applicable to RBM, specify them for their specific circumstances, and generally promote policy learning and a continuous improvement of RBM. The proposed "CIP Approach" consists of the following steps, with several feedbacks (Figure 2, see p. 52):
Figure 2: The Cyclical Implementation Programme (CIP) approach to river basin management (with major feedback mechanisms)

1: Check of national legislative and organisational framework
Without a basic national legislative and organisational framework RBM will not be possible. For example, it should be clear who has jurisdiction over the different waters. If a basic framework is in place, it may be advisable not to try and perfect the framework, but instead continue with the next steps; it is always possible to return to this step if later on some bottlenecks appear (cf. § 4).

2: International co-operation agreement (for international basins)
Effective management of international river basins can only be based on effective RBM in the basin countries concerned, while in addition the basin countries must agree to co-operate with each other. The agreement could take the form of a legally binding treaty, establishing a river basin commission, but non-binding declarations could work just as well, and sometimes even better: they are easier to reach agreement on and can be more ambitious. Agreement could be implicit: the main thing is that there is a willingness to co-operate. If co-operation at the political level is not yet feasible, it may still be feasible to co-operate at the technical level and increase mutual understanding, eventually leading to co-operation at the political level (cf. § 7).

3: Planning
After establishing a basic legislative and organisational framework (if this was not yet present), and after sufficient willingness to co-operate internationally has developed (for international basins), it is time to assess in some detail the present situation in the basin and forecast developments; to determine long-term aims and medium-term goals and targets; and to propose measures for bridging the gap between the present/forecasted situation and the aims/goals. In other words, it is time to do some planning. (For other functions of planning,
for the relation between national and international and operational and strategic plans: see § 5. For public participation in planning: see § 9. For analytical support for planning: see § 6.)

4: Implementation

Plans are nothing without implementation: ultimately, their purpose is to orient operational RBM and improve its effectiveness. Implementation is therefore a pivotal step in any RBM strategy (cf. § 3. See also § 6 on analytical support and § 9 on public participation).

5: Formal evaluation

Any strategy can benefit greatly from some form of formal evaluation. Were the targets, goals and aims reached or at least brought nearer? Were the planned measures all implemented, and if not, why not? Were the measures effective? Could the planning process have been better, and were there any crucial bottlenecks in the legislative and organisational framework? Evaluations such as these can provide valuable input for a new round and contribute to a continuing improvement of RBM. A realistic but ambitious deadline could be set for this step, as they should be set for the other steps.

REFERENCES


PROBLEMS IN THE MANAGEMENT OF INTERNATIONAL RIVER BASINS - THE CASE OF THE INCOMATI

Álvaro Carmo Vaz

1 Introduction

River basin management in Mozambique is an area of activity that faces enormous difficulties. This is due to the characteristic limitations of a very poor country, after many years of a cruel and devastating civil war, and also to the specific situation of the country's river basins, where the most important ones are international river basins.

The Incomati river basin, shared between Mozambique, RSA and Swaziland, is used to illustrate the problems in the region and the ways to possibly cope with them.

2 Institutional Set-up of Water Resources Management in Mozambique

The institution responsible for water resources management in Mozambique is the National Directorate for Water (DNA). Water resources management has been always centralized in DNA headquarters in Maputo, both for the planning and the operational tasks. DNA is also the central body that establishes coordination links with other Mozambican institutions related with water resources, like the Agriculture, Environment and Energy Sectors.

In the 1980s, the capacity of DNA in water resources management decreased very much, with various factors contributing to it. On the one hand, the civil war that ravaged the country made inaccessible large parts of the rural area and caused the collapse of the hydrological observation networks. On the other hand, an almost absolute priority was given to urban and rural water supply, in comparison to water resources and agricultural development. This was also in part the result of the disruption of life in most of the rural areas and, consequently, the mounting social pressures in the cities and small towns.

At the end of the decade, the radical change in the economic policy adopted by the Mozambican Government, moving to a market economy, had a negative impact in many areas of the public administration, with qualified and experienced people going to work in the private sector. This situation occurred in the water resources management area, where many top-level staff left DNA.

More recently, particularly after peace was restored to the country, there is an effort to increase the capacity in this domain. This is reflected by a series of initiatives that took place in the beginning of the 1990's.

In 1991 a new Water Law was promulgated, establishing basic principles of water management. These principles included:

- Water considered as a scarce resource
- The need for its conservation and sustainability of use
- The economic value of water
- The prevention and combat against pollution
- The public domain of water
- The licensing of water abstractions and effluent discharges
- The role of private initiative in water development

Also foreseen in the Law was the decentralization of water management, mainly in its operational stages (for instance, the operation of regional hydrometric networks, the operation
of reservoirs, the licensing of water uses) under a general policy framework that is centrally defined.

This decentralization is to be materialized through the creation of five Regional Water Authorities (ARAs), each grouping contiguous river basins (see map 1). ARA Sul, covering the southern part of the country, is in operation since 1992. ARA Centro, which includes the basins south of the Zambezi, in the central part of the country, started operations in the end of 1997. It is planned that the other three ARAs will start operating – at a basic level – in 2000. The ARAs receive guidance and technical support from DNA, through its Department of Water Resources Management, which also has a monitoring role.

The decentralization process presents various effective advantages. It puts the water management authorities much closer to the water users, brings greater flexibility to react to unexpected events, links the hydrometric network stations to the real needs of the management, and provides the planning authorities at the central level with more realistic inputs. The main constraints of the decentralization process are the scarcity of technically qualified personnel and the lack of financial resources. This has led in fact to a significant delay in the implementation of the de-centralization process.

Another important change introduced by the Water Law is the creation of a National Water Commission (CNA) that is composed of seven ministers (responsible for the sectors public works, agriculture, energy, environment, health, finances and state administration), with a secretariat provided by DNA. This Commission functions at the level of ministers for decision making and at the level of experts for the preparation of the dossiers. The CNA is an excellent forum to guarantee that the main components of an integrated water development process are duly considered. It is expected to promote the best conditions for balanced water developments: for example, to create an equilibrium between the powerful energy sector and the much weaker sectors of agriculture and environment.

- The CNA, in its present configuration, is a governmental institution, emanating from the Council of Ministers. One could discuss about the convenience of having, in parallel, a consultative body that would also include representatives of other parties besides the representatives of the Government and DNA: water users, consumers associations, industries, consultants, professionals, and NGOs involved in the water sector.

- Internally, DNA has recognized the major importance of the international river basins in terms of the global water resources of Mozambique. This has led to the creation in 1996 of an International Rivers Office (Gabinete de Rios Internacionais - GRI).

- The weakness of the human resources of the water resources management sector lead to the concentration of the policy and planning at the central level (DNA), leaving to the ARAs the task of operating the hydrological networks and the hydraulic infrastructures and dealing directly with the water users.

- DNA has done in the past and is now starting again to do river basin master plans – evaluating the water resources availability, compiling demand forecasts from the actual and potential consumers and checking their balance in the foreseeable future. Considering the stage of development of Mozambique, naturally there is a strong emphasis on the need for construction of new hydraulic infrastructures. Other types of measures – legal and regulatory, financial – are also included. Particular attention is now given to the environment, something that was almost left out in the plans prepared during the 1960s and 1970s. As the country has until now made very limited use of its water resources, the basin plans are also an indication of a development potential.
Problems in the Management of International River Basins - The Case of the Incomati

ARA Sul – 1 to 5  ARA Centro – 6,7  ARA Zambeze – 8  ARA Centro-Norte – 9 to 11
ARA Norte – 12,13

Map 1: The main river basins
Until now, the decision making process is all within the CNA, DNA and other State institutions. Although the Water Law of 1991 and the National Water Policy, approved by the Government in 1995, indicate the need for a large involvement of the communities and the private sector, this is not happening in practice. The main reasons may be the lack of a tradition of public debate and participation, as well as certain continuity with the past in terms of the State making all the important decisions.

When it comes to the operational decisions, concerning the daily water management and decisions to be taken along the year, then the ARAs are the seat of decision making, and the various water users and consumers have a more important say. Their participation is organized through basin Committees that include the water managers and representatives of the water users. These Committees meet regularly during the year, particularly before each agricultural season starts. Until now, they have been established only for three river basins (Umbeluzi, Incomati and Limpopo), all managed by ARA Sul.

The contracts for the supply of raw water too are established between the users and the ARAs and not with DNA. For example, the public company in charge of Maputo urban water supply has a contract with ARA Sul; HICEP, another public company that manages the large irrigation perimeter of Chokwé (20,000 ha), also has a contract with ARA Sul to receive water for irrigation from the Massingir reservoir.

One important aspect that has been introduced by the Water Law is the requirement that the abstraction of raw water should be paid for. The present tariff is about USc 0.4 /m³, which does not create major difficulties to the urban water companies or to industrial consumers. However, there is a certain resistance in the agricultural sector (irrigation), which was not used to have to pay for the water.

3 The Water Resources of Mozambique

Mozambique is a country whose geographic characteristics introduce some specific features in relation to its water resources. It has an area of approximately 800,000 Km² with a very long coastline of approximately 3,000 km. Almost all of the southern part of the country (from the Save basin to the south) is a very flat, with altitudes below 200 meters. The Southern Mozambique is, in fact, composed of the alluvial plains of some large rivers that have their source in countries located upstream: RSA (Maputo, Incomati, Limpopo), Swaziland (Umbeluzi) and Zimbabwe (Save). The center part of the country is mainly occupied by two basins (Buzi and Pungué) with their sources in Zimbabwe. The largest river of Mozambique is the Zambezi with its large delta occupying significant portions of the provinces of Sofala and Zamibia. Mozambique also shares with Tanzania the Rovuma river basin at the northern border of the country.

These international river basins (IRBs) that Mozambique shares with other countries have an enormous weight in terms of the global water resources of the country. This can be illustrated by looking at map 2 (which represents the IRBs of which Mozambique is part) and by a few facts and figures:

- The area of Mozambique included in IRB constitutes 52% of the total area of the country.
- The area of Mozambique included in IRBs is only about 20% of the total area of these IRBs.
- In all IRBs except one (the Rovuma basin) Mozambique is located downstream of all other riparian countries.
- In all IRBs except two (the Pungué and Buzi basins) the average flow that crosses the Mozambican border is much higher than the flow generated in Mozambique itself. For the

- 60 -
whole country, the flow that comes through the border is about 116,200 hm$^3$ annually, while the flow generated in the country is 106,300 hm$^3$ annually.

Map 2: International river basins shared by Mozambique
Another important aspect that affects the water management in Mozambique is the lack of sufficient hydraulic infrastructures, particularly storage reservoirs. In fact, despite of the surface flows showing sharp variations not only within one year, but also from year to year, as is characteristic for the rivers in tropical regions, there are very few large reservoirs in the country to allow for the regulation of those flows.

As the development of the water resources in the other riparian countries is continuing and even accelerating, the tendency will be that Mozambique receives in the future less and more polluted water.

4 The Incomati River Basin in Mozambique

The general situation concerning IRBs described before becomes even worse when the southern part of the country is taken into consideration. This region, to the south and including the Save basin, has an average annual flow of 20,770 hm³ (which corresponds to a depth of 108 mm), but from his total 16,975 hm³ (88 mm) comes through the border.

The main economic activity in this region is agriculture. However, the climatic conditions are quite adverse. In fact, most of the region could be classified as "semi-arid". This led to large investments being made in the past, since the mid 1950's, in the construction of large hydraulic infrastructures such as storage dams, water intakes and main irrigation schemes. Reference can be made here to Massingir, Corumana, Pequenos Libombos and Macaretane dams, to the Chokwè irrigation perimeter, the sugar cane plantations and factories, and to the citrus irrigation developments. In spite of these efforts and investments, only one agreement on sharing water resources was reached – the agreement for the Umbeluzi river basin between Mozambique and Swaziland.

The Incomati basin is one of the most important ones in this southern region, either in terms of catchment area or in terms of water developments already in operation. Mozambique considers the boundaries of the basins defined by taking as the reference section the mouth of the river at the Indian Ocean. This (correct) definition brings as a consequence that the Incomati basin includes RSA and Swaziland as basin countries even though Swaziland does not share the basin of the main tributaries like the Crocodile and the Sabié rivers.

The Incomati river basin has an area of about 46,800 km², distributed between Mozambique (15,500 km², 33%), RSA (28,700 km², 61%) and Swaziland (2,600 km², 6%). (See map 3) In the west of the basin it rises in the mountains and plateaus to more than 2,000 m and drops to the homogeneous flat plains in Mozambique, east of the Libombo range, at an elevation generally below 150 m.

The following table presents the natural mean annual runoff of the main catchments within the Incomati basin.

<table>
<thead>
<tr>
<th>Catchment (sub-basin)</th>
<th>MAR (hm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Komati</td>
<td>1,420</td>
</tr>
<tr>
<td>2 Crocodile</td>
<td>1,226</td>
</tr>
<tr>
<td>3 Sabié</td>
<td>750</td>
</tr>
<tr>
<td>4 Massintonto</td>
<td>22</td>
</tr>
<tr>
<td>5 Uanetze</td>
<td>14</td>
</tr>
<tr>
<td>6 Mazimchopes</td>
<td>21</td>
</tr>
<tr>
<td>7 Incomati</td>
<td>134</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>3,587</strong></td>
</tr>
</tbody>
</table>

Table 1: Mean Annual Runoff of the Incomati basin and its main sub basins
Problems in the Management of International River Basins - The Case of the Incomati

Map 3: The international Incomati river basin

LEGEND:
- CATCHMENT BOUNDARY
- INTERNATIONAL BOUNDARY
- LAKE RESERVOIR BOUNDARY
- SOURCES
- TOWN
- EXISTING DAMS
- NEW DAMS CONSIDERED

MOÇAMBIQUE
SOUTHERN AFRICA
SWAZILAND

- 63 -
The flow that is generated within the borders of Mozambique is only about 5% of the MAR, putting the country in the complete dependence from the flows crossing the border. This is the consequence of the rainfall pattern, dominated by frontal precipitation that occurs in the mountains and high plateaus of RSA and Swaziland.

The total area developed for irrigation in the three countries totalled in 1991 about 126,000 ha, with 23% in Mozambique, 66% in RSA and 11% in Swaziland. There were at that time plans at various levels of investigation for additional irrigation of about 15,000 ha in RSA, 36,000 ha in Mozambique and 7,500 ha in Swaziland.

Irrigation is undisputedly the major water consumer in the Incomati basin. Other consumers are (or will be significant in the future):

- Urban and industrial water supply, where special reference can be made to Maputo, the capital-city of Mozambique, which in the not very distant future will have to recur to the Incomati water resources
- Afforestation
- Conservation, where attention must be paid to the river systems ecology as well as to the estuary and coastal area
- Livestock and game

A study (JIBS) was done by a RSA consultant in association with a Mozambican company, acting on behalf of the three basins States. The study was finished in 1994 but it could not be completed because the Mozambican authorities did not cooperate, which severely limited the consideration of the water requirements for Mozambique. This decision of the Mozambican authorities seriously undermined the study itself and Mozambique's negotiating position. The study considered a large number of alternatives, all of which indicated that the water available to Mozambique would be insufficient to fully develop its potential in the basin if all considered developments in RSA and Swaziland would take place.

The basin has six storage reservoirs with capacities above 50 Mm³, the largest one being Corumana dam in Mozambique. However, there are concrete plans to build a new large dam in Swaziland (Maguga) while Mountain View, in RSA, is under consideration. On the Mozambican side, a feasibility study on increasing the capacity of Corumana dam is being prepared, while apparently the Government of Mozambique still keeps the Moamba dam on the shelf.

The Incomati basin in Mozambique is managed by ARA Sul through the UGBI - the Incomati basin management unit. The UGBI operates the hydrometric networks, establishes the cadastre of the users and operates the Corumana reservoir. It liaises with the water users in the basin, monitors the consumption and collects the taxes for water abstractions.

The Incomati Basin Committee includes the major water users - the sugar cane factories, associations of farmers, the electrical utility EDM (Corumana has a hydropower station) and representatives of other interests like the Ministry of the Environment. The Committee is still at an initiating stage and the participation of the water users is not very active.

The UGBI has great limitations in terms of qualified human resources and financial capabilities. It is still far from working as a self-sufficient autonomous body as intended in the Water Law. The management tools that are used are also very basic and there is much room for improvement in this area – for example, in terms of models for reservoir management, flood forecast, flood propagation wave, to consider only the engineering side. It needs also to improve the financial management greatly to attain the desired sustainability.

Two other aspects where there are many insufficiencies concern the observation network and the environment. The observation network has been almost completely destroyed during the war and is recovering at a very slow pace. In particular, monitoring of the water quality at the border and at Corumana reservoir is missing, as well as a groundwater observation network. In relation to the environment, there are no studies about the situation, either along
the various river stretches or at the estuary, and both regarding the past, before the major water developments in Mozambique and in the upstream countries, and regarding the impacts of these developments. For example, there is a lack of research about the effect of the almost drying of some stretches of the river during some months or the effect of the increased salt-water intrusion in the estuary.

The management capacity of UGBI/ ARA Sul is obviously limited by the fact that the Mozambican part of the basin is at the downstream end, with almost all of the water coming through the border. Therefore, the negotiations with RSA and Swaziland are fundamental for the future development of the basin in Mozambique.

At the time of Independence, Mozambique inherited from the Portuguese colonial regime a situation in which there were almost no agreements on sharing water resources and its management in common river basins. Portugal had agreed with RSA and, after the independence of Swaziland, with this country, on principles of best joint utilization, negotiations and collaboration regarding data exchanges, consultation and joint studies. Besides this general agreement, Portugal only got from RSA the authorization to flood an area of about 64 ha immediately upstream of the border corresponding to the full supply level of Massingir dam.

After Independence, Mozambique, whose lack of experienced staff was notorious at that time, signed with Swaziland an agreement to share the waters of the Umbeluzi river basins. This agreement, one and a half pages in length, makes no mention whatsoever of important problems like the exchange of information, joint control of measuring stations or water quality at the border, nor does it prescribe regular meetings between the two countries for verification of its implementation.

The negotiations with RSA (the main partner of Mozambique in the basins of the southern region) and Zimbabwe, developed very slowly during the last years of the 1970s. This was due mainly to the political conflict in the region, where Mozambique did not have diplomatic relations with either with RSA or the then colony of Rhodesia (which in fact was making an undeclared war against Mozambique).

Ways to conduct negotiations with RSA regarding the Incomati basin were found in the beginning of the 1980s, but the beginning of the civil war in Mozambique decreased the capacity of DNA to deal with these issues. A Tripartite Permanent Technical Committee (TPTC) was established in 1983 but did not meet regularly, possibly due to the degradation of the political situation in Mozambique.

The negotiations were resumed in the beginning of the 1989. RSA wanted to build a new dam (Driekopies) and Swaziland had the same intention (Maguga), and it was required that Mozambique should agree with these new developments. In 1991 an agreement was signed between the three countries, in which Mozambique accepted the construction of those two dams. The agreement furthermore stipulated that:

- A joint study for the whole Incomati basin should be urgently executed by the three countries to serve as a basis for future negotiations on water sharing.

- As an interim measure, until a sharing agreement was reached, RSA should refrain from building any major storage works in the Sabié sub-basin (upstream of the Mozambican Corumana dam) without prior consultation at the TPTC.

- As an interim measure, until a sharing agreement was reached, RSA should guarantee a minimum flow of 2m³/s at the Ressano Garcia border.

Unfortunately, things did not evolve positively. Mozambique did not participate in the Incomati study – a very unfortunate and wrong decision – and the study remains to be completed. Mozambique has now obtained funds to complete the study with a detailed
analysis of Mozambique’s water demand and ways to make it compatible with those of RSA and Swaziland.  

The minimum flow of 2 m3/s was also not always complied with by RSA, alleging that, in a situation of serious drought, they had not enough water stored in reservoirs and all consumers had to be rationed.

In addition, RSA announced the construction of the Injaka dam in the Sabié river, in spite of the agreement of 1991. While RSA says that it tabled it at the TPTC and that it could not wait any longer for an agreement because of domestic and environmental needs, the Mozambican authorities presented it internally as a surprise and a violation of the agreement.

Although the meetings between the parts became now much more frequent, especially after 1994, there is still no evidence of concrete positive results.

The preceding points illustrate how little has been achieved by Mozambique in its relations with SADC countries with whom it shares river basins. Basically, the general attitude has been that each country promotes its own water developments, trying to cope with increasing water demands.

Since agriculture is prominent in the development plans of any of the SADC countries and since, in this region, a more productive agriculture implies irrigation, the growth of demand has been impressive. In the particular case of RSA, demands for urban and industrial water supply became also very significant. In addition, the drought that plagued the region for more than 10 years, since 1982, also contributed very much to the attitude adopted by the various countries.

Mozambique has also taken the same attitude, for example, with the construction of the irrigation perimeters of Chokwé, Xai Xai, Incomati and Sabié, and the Massingir and Corumana dams. While these developments affect the upstream countries, as they must take them into consideration as existing developments, they do not have the same physical consequences as developments in upstream countries have in Mozambique.

This way of acting unilaterally has contributed to create and strengthen a sense of distrust in the Mozambican authorities and in the public opinion with respect to the authorities of the other riparian countries. Obviously, the continuation of this line of behavior will mean for Mozambique:

- Less and less water, especially during the dry season
- More pollution coming through the border, mainly from agrochemicals (the situation is already creating concerns in the Elephants river and Massingir dam)
- The continuation of floods (if no strategies for flood mitigation is agreed upon with the upstream countries)

This will not only hamper any prospects of serious water-based development projects in southern Mozambique but will have, of course, other negative impacts - for instance, in terms of the coastal and river ecology.

Another aspect that may increase the potential for political conflict is the widespread feeling amongst the Mozambican population that they consented to enormous sacrifices for the radical political changes required in Zimbabwe and RSA and, instead of gratitude, they receive less and less of this most precious resource – water.

It is important, also, to look at the Mozambican institutions with a critical eye and evaluate how they have been performing and how that performance could be improved. It seems clear that the attention provided by DNA to the management of the country’s water resources and, particularly, to the IRBs and to the negotiation process was insufficient. This happened most probably due to:

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2 The completion study will start soon and shall be finished by mid-2000. It will serve as a technical basis for a water sharing and joint management agreement.
Problems in the Management of International River Basins - The Case of the Incomati

- General lack of enough qualified staff at DNA
- The war situation
- Scarce financial resources

However, the fact remains that Mozambique and DNA have been too passive in face of the developments taking place in the other countries, instead of being the most interested party in promoting negotiations and agreements. A country that is located downstream of all others must have a very dynamic attitude and combat the present tendency of large impact decisions being taken in each country individually.

5 Improvements Required in the Future

It is evident that no harmonious process of integration of the economies of the SADC countries can take place if the actual way of decision-making on water development projects remains the same. Water is a sensitive issue, with direct impact on the life of people, both in urban centers and in rural areas. This makes it also a sensitive political issue, if not immediately at least in the medium term. The potential for political conflict should then be dissipated by changing the present course.

Some important steps have already been taken: the signature of the SADC Protocol on Shared River Basins, the creation of a Water Sector at the SADC level as well as the new organization for the management of water resources in Mozambique. Positive changes are also the increase in regional meetings between water management officials of the various countries; and the public statements made by RSA authorities that the interests of all countries sharing a common basin must be taken into consideration when decisions on projects are made.

Also on the positive side is the growing interest of donors like the World Bank, The Netherlands and the Nordic countries to support the water resources sector, in parallel to water supply and sewerage which have until now been the top priority. The National Water Development Program of Mozambique, funded by the World Bank and various donor countries, includes a Water Resources management component. WRM is also the main focus of support projects funded by the Netherlands for DNA and for ARA-Sul. This will allow for the strengthening of DNA and for the elaboration of basin development plans in Mozambique, a most required basis for a negotiation process.

One of the main aspects for the changes to take place is to create an environment of trust between the countries. For this purpose, one immediate measure, which is not difficult to implement, should be the free exchange of hydrological data and free access for each country's officials to the relevant studies, plan and reports on water development projects of the other countries for the shared river basins. In this respect, DNA and other water related agencies should use all opportunities provided by existing agreements as well as the contacts and links established with corresponding institutions of other SADC countries with which it shares river basins.

Another useful measure is to create and/or put in operation Technical Committees, one for each IRB, with the obligation to meet regularly and present to the respective Governments the progress being made. At the level of each Technical Committee, a well-defined agenda should be established, indicating the more pressing and urgent problems, the studies to be done and the responsibilities of each country. It is quite clear that only with a regular and continuous process of negotiations can the various basin countries expect to achieve the agreements where sustainable and equitable development for all can be founded.

It would also be important to involve not only the Water Authorities of each countries but other type of institutions like the universities, research centers, NGOs and representatives of local communities. These other institutions may frequently bring new perspectives for

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existing problems and facilitate the creation of much required consensus. At a certain point, the involvement of donors and funding agencies could also help by introducing a more neutral perspective.

This push to improve the water resources development of the IRBs will require significant additional financial inputs. This is an effort that each country per se, the countries together and SADC should make towards the donor community.

It is obvious that, internally, each country will also have to strengthen its own financial and human resources capacity. In the case of Mozambique, the priority to the water resources sector and to the IRBs must be translated into more and better resources allocated to this sector, both at the central level and at the Regional Water Authorities. Together with better information to the general public and more open debate about the issues and problems of those IRBs, this will help Mozambique to present more consistently its concerns, projects and proposals.
1 General Information of the Basin

1.1 Geology

The Yellow River rises from the Yueguzonglie basin at the northern side of the Bayankela Mountain in Tibet highlands, with an elevation of more than 4,500 m above sea level. It flows through Qinghai, Sichun, Gansu, Ningxia, Inner-Mongolia, Shanxi, Shaanxi, Henan and Shandong provinces and autonomous regions and discharges into the Bohai sea, with a total length of 5,464 km, a water-drop of 4,480 m, and a basin area of 795,000. The Yellow River is the second largest river in China. (Map 1)

Map 1: Sketch of the Yellow River Basin

The Yellow River basin consists of three parts from west to east, with a decreasing elevation. The top part are the Qinghai Highlands in the north of the basin, which has an average elevation of more than 4000 m above sea level. The second part is up to the Taihang Mountain in the east. Most of this stage is in the Yellow Plateau and part of it belongs to the Inner-Mongolia Highlands. Its elevation varies from 1000 to 2000 m above sea level. From the Taihang mountain to the Bohai Sea is the third part. This part is dominated by the alluvial plain of the lower reach of Yellow River, most with an elevation of less than 100 m above sea level. The rolling area in this part of the basin has an elevation from 400-1000 m and delta area at the mouth of the Yellow River has an elevation of less than 10 m.

The main course of the Yellow River is divided into three reaches according to the basin characteristics (Table 1): the upper reach, the middle and the lower reach. The upper reach is rich in water resources and contributes about 50% of the total annual runoff of the river. At middle reach the Yellow River cuts through the Loess Plateau, where heavy storms often

1 Director, senior engineer, Institute of Hydraulic Research, Yellow River Conservancy Commission
occur and soil loss is serious. Floods and sediments originating from this region is most harmful to the lower reach of the Yellow River. The lower reach is often referred to as a “suspended river.” Flood control in this reach is always a challenge task.

<table>
<thead>
<tr>
<th>Reach</th>
<th>Start and end</th>
<th>Basin area (km²)</th>
<th>Length main course (km)</th>
<th>Elevation drop (m)</th>
<th>Slope (%)</th>
<th>Tributaries (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole reach</td>
<td>Source-Estuary</td>
<td>794,712</td>
<td>5463.6</td>
<td>4480.0</td>
<td>8.2</td>
<td>76</td>
</tr>
<tr>
<td>Upper reach</td>
<td>Sources-Hekouzhen</td>
<td>428,235</td>
<td>3471.6</td>
<td>3496.0</td>
<td>10.1</td>
<td>43</td>
</tr>
<tr>
<td>Middle reach</td>
<td>Hekouzhen-Taohuayu</td>
<td>343,751</td>
<td>1206.4</td>
<td>890.0</td>
<td>7.4</td>
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<tr>
<td>Lower reach</td>
<td>Taohuayu-Estuary</td>
<td>22,726</td>
<td>785.6</td>
<td>93.6</td>
<td>1.2</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1: Characteristics of each reach of the main course of the Yellow River

1.2 Climate

The Yellow River basin is located between the dry area of northwest China and the wet area of southeast China. Most areas of the basin have an arid or semi-arid continental monsoon climate, controlled by the cold air masses from the polar region. Northwestern winds dominate in winter with rare precipitation and snow. In summer the basin is mainly affected by oceanic anticyclone of the west Pacific Ocean. Water vapor is plentiful and precipitation is fairly high. The annual average temperature in the basin varies from -4° C to 14° C. The annual average precipitation ranges from 600 mm in the southeast to 200 mm in the northwest, but is on average 478 mm.

1.3 Water and Sediment

The Yellow River is a well-known sediment laden river in the world. The annual average sediment load measured at the Sanmenxia station is approximately 1.6 billion tons and the average sediment concentration is 35 kg/m³. However, the total volume of annual runoff is only 58 billion m³. Sediment of the Yellow River is yielded mainly from the Loess Plateau, which is responsible for 90% of the total load. Coarse material with particle sizes larger than 0.05 mm is mainly produced from this area.

1.4 Social and Economic Conditions

According to the statistics of 1990, there are 97.81 million people settled in the Yellow River basin, or 8.6% of the total population of the nation. The land in the basin, 794 thousand km², constitutes 8.3% of the total land of the nation.

Up to 1990, 37 of the 45 major minerals found China were found in the basin. The deposited volumes of 8 of them, such as rare-earth metals, gypsum and coal, contributes more than 32 % of the total volume in China. The oil and mirabilitum reserves are about 16%-32% of the nation’s total reserves. Reserves varying from 10-16% of the nation’s total are tronite, trona, copper, gold and several others. The large hydropower potential in the upper reach, coal in the middle reach and oil and natural gas in the lower reach make the basin energy-rich.

The Yellow River basin plays an important role in China. It has been the agricultural and economic development zone in China since very early times. Agricultural products such as wheat, cotton, oil and tobacco take an important position in China.
Numerous new industrial bases and cities have been founded in the Yellow River basin. Energy industries such as coal, power-generation, petroleum and natural gas have pronounced resources advantage. Coal production is more than 50% of the nation’s total production and petroleum production is about 25% of the nation’s total. Nonferrous metallurgical industries, such as lead, zinc, aluminum, copper, molybdenum, tungsten and gold as well as rare-earth metals industries also have comparative superiority. The textile industry has an important position in the nation as well.

The flood protection area, which covers a total area of 250,000 km$^2$, has Zhengzhou as its axle center and reaches Haihe River in the north, and Yangtze River and Huaihe River in the south. Based on historical records and analysis of the variations of topography and cultural features, if the embankment is breached in the north and in the south for the current river channel, the maximum range impacted by flood would be 33,000 km$^2$ and 40,000 km$^2$ respectively. The total area affected by floods is 120,000 km$^2$. There are 7.33 million hm$^2$ of cultivated land and the population in this area is 78.01 million.

1.5 The Floods of the Yellow River

The main floods of the Yellow River occur in July and August. Most of the floods occur from the middle reach down. The floods are peak floods with a short duration, rising and falling quickly. Historical investigations show the largest flood occurred in 1843, with a peak discharge at Shanxian (near Sanmenxia) station of 36,000 m$^3$/s. The maximum flood measured occurred in 1958, with a peak discharge at Huayuankou hydrological station of 22,300 m$^3$/s.

2 Achievements of Development and Treatment of the Yellow River

2.1 Historical Evolution of the Yellow River and Its Hazard

In history the water courses of the upper and middle reach of the Yellow River do not change significantly. Only the lower reach changes frequently. In the past 2000 years the river course of the lower reach has alternated 8 times. The current river course is formed through years of flood draining and sediment transport. The river course has been stabilized between the embankments on both sides. Bed elevation of the river is generally 3-5 m higher than the ground outside the embankment and at some locations even 10 m. Channel bed elevation increases about 0.05 to 0.1 m per year due to sediment deposition. Upstream of Gaocun station, the river is braided and the distance between the embankments varies from 5 to 20 km. From Gaocun to Taochengpu, the river is transitional and the distance between the embankments is between 1.5 and 8.5 km. From Taochengpu to Lijin, the river meanders and the distance between the embankments is about 0.4 to 5 km. Downstream of Lijin is the estuary region. On average 1.0 billion tons of sediment are transported to the delta annually, and as a result the delta area increases with 25 to 30 km$^2$ per year.

Floods and droughts occurred frequently in the Yellow River basin in history. Thus, the Yellow River has been called as the “Sorrow of China”. Most of the basin is arid or semi-arid. Rainfall is not only small but also varies considerably. Droughts occur very often. Enormous historical records and data of the present age show that the frequency of droughts is high, the areas affected large, and the population impacted huge.

Flood hazards in the lower reach of the Yellow River have always been the focus of the world attention in the history. In the period 602 BC to 1938 AD embankments brook in 543 years in total 1590 times. The river had changed its main course five times. Each breach and each river course alteration caused tremendous disasters.
2.2 Achievements of Development and Treatment of the Yellow River in the Past 50 Years

a) Construction of the flood control engineering system
The present flood control goal for the lower reach of the Yellow River is that the embankment will not breach when the peak discharge at Huayuan Kou station is 22,300 m³/s. Moreover, every effort should be made and every measure taken to minimize the flood hazard when an extraordinary flood occurs.

The flood control engineering system that has been gradually formed since 1950 is to “retain water in the upper and middle reaches, drain water at the lower reach, and divert and detain water on both sides of the river”, guided by the notion of “stabilizing the flow by widening the channel”. The engineering works for retaining water include:
- The Sanmenxia reservoir at the main course of the Yellow River, which controls 91.4% of the total basin area
- The Luhun reservoir and the Guxian reservoir on the Yi River and Luo River, designed to reduce flood risk for the lower reach of the Yellow River and the city of Luoyang, combined with the Sanmenxia and Xiaolangdi reservoirs
- The Xiaolangdi reservoir which controls 92% of the total basin area and has a total capacity of 12.65 billion m³ and a long-term effective capacity of 5.1 billion m³.

The draining engineering works include the embankments of the main course of the Yellow River and its tributaries and the channel harnessing engineering works.

The diverting and detaining works include the Dongpinghu reservoir, the Beijindi flood detaining area, the Qihe extending area, the Kenli extending area and the Dagong diverting area.

The Dongpinghu reservoir is a key diverting project at the lower reach of the Yellow River. Its current operation capacity is 3.05 billion m³. The main task of this reservoir is to keep the discharge downstream of Aisan below 10,000 m³/s, thus guaranteeing the safety of Jinan city, the railroad from Tianjin to Shanghai, and the vast area along both sides of the Yellow River.

The Beijindi detaining area was constructed in 1951. It is one of the key engineering measures to control extraordinary floods for the lower reach of the Yellow River. The effective detaining capacity is 2 billion m³. The capacity for Qihe and Kenli extending area is 0.39 and 0.327 billion m³, respectively.

Non engineering measures for flood controls include the flood control organization system, the flood control communication system, the hydrology monitoring and forecasting system, the flood regulation, command and decision making support system, and the management of flood plain, the diverting and detaining area, etc.

The economic and social benefits of flood prevention of the lower reach of the Yellow River are huge. Up to now, the central government has invested 7.0 billion RMB yuan for projects of flood control and the total benefits for flood hazard reduction is about 400 billion RMB yuan.

b) Development and utilization of water resources
The Yellow River is the key supplier of water for Northwest and North regions of China. It does not only provide water resources within the basin for social and economic development, but also supplies water to areas outside the basin and keeps necessary amount of water for transporting sediment into the sea.

According to statistical analysis of data from 1919 to 1995, the long term average annual runoff is 58 billion m³. Combined with the ground water, the total water resources in the basin is 72.8 billion m³. For the years 1988 to 1992 on average 39.5 billion m³ was abstracted
annually from the Yellow River and 30.7 billion m³ was consumed. Water consumed for agriculture irrigation was about 28.4 billion m³, or 92% of the total water consumption. 2.3 billion m³, or 8%, was consumed by industry households together.

Nine reservoirs and hydropower stations have been built on the main course of the Yellow River. Another two are being constructed: Wanjiazai and Xiaolangdi reservoirs. The total capacity of these reservoirs is about 56.3 billion m³ and the effective capacity 35.57 billion m³. The installed hydropower capacity is 9.156 million KW and the annual average power generated is about 34.31 billion KWh, which is about 29.3% of the total capacity and 30.2% of the power generated annually, respectively.

The irrigation area in the basin and its vicinity at the lower reach used to be 0.8 million hm², but increased to 7.126 million hm² in 1990. The profits of irrigation are very remarkable in the Yellow River basin. Comparing with non-irrigated areas, agricultural productivity in irrigated areas could increase by 3 to 5 times. From 1950 to 1995 investments for irrigation were 42 billion RMB yuan. The ratio of investment to benefit is 1 to 4.

c) Soil loss and water and soil conservation

Soil loss in the Yellow Plateau is the most serious in China. The total loss area is 454 thousand km². Sediment yield from this area is 90% of the total annual sediment of the Yellow River. In 1997, water and soil conservation measures were taken in an area of about 166 thousand km², about 1/3 of the total loss area. Increases in grain yield from water and soil conservation measures is about 4 billion kg annually. In addition, it has solved drinking water problem for more than 10 million people and 15 million livestock. More than 10 million people have obtained adequate food and clothing through these measures. Owing to hydraulic engineering and water and soil conservation measures, annual sediment yield has decreased by 0.3 billion tons on average, which is about 18% of the total annual sediment load of the Yellow River.

3 Basin Management

3.1 Basin Authority and its function

The Yellow River Conservancy Commission (YRCC) is an agency of the Ministry of Water Resources and is authorized to manage the Yellow River Valley and continental rivers in Xinjiang Uygur and Inner Mongolia Autonomous regions and Gansu and Qinghai Provinces. According to the principle of unified management and multi-level management, it is responsible for the unified management of water resources and river channels; comprehensive management of the basin; developing and managing the important controlling hydraulic structures; conducting planning, management, coordination, supervision and service; and improving the management of rivers and the comprehensive development, utilization and protection of water resources. Its main functions are:

- To be responsible for the implementation, supervision and inspection of laws and regulations, such as the Water Law and the Soil and Water Conservation Law, in the Yellow River Basin.
- To formulate basin-wide policies and statutes and work out a strategic plan and long-term and mid-term programs for water development of the whole river basin.
- To work out a comprehensive plan and the related special plans jointly with other departments and other provincial governments concerned with the unified management of water resources and the organization of monitoring and evaluation of water resources of the basin.
Supervisory and coordinating tasks: to supervise the protection of water resources of the catchment; manage rivers, lakes, estuaries; work out scenarios of flood prevention, examine the scenarios of flood prevention for trans-provincial rivers, coordinate the daily work of flood control and drought resistance of the basin, instruct the safety and construction of flood detention basins within the catchment; coordinate and handle water event disputes between departments and provinces; conduct the prevention, supervision and comprehensive management of key soil and water loss areas of the basin and instruct the soil and water conservation work of local governments; and check and examine the engineering projects financed by the central and local governments.

Investments: to work out an annual proposal for catchment engineering investments provided by the central government; to be responsible for implementation after approval; to be responsible for overall management and development of the basin, conduct the construction and management of key and trans-provincial hydraulic projects; to instruct the management of rural and urban water conservancy and hydraulic engineering projects and rural electrification work.

The headquarters of YRCC is situated in Zhengzhou, Henan Province. There are more than 29,000 staff and workers altogether, among which are some 9000 technical personnel, including some 1000 senior professionals covering more than 60 subjects. The technical strength of the YRCC is significant, especially superior in the domains of hydrology, sediment, river training, flood prevention works, basin planning, soil and water conservation, survey and design, demolition engineering, water quality monitoring, computer network, software and hardware development and micro-wave communication.

3.2 Management of Flood Control

Flood control is one of the most important tasks of the YRCC. For other rivers in China, flood control and flood control engineering works are conducted by local governments. However, in the Yellow River basin especially in its lower reach, YRCC plays a very important role.

a) Flood control organization

Lead by the State Headquarter of Flood Control and Drought Resistance, flood control headquarters and agencies are established in each province. The Headquarter of the Yellow River is in Zhengzhou. The Governor of Henan Province is the commander in chief and is fully responsible for the flood control of the lower reach of the Yellow River. The Director of YRCC is the executive deputy commander. Other deputy commanders include the vice-governor of Henan, Shanxi, Shaanxi and Shandong provinces. The deputy commander of each province is responsible for flood control of the province he or she serves. The office of the Headquarter of Flood Control and Drought Resistance of the Yellow River, set up in YRCC, is in charge of the daily works of flood control. Districts and counties that have flood control tasks also establish headquarters of flood control. They are responsible for flood control of the areas covered by the district or county. The administrative leading cadre of district or county takes full responsible for flood control of the county or district he or she served. Office is also set up to deal with daily works.
The teams for flood combating and rescuing include specialized personnel, mass organization, the PLA and armed police. The staff and works of the YRCC is the core technical force for engineering and emergency rescue. They are in charge of construction, management and maintenance of flood control engineering works, monitor and report of hydrology and engineering works, and maintain the communication system. The mass organizations take the duties of embankment inspection for any possible failure and of transportation of flood control materials. PLA and armed police are the main forces for flood combating and rescuing. Their major tasks are guarding the embankments and rescuing engineering works of the key river segments; demolishing the coffer dams in front of the
flood diverting gates and obstacles in river channel and the flood plain; rescuing and moving civilians in the flood plain; and the diversion of water to detention areas in case of emergency.

b) Construction of flood control engineering works
According to the principle of comprehensive management and development of the Yellow River, YRCC is responsible for planning the management and development of the Yellow River and implementation in phases after approval by the State Council. The key engineering projects are listed in the national budget and financed by the central government. YRCC is in charge of the management of the key engineering structures.

The reinforcement of the embankments at the lower reach of the Yellow River, the river training works and the construction of flood detention and diversion areas are carried out by YRCC. YRCC is also responsible for the management and maintenance of these engineering works. Because of changes in the river channel and its discharge capacity, river embankments have been reinforced and elevated three times since 1949. River harnessing and flood plain protection engineering works have been widely conducted in the lower reach of the Yellow River. These works have made it possible to keep the channel relatively stable.

c) Scenarios of flood control
To prevent and reduce flood hazards, YRCC makes every year scenarios for flood control of the Yellow River. The scenarios include flood handling, flood control regulation, flood prediction, communication guarantee system, material supply, etc. These scenarios are:
- Scenarios of flood handling in the lower reach of the Yellow River
- Scenarios of flood control regulation in the lower reach of the Yellow River
- Scenarios of flood prediction of the Yellow River
- Scenarios of the communication guarantee system of the Yellow River
- Scenarios of the supply and regulation of flood control materials
- The flood control scenarios of the Sanmenxia Reservoir
- The flood control scenarios of the Luhun Reservoir
- The flood control scenarios of the Guxian Reservoir
- The flood control scenarios of the Xiaolangdi Reservoir
- The flood control scenarios of the north branch of the Yellow River in Shanxi province
- The flood control scenarios of the north branch of the Yellow River in Shaanxi province
- The flood control scenarios in Shanxi part of the Sanmenxia Reservoir area
- The flood control scenarios in Shaanxi part of the Sanmenxia Reservoir area
- The flood control scenarios in Sanmenxia city of the Sanmenxia Reservoir area
- The flood control scenarios of the Jintihe River
- The flood control scenarios of the Yellow River in Henan province
- The flood control scenarios of the Yellow River in Shandong province

d) The Decision Support System for flood control of the Yellow River
The Decision Support System for flood control of the Yellow River has been developed for 10-odd years. Supported by advanced network technology and computer hardware, and involving co-operative efforts of several departments, this system has greatly improved the accuracy of decision making for flood control of the Yellow River. The system has formed a network that connects by cables, digital macro-wave, X.25 and satellite the Information Center of the Ministry of Water Resources, hydrology stations, and the local River Engineering Affair Bureau. Information provided by the system include mainly:
- Meteorological information, such as normal meteorological data, satellite cloud atlas, radar picture, fax chart and results of numerical prediction
- Precipitation information, such as real-time charts of point rainfall and regional rainfall of the Yellow River basin and the nation
- Hydrological information, such as real-time and historical hydrological information (hydrology station, water stage station and reservoir station) of the Yellow River
- Engineering, social and economic information, such as the information of flood control engineering works of the Yellow river and social and economic information of the flood protection area
- Remote sensing information such as remote sensing picture and data analysis

The Decision Support System for flood control of the Yellow River consists of the following sub-systems:

- Information inquiring system, which provides various information services for flood control
- Storm forecasting system, which provides long-term, interim and short-term storm predictions
- Flood forecasting system, which provides flood warning, real time flood prediction, and flood simulation
- Hazard evaluation system, which can estimate the flood inundation areas and the damages with the support of the flood forecasting system and a social and economic database
- Flood control regulation system, which can provide flood regulation schemes based on storm, results of flood prediction, condition of the engineering works, and the possible hazard analysis

3.3 Management of Water Resources

YRCC has always attached great importance to the planning and management of water resources of the Yellow River basin. Great amounts of investigation and evaluation with respect to the water resources in the Yellow River basin have been carried out. A water allocation plan has been formulated. Planning of the development and utilization of water resources has been conducted and the water demand-supply plans for the long term and interim term have been made. In view of the frequent low flows at the lower reach of the Yellow River, studies have been carried out and vigorous measures have been adopted for long-distance water allocation.

a) Enhancing the planning of water resources and bringing forward the allocation plan of possible water supply

The Prediction of Development and Utilization of Water Resources of the Yellow River, which had provided evidence to the State Council for approving the allocation plan of possible water supply by the Yellow River, was carried out in 1984, based on a great amount of investigations. The development and utilization principle and planning of water resources in the future was formulated in the Planning Outline of Development and Treatment of the Yellow River, which was examined and approved by the State Planning Committee in 1997.

The Allocation Plan of Possible Water Supply of the Yellow River was the first plan established in major rivers in China. This plan has enhanced the macro-control of water resources and appropriate arrangement of water source. It has also promoted the planning of water utilization and water conservation in provinces and regions.
b) The permit system for abstracting water from the Yellow River

According to the Implementation Means of Permit System for Abstracting Water and the Announcement of Management Limits of Authority of the YRCC for the Permitting of Water Abstractions, YRCC acted fully or partially for permitting water abstractions from the main course of the Yellow River and from its major tributaries. YRCC controls the total amount of water permitted to be abstracted by each province according to the Allocation Plan of Possible Water Supply approved by the State Council. Annual inspection is carried out for the permit of abstracting water.

c) Developing the water allocation plan for the lower reach of the Yellow River and distant water allocation

To improve water use at the lower reach, YRCC has made a water allocation plan for the period of January to June and November to December every year since 1996. In addition a monthly plan is made according to the water yield of the river. Real-time control of the Sanmenxia reservoir is applied to reduce conflicts between water uses at the lower reach of the Yellow River.

To relax the situation of water shortage for people and livestock in the estuary region, distant water allocation has been performed according to the arrangement of the Headquarter of National Flood Control and Drought Resistance and the Ministry of Water Resources. Outstanding results have been achieved.

d) Planning for and means of water allocation and enhancement of real-time water allocation

According to the Allocation Plan of Possible Water Supply of the Yellow River, made in 1987, studies have been conducted in 1998 on water allocation in dry years. The Regulation and Management Means of Water Yield of the Yellow River was put forward and approved by the State Planning Committee and the Ministry of Water Resources. This regulation and management means has authorized YRCC to regulate water yields of the Yellow River integrally. It has also stipulated the regulation principles and limits; the reporting, approval and supervision of water use; and matters in special cases. In order to carry out these means effectively, YRCC has established a water regulation and management origination.

e) Enhancing the monitoring and protection of water resources

YRCC has established 50 cross-sectional stations and 13 key stations for monitoring the water quality of the Yellow River. Monitoring is also conducted at key outlets of pollution and the boundary sections between provinces. Monthly, seasonal and annual reports of water quality of the Yellow River are published. According to the Water Quality Regulation of Abstracting Water from the Yellow River, water quality at the intake point and the outlet are monitored.

4 Other Key Issues

4.1 Basin Planning

Since the founding of the People’s Republic of China, studying and developing the Yellow River have been put on the agenda. In 1952, the preparation of a Yellow River Plan was put forward. In 1954, “The Technical and Economic Report of the Comprehensive Utilization of the Yellow River”, which was also referred to as the Yellow River Plan, was completed. This plan was examined and approved by the 2nd session of the 1st National People’s Congress in July 1955. This was the first comprehensive planning of the Yellow River. The planning

Later in the 50s, in view of the implementation of the first comprehensive plan and the problems exposed, it was proposed to make several more detailed plans: Water and Soil Conservation Planning, Channel Regulating Planning, and the Development Planning of the Main Course and the Tributaries. However, due to the influences of the “Great Leap Forward” and the “Three-year Difficult Period,” revising of the planning did not follow the planning procedure and the investigation and analysis in depth did not combine with the reality of the Yellow River. Thus, many of the planned projected should not and in fact were not carried out.

In 1965 a planning team was organized to revise the plans once again. Due to the “Cultural Revolution”, the project was stopped after one year of work. Nevertheless, two breakthroughs were made. First, the yielding limits of coarse sediment and its influence to the lower reach of the Yellow River were, for the first time, established. These provided sound evidence for trapping sediment in the Middle Reach of the Yellow River. Secondly, due to unmatched sediment load and flow discharge of the Sanmenxia Reservoir, the idea of regulating water discharge and sediment load was, for the first time, proposed. This has provided a theoretical base for rebuilding the Sanmenxia Reservoir, featuring the construction of a reservoir on the main course of the Yellow River, and for transporting sediment through the lower reach of the Yellow River.

In 1975 the plans were revised again. The planning was not finished completely. Several specific reports were made:
- Report on Defending Extraordinary Floods of the Lower Yellow River
- Report on the Envisaged Approach for Reducing Sediment Deposition in the Lower Yellow River
- Report of Planning Revising on the Comprehensive Utilization of Water Conservancy Project on the Main Course of Yellow River

In the 80s the focus of the nation shifted to economic development. It was demanded to conduct planning work for major rivers. In 1983 YRCC appointed a leading team for the planning work. The assignments for revising the planning were approved by the State Planning Committee in 1984. Since massive amounts of works were involved, the project lasted for more than 10 years. The plans were examined and approved by the State Planning Committee in 1997. The main contents of this planning include: flood prevention for the lower reach of the Yellow River; reduction of deposition in the channel of the lower reach of the Yellow River; water and soil conservation; layout of water conservancy project in the main course; development and protection of water resources; irrigation; and navigation on the main course. Meanwhile, four specific plans were prepared:
- Water and Soil Conservation Planning of the Yellow Plateau
- Navigation Planning of the Yellow River Water Network
- Utilization Planning of Water Resources of the Yellow River
- Protection Planning of Water Resources of the Yellow River

In addition, YRCC is making the Plan for Flood Prevention of the Yellow River Basin (Region), the Plan for Water Conservation, etc.

4.2 Policy, Laws and Regulations

The Central Government lays the outmost stress on the Yellow River. A series of principles, policies, general water laws, water administration regulations and basin oriented water laws have been made. They involve the water administration of the Yellow River, the management of water resources, management of water conservancy project and engineering affairs of the
Yellow River, management of flood control, water and soil conservation, protection of water resources, etc. Examples are given below.


In addition, there are a lot of local laws and regulations relevant to the management and development of the Yellow River. For example, “Management Means of Water Conservancy Project of the Yellow River of Shandong Province”, “Regulation for Certain Problems in River Channel and Flood Detention Areas in Henan Province”, etc.

4.3 Use of Foreign Capital

Since the 80s, YRCC has conducted 29 international cooperation projects. These projects include bilateral cooperation and the import and development of equipment. Most of these projects have played a vigorous role in improving the conditions and heightening the scientific content of the management of the Yellow River. For example, the project of water and soil conservation in the Yellow Plateau, which uses a loan from the World Bank, is a large project that uses foreign capital. The first phase of this project was in effect in October 1994. In 1995, the president of the World Bank spoke highly of the grand scene and the scientific layout when he was inspecting the project. The World Bank set this project as a flag project for agricultural loans. Interim evaluation of the project passed smoothly in 1998. In June 1999, a contract was signed with the World Bank in Washington for the second phase of this project.

The first phase of this project involves 22 counties in four provinces. The total area is 15,559 km², which has a loss area of 13,990 km². The total investment is 250 millions US Dollar, of which 150 millions US Dollar is loan from the World Bank. After completion of the first phase, the treatment level of the involved area will increase from 21.3% to 57.5%. This is a successful project using a World Bank loan. The main experiences learned are:

1. A united system of coordination and management is the organization guarantee of a normal execution of the project and of achievement results.
2. A scientific, united and perfect planning system laid a solid foundation for smooth implement of the project.
3. A strict management system of investment and finance guarantees the appropriate use of project funds.
4. Strict quality control and effective monitoring and supervision are applied to the project.
5. The investment perception is changed and emphasis is put on economic profit.
6. The importance of improving the scientific and technical level and using modern technology and management means to push forward and promote sustainable development and to teach high quality personal for water and soil conservation works.
MANAGEMENT OF INTERNATIONAL RIVER BASINS; THE CASE OF THE DANUBE RIVER

László Kardoss

1 Introduction

The Danube basin is faced with a number of problems well known to the community dealing with integrated water management. The basin is international, shared by 17 countries with an enormous difference in economic development. The basin countries and the European Union conceived the Environmental Programme for the Danube River Basin in 1991 in order to overcome the problems they are facing concerning sustainable development. The programme laid down the foundations, on which the International Commission for the Protection of the Danube River (ICPDR) could be formulated and its entering into force and operation could start. The programme was supported by the European Union's Phare and Tacis programmes (totalling up to EUR 28 million), UNDP GEF (totalling up to USD 12 million) and other bilateral donors and NGOs (especially at the initial phases). This paper - utilising and drawing on the available information of the EPDRB - discusses the results of the programme so far with special attention to the theme: Integrated River Basin Management.

2 Hydrology, morphology and climate of the Basin

The Danube river is 2,857 km long and drains 817,532 km². The drainage area includes: part of Bosnia and Herzegovina (51,000 km²) and Hungary (93,000 km²); most parts of Austria (80,731 km²), Croatia (34,760 km²), Romania (237,500 km²), Slovenia (17,622 km²), Slovakia (47,061 km²) and the Federal Republic of Yugoslavia (102,000 km²); significant parts of Bulgaria (33,588 km²), the Czech Republic (20,690 km²), Germany (56,240 km²), Moldova (8,300 km²) and the Ukraine (35 040 km²). Parts of the basin smaller than 2,000 km² are situated in Switzerland, Italy, Poland and Albania. The Danube River discharges into the Black Sea through a delta, which is the second largest natural wetland area in Europe. An overview of the basin with the main sub-catchments is shown in Figure 1 (p. 83).

The Basin makes up an aquatic ecosystem with numerous important natural areas including wetlands and flood plains. It is of high environmental value, but of economic and social significance as well in the European setting. It supports the drinking water supply, agriculture, industry, fishing, tourism and recreation, power generation, navigation and the end disposal of waste waters. A large number of dams, dikes, navigation locks and other hydraulic structures have been built.

Utilising water resources and capacities for important human activities, such as municipalities, industry and agriculture, has caused changes in the river regime. This has created problems of water quality and quantity, including significant environmental damage and impaired quality of life, such as public health problems.

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2.1 The main Sub-River Basins of the Danube

The Sava river is the largest Danube tributary. It rises in the western Slovenian mountains and passes through Croatian lowland before forming the border between Croatia and Bosnia-Herzegovina. Its main tributaries are the Kipa, Una, Vrbas, Bosna and Drina.

The Tisza river is the longest (966 km) and in terms of catchment (157,200 km$^2$) the biggest tributary of the Danube river. Its flow volume comes second after the Sava river. Its main tributaries are the Hornad, Bodrog, Slana and Bodva in Slovakia; Rica, Teresva, Tereblia, Borjava, Latoritsa and Uz in the Ukraine; Somes, Crisul Repede, Crisul Alb, Mures, Timis, Bega in Romania; Tarna, Koros, Krasna, Szamos, and Maros in Hungary.

The Drava/Mura river basin is situated in the middle of the Danube basin. The main river of the subbasin is the Drava, its length is 893 km. The total area of the subbasin is 41,893 km$^2$. The main tributaries are the Mura, Rinya, Fekete-viz, Mislinja, Meza, Dravinja, Pesnica and Bednja.

The Morava river basin is one of the major northern tributaries, emptying into the Upper Danube. Its basin of 26,580 km$^2$ is shared by the Czech Republic (20,623 km$^2$), Austria (3,700 km$^2$) and Slovakia (2,257 km$^2$). Its main tributaries are the Becva and Dyje.

The Siret river basin is situated in the eastern part of the basin and of the Carpathians. It has the third-largest catchment area. Main tributaries are the Suceava, Moldova, Bistrita, Trotus and Buzaul.

The Prut river is the last tributary of the Danube, with its mouth just upstream the delta. Main tributaries are the Ceremus, Volovat, Baseu, Corogea, Jijia, Chinej, Cigur and Lapusna.

2.2 Climate and morphology

The geography of the Danube river basin is very diverse. It includes high mountain chains, large plains, sand dunes, large forested or marshy wetlands and, very specifically, the karst and the delta. Similarly, climate and precipitation vary significantly; and they continuously form the basin’s landscapes.

Generally, the Danube basin is dominated by a continental climate (central and eastern regions). Only the western parts of the upper basin in Germany are influenced by the Atlantic climate and the southwest of the basin (former Yugoslavian countries) by the Mediterranean climate. The Alps in the west, the Dinaric-Balkan mountain chains in the south and the Carpathian mountain bow in the eastern centre are distinctive morphological and climatic regions and barriers. These mountain chains receive the highest annual precipitation (1,000-3,200 mm per year), while the inner and outer basins (Vienna basin, Pannonian basin, Romanian and Prut low plains), the uplands of the Czech Morava and the delta region are very dry (350-600 mm per year). The rivers with their water and moisture from the wet mountains help to balance evapotranspiration deficits, typical of the Pannonian plain and the delta, in the dry lowlands. 50 to 70 days of annual snowfall are recorded at high elevations in the Alps and in the Carpathians, while the plains have just 1-3 days/year of snowfall.

3 Hydraulic structures along the Danube

Hydraulic works in the form of dams and reservoirs are found in all mountainous areas of the Danube basin, while most navigation channels, dike and irrigation networks concentrate on the lowlands along the central and lower Danube.
Figure 1: The Danube basin

Today, hydropower utilisation and energy production varies substantially from country to country. In Hungary, the 28 MW hydropower generation accounts for approx. 0.6% of electric power in the country, whilst in Austria the generated 160,000 MW represents approx. 70% (is this for the country or the Danube) of the electric power generated.

The biggest hydropower dam and reservoir system along the entire Danube is located at the Djerdap (Iron Gate) gorge (117 km long). It is a peak operation system with two dams, jointly operated by Romania and the Federal Republic of Yugoslavia (average Danube flow: 5,500 m³/sec, overall drop: 34 m; installed capacity: 1,266 MW, annual production: 6,490 GWh.

These reservoirs (volume 3.2 billion m³; length: 270 km) trap 20 million tons of sediments per year, thus serving both as an important nutrient sink and as a deposit of hazardous and toxic matter for pollution coming from the upstream Danube catchment. At the same time the sediment deficiency downstream has been creating erosion problems since the start of dam operation in 1970.

An example of the serious impact of the hydraulic structures on rivers is the upper Danube between the source and Bratislava (the first 1,000 km) with a chain of 58 dams (on average one dam every 17 km), and with only three free-flowing sections left (Straubing-Vilshofen in Bavaria, the Wachau in Austria and Vienna-Bratislava). A similar situation with cataracts of dams is given for most alpine and Carpathian tributaries (e.g. Lech, Isar, Inn, Enns, Mura, Drava, Sava, Vah, Somes, Crisuri, Jiu, Olt, Arges, Ialomita or Siret/Bistrita).
4 Demographic, social and economic characteristics

As indicated already, there are 17 DRB countries in the Danube Basin, of which 4 countries have a very small share and do not participate in the Danube River Basin activities.

**Upstream countries**
Germany and Austria are located at the upper end of the DRB and have, compared to all other DRB countries, significantly higher development levels, represented by as high per capita income as about USD 25,000 per annum. In certain areas, they have achieved high standards of emission reduction and water pollution control.

**Middle reach countries**
Hungary, the Czech Republic, Slovakia, Slovenia and Croatia are located in the middle Danube River Basin. They are in various stages of overcoming the former central state planning systems and have reached medium economic development levels, represented by annual per capita incomes ranging between USD 4,000 and USD 9,000. The economic transformation process has caused a significant reduction of industrial and agricultural production, thus temporarily reducing production-related pollution loads. This has created the opportunity to establish and integrate environmental objectives into industrial and agricultural policies before economic activities are going to recover again.

**Yugoslavia and Bosnia - Herzegovina**
These two countries in the middle Danube River Basin are still in the critical phase of overcoming the Balkan war impacts. In the coming period their main task will be to reorganise their political, legal, administrative and socio-economic structures in order to comply with the requirements of the starting process of economic liberalisation and privatisation as well as international normalisation. With annual per capita incomes of USD 1,100 (BiH) and USD 1,500 (Yugoslavia) both countries will clearly remain below their prewar levels for some time to come.

**Downstream countries**
Romania, Bulgaria, Moldavia and the Ukraine - located in the lower Danube River Basin - at the same time are facing serious social problems. They are in such a difficult phase of economic transition that environmental protection and pollution control investments are not among the priority tasks defined for the near future. The economic status of these countries is clearly documented by per capita incomes ranging between USD 500 and USD 1,500 per annum.

4.1 Population

The present population of the thirteen DRB countries is about 223 million. According to national estimates, the present population living in the Danube River Basin is about 85 million, 37% of the total population of the 13 DRB countries. The average share of urban population in the DRB is about 57%, and thus about 6% lower than the average share in the 13 DRB countries.
Table 1: Population in the Danube basin, per country, 1995

As the area of the DRB is 817,000 km², the average population density is 103 people/km², about 14% lower than the average population density of the 13 DRB countries.

Based on the national projection figures it can be anticipated that by the year 2020 the population living in the Danube River Basin will be at the same level.

4.2 Economies

The extremely different economic development and actual status in the particular DRB countries are basically reflected by the country-specific GDP. In 1997, the GDP of the DRB countries varied from USD 1.9 billion in Moldova to USD 2,034 billion in Germany.

In 1996, the country-specific composition of the GDP for the main economic sectors varied as follows:
- The share of the agricultural sector between 1% in Germany and 34% in Romania;
- The share of the industrial sector between 19% in Romania and 45% in the Ukraine;
- The share of the "tertiary sector" (comprising all residual subsectors) between 37% in the Ukraine and 70% in Austria.

National Income per Capita
In 1997, the GDP per capita varied in the 13 DRB countries between USD 500 per annum (Moldova) and USD 25,600 (Germany), i.e. by a factor of about 50.

Table 2: Annual GDP per capita in the basin countries (USD/capita/year)

5 International treaties in the basin

The Danube basin countries are parties to international agreements that impact their policies on sustainable development. The ratification status of the different treaties is shown in Table 3 (p.87).

Europe Association Agreement
Europe Agreements have been concluded between the EU and Bulgaria, the Czech Republic, Hungary, Romania, Slovakia and Slovenia to prepare for their eventual accession to the
European Union. The agreements provide for increased co-operation in a number of areas including the sustainable approach toward the environment. It is foreseen and experienced that a gradual approximation of policies, laws, and EU environmental standards will take place. Considering the serious economic and financial constraints some of the basin countries are faced with, this is seen to be accomplished in the medium term.

**Environmental Action Programme for Central and Eastern Europe (EAP)**
In April 1993, the EAP was endorsed by the Environmental Ministers of the region, the UN Economic Commission for Europe (ECE) and the Environmental Commissioner of the EU. The EAP represents a broad consensus on environment and development. It calls for government actions in three areas: integration of environmental considerations into the process of economic reconstruction to ensure sustainable development, institutional capacity building and immediate actions where human health or natural ecosystems are severely jeopardised.

**Convention on the protection and use of transboundary watercourses and international lakes**
The convention was adopted by the Senior Advisers to ECE Governments on Environmental and Water Problems in March 1992, and signed by 22 countries and the European Community. The convention aims at strengthening the protection and ecologically sound management of surface and subsurface waters by providing a framework for regional co-operation on transboundary problems.

**Convention on the Protection of the Black Sea against pollution (Black Sea Convention)**
The Convention established a common legal regime for controlling marine pollution in the Black Sea. It was signed by the six Black Sea coastal countries in April 1992 and came into force in February 1994. The convention contains a legal framework for the establishment of a Black Sea Commission and provides protocols for the protection against land-based sources of pollution, for regulating dumping and for an emergency response in the case of spills. The Secretariat is established in Istanbul.

**Declaration on the protection of the Black Sea (Odessa Declaration)**
This declaration was adopted in April 1993. It expresses principles, goals, common priorities and lists nineteen regional and national actions to be taken by the Black Sea states to rehabilitate, protect and preserve the Black Sea. Amongst such actions are pollution control measures including the harmonisation of standards, assessment of contaminants and their sources, integrated coastal zone management and compulsory environmental impact assessment.

**Convention on wetlands of international importance, especially as wildfowl habitat (Ramsar Convention)**
The Convention, signed in Ramsar, Iran in 1971, sets out measures for the protection of wetlands, particularly those which are important wildfowl habitats. This Convention has been ratified by all Danube River Basin Countries except Moldova and the Ukraine. The 80 contracting parties and the former USSR have adopted the statement on “Guidance for the implementation of the Wise Use Concept”, one of the key elements of which is the development and implementation of national wetland policies as tools for the delivery of wise use.
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Table 3: Danube states which have signed or ratified relevant international conventions as of mid-1999

* Convention on the protection and use of transboundary watercourses and international lakes
** Convention on the protection of the Black Sea against pollution
*** Convention on wetlands of international importance, especially as wildfowl habitat
**** 1997 through declaration of continuity after the USSR
**Convention on biological diversity**
The Convention was signed by 72 countries and the EU at the UN conference on Environment and Development in Rio de Janeiro in July 1992. Eight of the Danube states are signatories.

**Danube River Protection Convention (DRPC)**
To secure the legal basis for protecting the water resources, the Danube River Basin countries and the European Communities signed the *Convention on Co-operation for the Protection and Sustainable Use of the Danube River* (the Danube River Protection Convention - DRPC) in Sofia, on 29 June 1994. The Convention aims at achieving sustainable and equitable water management. They decided to start the implementation of the Convention on an interim basis, before it would enter into force. An (Interim) International Commission (ICPDR) and (Interim) International Secretariat (IS) were established. A memorandum for close cooperation between the TF of the EPDRB and the ICPDR was agreed upon in 1995.

The Convention entered into force in October 1998 and the EPDRB is closely linked to it. According to the new structure of the ICPDR the Task Force of the EPDRB has been transferred into a Programme Management Task Force (PMTF). The PMTF is a supporting body to assist the ICPDR in its work, especially regarding project identification and financing and technical assistance for the implementation of the Convention. To achieve this, the PMTF has a broad membership including governments and organisations (i.e. donors and IFIs) which are not Contracting Parties to the Convention (See Figure 2).

**The Environmental Programme for the Danube River Basin**
Recognising the growing regional and transboundary character of the water management and related environmental problems, the Danubian countries together with the interested members of the international community met in Sofia in September 1991 to consider a new regional initiative to support and enhance the national actions that would be required. The countries agreed to develop and implement a programme of priority actions and studies in preparation for a new convention that would provide an effective mechanism for regional co-operation. The countries also agreed to form a Task Force to oversee the Environmental Programme for the Danube River Basin (EPDRB). The Commission of the European Communities (CEC), in its role as G-24 Co-ordinator, agreed to provide support and co-ordination for the Task Force.

The main objective of the EPDRB is to strengthen the operational basis for environmental management in the Danube River Basin. The main lines of action in the Work Plan (1992) for the first phase (1992-1996) were:
- short-term activities
- strategic and pre-investment activities
- institutional development and environmental management activities

The basin countries – after working on the programme for three years – approved a Strategic Action Plan at the ministerial level for implementation. The Strategic Action Plan is the result of the first three-year phase of the Danube Environmental Programme. It provides direction and a framework for achieving the goals of regional integrated water management and riverine environmental management expressed in the Danube River Protection Convention. It also aims to provide a framework in support of the transition from central management to a decentralised and balanced strategy of regulation and market-based incentives.
6 Strategic Action Plan

The Action Plan lays out strategies for overcoming the water environment-related problems in the Danube River basin. It sets targets to be met within ten years and defines a series of actions to meet them.

The Action Plan is addressed to the officials of national, regional and local levels of government who share responsibility for implementing the Convention and the national environmental action programmes under the Environmental Action Programme for Central and Eastern Europe. Industry, agriculture, NGOs and the public will also have important roles to play. The regional strategies set out in the Action Plan are intended to support national decision-making on water management, and on the restoration and protection of vulnerable and valuable areas in the Danube River basin.

The Action Plan supports the process of co-operation and collaboration set out in the Convention to address transboundary problems.

The Action Plan lays out strategies for overcoming the water environment-related problems in the Danube River basin. It sets short, medium and long-term targets and defines a series of actions to achieve them. A short-term target should be reached within a period of three years, that is by 1997. A medium-term target should be reached within a period of ten years, that is by 2005. A series of actions to achieve these targets is described for each sector – public authorities at central, district and local levels; municipal water companies and utilities; industrial enterprises; the general public and NGOs; and agricultural enterprises and the farming community.

These actions will be implemented through National Action Plans (NAPs) to be drawn up by the Danube basin countries assisted by the Danube Environmental Programme. The National Action Plans will be crucial in identifying projects that can be funded and implemented, and their preparation is the first priority.

6.1 Fundamental principles and approaches for environmental protection

Despite the diversity of problems, interests and priorities across the Danube River basin, the Danubian countries share certain values and principles relating to the environment and the conservation of natural resources. These values and principles underlie the goals and actions for the restoration and protection of the Danube River basin set out in this Action Plan.

The precautionary principle

The precautionary principle states that planning and actions should take into account the possibility that adverse effects might occur, even when firm evidence is lacking. In other words, it is better to be safe than sorry. It may justify limits on the discharge of a hazardous substance even though adverse effects on human health or the environment have not been conclusively proven. The lack of information about the state of the environment in the Danube River basin and the general lack of understanding of the complex dynamics and relationships in the riverine and aquatic environment make this principle especially relevant to the Action Plan.

The CEE countries, in particular, will be taking many strategic decisions regarding industrial development and agricultural policy which could have far-reaching effects on water and environmental quality. Use of the precautionary principle in making policy and investment choices which might affect the environment of the Danube River basin can help bring greater concern for the environment into decisions in other sectors.
Figure 2: Structure of the International Commission for the Protection of the Danube River
Best Available Techniques/Best Environmental Practice (BAT/BEP)

Best Available Techniques (BAT) means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. It is applied to industrial and other point sources of pollution. Best Environmental Practice (BEP) means the application of the most appropriate combination of sectoral environmental control strategies and measures. It is applied to non-point sources of pollution such as agriculture. These approaches do not imply fixed, predetermined solutions to problems. The choice of BAT or BEP depends on practical and economic factors as well as technologies. The result should be the adoption of the most cost-effective solutions, taking into account the full value of environmental functions and processes, and biological diversity.

Control of pollution at the source

The Action Plan gives higher priority to preventive actions, such as the reduction of waste through cleaner technologies and processes, than to curative actions. It is generally less expensive to prevent the creation of harmful wastes or pollution than to repair the damage to the environment afterwards. Reduction of pollution at source can also be encouraged by changes in patterns of consumption, for example if consumers select environmentally benign products such as phosphate-free detergents or recyclable packaging materials. Reducing harmful materials in products lessens reliance on costly end-of-pipe control technologies and helps to reduce the generation of hazardous wastes. Environmental audits have proven to be a useful tool in identifying ways to control industrial pollution and wastes at the source.

The polluter pays principle

The polluter pays principle and the related ‘user pays’ principle state that the polluter or user of natural resources should pay for the cost of maintaining the resources or repairing the damage done to them, usually through a fee or levy paid to government. These fees offer financial incentives to polluters and users of natural resources to reduce pollution and make more efficient use of resources. The fees can also provide much-needed revenues to water management authorities for maintenance and investment.

Regional co-operation

Regional co-operation means the full participation in and utilisation of regional mechanisms and structures for international co-operation, consultation and co-ordination on policy and action. Water quality and quantity and the health of the river’s aquatic habitat and biodiversity depend on what all the water users in the river basin are doing. Regional co-operation can strengthen the efforts of the Danubian countries to adopt and implement legal, administrative and technical measures to prevent and reduce transboundary impacts; to monitor water quality and resources; and to harmonise water quality standards and pollution controls.

Shared information

The sharing and exchange of data and information is fundamental to regional co-operation and to the understanding and solution of regional problems. The Danubian countries should share information on, for example, sediment transport and erosion, nutrient balances, low flow and water quality control, legislation and integrated planning (see Article 12 of the Danube River Protection Convention). The SAP also defines the understood aspects of integrated and regional water management as follows:
Aspects of integrated and regional water management
Integrated water management concerns both minimising the conflicts between different water uses and users, and optimising the economic, health and environmental benefits from water resources on a sustainable basis. Some types of water use do not necessarily conflict. Other uses are exclusive or lead to conflicts about the quality or quantity of water available to other users. Although the surface waters of the Danube and its tributaries are constantly being renewed, user conflicts cannot be solved while the polluting emissions continue. The groundwater needs particularly careful management since the degradation or reduction of groundwater is often irreversible or requires an extremely long period, in some cases centuries, for renewal.

Every use of surface waters requires maintenance of a minimum flow at all times or during critical periods. Human activities can harm water quality by discharging pollutants and waste products into the rivers or underground aquifers of the Danube River basin. Hence, the water quality management objectives for a river reach depend on the water uses that will be maintained there. The ultimate criterion will be set according to the users with the need for the highest quality of water or as needed to protect the ecosystems and biodiversity.

The water issues and problems of the Danube basin may have different regional or transboundary impacts. Some problems, such as water shortage in smaller tributaries, heterotrophic growth, oxygen depletion and microbiological pollution, are normally confined to limited river reaches or water bodies. They may cause health, economic or ecological conflicts of local, national and even transboundary importance. On the other hand, the pollution load of nutrients will normally not cause severe local water quality problems. However, it is one of the most important problems of the Danube's wetlands and the Black Sea.

The Strategic Action Plan covers both local and regional concerns and emphasises actions that have both local and regional benefits. Local needs and problems will normally be the most important criteria for actions and investments in each country. By participating in the Danube Programme and by signing the Convention, the Danubian countries are also committed to solving regional and basin-wide problems.

6.2 Goals, targets and phased programme of actions set in the SAP

The Strategic Action Plan describes a framework for regional action which will be implemented through National Action Plans (NAPs). It contains: four goals for the environment of the Danube River basin; strategic directions; a series of targets within a time frame; and a phased programme of actions to meet these targets.

The goals set the priorities. The strategic directions explain the approach. The targets identify necessary policy and regulatory reforms, and key programmes and institutional measures that need to be taken. A sustained effort over the coming years will be necessary. Government, industry, agriculture and the public must co-operate to implement the phased programme of actions which meets these targets.

Among the Strategic directions, which identify the policies, it distinguishes the following entries:

Integrated water management
Integrated water management means covering water allocations, water use and water discharge permits on the basis of integrated and comprehensive plans developed by means of a broad-based participatory planning process. It focuses on the tributary river basin or subbasin.
Environmentally sound sectoral policies
A clear and consistent legal and economic framework is needed to encourage investment in waste reduction and control, to introduce environmentally sound products and practices, and to mobilise financial resources for water and environmental management. This should focus on incentives (implementing a more effective pollution fee and fine system), and on financing actions (developing a viable funding mechanism for project investment).

Investments
Investment policy should focus on the rehabilitation and expansion of drinking water systems, on municipal waste water and solid waste management systems, on industrial pre-treatment plants and on the replacement of industrial process technology to minimise and eliminate waste. The clean-up and restoration of polluted sites are also important. Planning and project preparation, particularly the feasibility study, is vitally important for developing affordable financing plans and implementation plans.

7 Analytical tools
Under the EPDRB there were several subgroups of the Task Force formulated in order to address specific issues of the effective water management. Subgroups so formulated include the Accident Emergency SG and the Monitoring, Laboratory and Information Management SG. Since the entering into force of the Danube Convention these subgroups have been transferred to the ICPDR as its Expert Groups. The Emission Expert group was established by the ICPDR. Its first years of practical operation were supported by the Phare MC Environmental Programme.

7.1 Accident and Emergency Warning System (AEWS)
The 1992 Work Plan of the EPDRB gave immediate priority to the development of a Danube Accident and Emergency Warning System (AEWS). The objective of this system is to increase the safety of the population and to protect the environment should accidents occur. The EPDRB Task Force established the same year the AEWS Sub-Group to carry out the design and the development of this system. The financial and technical support were ensured by the Phare Multi-Country Environmental Programme, and the Tacis CBC Programme to have Moldova and the Ukraine fully connected to the system.

The 1996 inauguration of the first stage of the AEWS took place on 11 April 1997 in Vienna in an official ceremony. The permanent operation of the system since April 1997 provided experiences supporting the further development of the second stage of the AEWS.

At the beginning of 1997, the Sub-Group discussed priority actions and adopted a programme of future work until the end of 2000. Emphasis was placed on the improvement of detection and reporting of accidents and on enforcing the sustainability of the system. The EPDRB Phare 1996 budget supported several projects aimed at: information enhancement e.g. PIAC exchanges and training; calibration of the Danube Basin Alarm Model (DBAM). A project was elaborated, discussed and approved for financing by Phare MCEP. Recently, within the framework of an exchange programme, training was provided to PIAC staff. Also recently, two studies were prepared and discussed: “Strengthening links with the Hydrometeorological Services” and “Automatic Water Quality Analysis stations: feasibility and specifications”.

The most important tool for the PIACs is the “Danube Basin Alarm Model (DBAM)”, developed within the framework of the Phare EPDRB Applied Research Programme. The final version of the DBAM was distributed to the Principal International Alarm Centres for
experimental implementation. A report evaluating the most feasible methods available for tracer experiments as a basis of the future calibration of DBAM was also prepared.

7.2 Monitoring, Laboratory and Information Management

At present, the MLIM SG consists of twelve representatives of Danube riparian countries (with the exception of the former Republic of Yugoslavia), nominated by their respective governments. The 12th state to join the SG was Bosnia-Herzegovina which was included in September 1996.

The overall objective of the MLIM SG is to create a strengthened and more strategic approach to environmental information management for the Danube River Basin. In this regard, the following specific objectives prevail:

- To assist with the improvement of environmental management through the strengthening of existing environmental networks
- To improve the comparability of sampling techniques and laboratory analyses
- To develop compatible information management systems supporting data managers at the national level as well as permitting the exchange of information at the international level.

In order to achieve the above-mentioned objectives the following (technical) tasks have been implemented:

- Implementation and consolidation of the Trans-National Monitoring Network (TNMN), including the main tributaries
- Technical support for equipment procurement
- Technical support to a large Integrated Training Programme
- Installation of three Working Groups (WG) to carry out the specific tasks resulting from the MLIM Implementation Plan
- Exchange of information and to liaise with other similar systems from other areas.

Three Working Groups: Monitoring WG, Laboratory Management WG and Information Management WG worked under the overall supervision of the SG. The main task of the Monitoring WG is to develop the Trans-National Monitoring Network (TNMN). The Laboratory Management WG has established links with National Reference Laboratories (NRLs) and co-ordinates its work with regard to Danube Water Quality monitoring. The Information Management WG aims at the establishment of links with National Information Centres (NICs) through Responsible Data Managers.

7.3 Emissions

The ICPDR established the Emission Expert Group (EMIS/EG) in 1995, but little or nothing was done until the beginning of 1997 for lack of financial possibilities of the downstream countries to support their members to attend the meetings or to organise the work.

The main tasks of the group are: inventories of point and non-point sources of pollution, development of action programmes and strategies, preparation of a list of priority pollutants and development of water quality standards (targets) for the Danube River Basin. Detailed plans and formats for emission inventories have been discussed and agreed. This involved three main components: municipalities, industries and priority substances. The emission inventories of municipal and industrial discharges have started. The first filled-in national emission tables were discussed in detail during several EMIS/EG meetings in 1998. The first report "Emission Inventory of Municipal and Industrial Discharges" has been prepared and agreed, and the further permanent updating and improvement of the emission data is in process. A first draft of "Danube List of Priority Pollutants" has been prepared and discussed.
8 Present activities of the EPDRB with special emphasis on Integrated River Basin Management

There are several projects in various phases of implementation within the EPDRB. As already explained in the paper, the method and practice of co-operation in implementing the Programme already ensures that the projects implemented are already elements of the overall puzzle to contribute to an integrated approach.

Within the Strategic Action Plan Implementation Programme several clusters of projects have been defined, including the cluster for River basin management. The cluster has been defined with a view to accelerating environmental improvement and the resolution of transboundary problems, especially environmental protection and nature conservation, in subbasins of the Danube river network through international co-operation in river basin management.

Several projects are identified in the programme, including some at final stages of completion.

At present there is one major case study under implementation: “International Co-operation for the Management of the Tisza River Basin, Preparatory phase”. Slovakia, Romania, the Ukraine, Hungary and the former Republic of Yugoslavia are participating in the project.

Among the objectives included in this project are the following objectives which are to contribute to the long-term objective of the programme:

- To support Hungary, Slovakia and Romania in the development of the transboundary Tisza River Basin management planning programme. (Note that the Ukraine will join this project through a Tacis funded project, starting approximately at the same time as the present one.)

- To promote cross-border co-operation in the Tisza River Basin between neighbouring municipalities or groups of municipalities in different Phare countries for joint investments in waste-water treatment facilities.
1 Introduction

The São Francisco is one of the most important rivers in Brazil, being known as the "River of National Unity". The Basin extends over approximately 640,000 km², comparable to the drainage basins of the Colorado or Columbia rivers of North America, and discharges an average of 3,800 m³ s⁻¹ across the North East Brazil Shelf to the Southwest Atlantic Ocean. The river covers a large portion of the area known as the "Drought Polygon of Brazil" as it traverses climatic zones ranging from humid to arid as it flows through five states in Northeastern Brazil: Minas Gerais, Bahia, Pernambuco, Alagoas and Sergipe.

The Federal District of Brasília and the State of Goias are also sometimes included in the watershed as the headwater tributaries originate in these areas. The basin is generally divided into the Upper, Middle, Lower Middle, and Lower subbasins, plus the oceanic end point, each with distinct environmental and socio-economic characteristics.

Four large dams have been constructed along the course of the river and are a major source for hydroelectric power with a combined yield of 10,000 MW. River water is also extensively used for irrigation. The river has a rich cultural history and played a central role in the development of the interior of Brazil in past centuries. The estuarine wetlands located at the debouchment of the river into the South West Atlantic form a particularly important and environmentally sensitive interface between the riverine and marine environments. The ecological structure and function of this interface, as well as its physical integrity, is currently under threat, due to unsustainable hydrological and land use management practices within the basin. Except for flood flows during the wet season, flow is contributed primarily from the humid and semi-humid areas near the headwaters. Tributaries in the arid and semi-arid regions of the Middle and Lower Middle subbasins are largely intermittent, although flood flows in these streams may cause localized problems of flooding, erosion and sedimentation which affect the entire lower portion of the river system and the coastal zone. Some 13 million people are resident in this basin, principally concentrated in the upper subbasin.

The Upper Subbasin is located in the southernmost part of the Basin, primarily within the State of Minas Gerais, in a region characterized by rolling hills and tablelands. The climate is humid temperate to sub-tropical, with an average precipitation of approximately 1,250 mm per year. This subbasin contributes more than 70 percent of the overall flow of the river. Belo Horizonte, the capital of the State of Minas Gerais, is located in this area, as are other, moderately sized, cities including Patos de Minas, Januária, and Betim. Development within this reach of the river includes large industrial plants, mainly for steel production and manufacturing of paper and automobiles, diversified mining, and irrigated agriculture based on the large Tres Marias Dam. Agricultural production is primarily soybeans and cattle, with higher value crops such as fruits grown within irrigated areas. This region also has large areas of cultivated forests of eucalyptus for use in the paper industry and in the production of charcoal for the steel industry. Over half of the population of the basin, or more than 7 million (1994 Census) people, lives in this subbasin.
The Middle Subbasin is located in the states of Minas Gerais and Bahia and is characterized by two distinct zones. The western portion of the subbasin is fed by orographic rainfall in the elevated areas, has perennial watercourses, and is relatively fertile, supporting cerrado or caatinga vegetation and agricultural production in both private and public irrigation schemes. The eastern portion of the subbasin is characterized by intermittent or seasonal watercourses, and supports considerably less development. Caatinga vegetation dominates in this semi-arid area, and agricultural production is limited to cattle and goat breeding, subsistence agriculture, and limited irrigated agriculture where water is available. Precipitation averages around 900 mm per year and there are no dams or reservoirs in this subbasin. The population is rural and sparse, mostly involved in agricultural activities and dependent on the river for irrigation, transportation and water supply, with more than half of the families classified as indigent or poor.

The Lower-Middle Subbasin is located in the states of Bahia and Pernambuco. The river is the boundary between the two states and represents a major source of irrigation water for fruit and vegetable production in the region of Petrolina and Juazeiro. Vegetation is predominantly caatinga, distinctive of the sertão region of Brazil, and the soils are mostly thin and non-productive. Precipitation averages about 500 mm per year. Development in this region has been strongly influenced by federally sponsored irrigation projects, implemented by the Companhia de Desenvolvimento do Vale do São Francisco (CODEVASF), which provided the base for subsequent private investment in high-value export vegetable crops. This subbasin also contains the majority of the hydroelectric power infrastructure within the Rio São Francisco Basin: the Sobradinho (34.1x10^9 m^3; 1,050 MW), Itaparica (10.7x10^9 m^3; 1,500 MW), Paulo Afonso (1x10^9 m^3; 4,400 MW) and Xingo (3.3 x10^9 m^3; 3,000 MW) dams provide renewable energy for most of Northeastern Brazil. This infrastructure also provides an opportunity for the development of river-borne intermodal transportation systems, as the river was originally marginally navigable in this region through to its upper reaches. In addition, an inter-basin transfer scheme, proposed for construction below the Sobradinho Dam to supply water to the Northeastern States of Ceará, Rio Grande do Norte and Paraíba, is still being analyzed. Most of the population is located in the cities of Juazeiro in Bahia and Paulo Afonso and Petrolina in Pernambuco.

The Lower Subbasin includes the states of Bahia, Alagoas, Sergipe and Pernambuco, the river forming the border between the states of Bahia and Pernambuco and between the states of Alagoas and Sergipe. Vegetation in this subbasin is mostly cerrado (and Mata Atlântica in the humid lower reaches), although there are large semi-arid areas, covered by caatinga, in the northernmost portion of the subbasin. Precipitation varies from 1,300 mm per year along the Atlantic coast to 500 mm per year along the upstream boundary. Population is concentrated near the coast in small municipalities and rural communities, and is generally classified as poor or indigent. Sugar and alcohol are the main agricultural products of the subbasin, with estuarine and coastal marine fisheries forming an important source of food and income. River navigation was historically important in the transportation of sugar and other agricultural products, limestone and building materials, but has declined in recent years due to aggravation of the river channel, which forced the development of the regional road system.

The lowest reaches of the subbasin contain an extended estuary and estuarine wetlands. The ecological regime of the delta and coastal areas represents an asset that has not been fully defined or protected. Some of this area has been developed for agricultural production using a system of polders and drainage channels.
Map 1: The São Francisco River Basin
The beach to the south of the delta is a principal nesting area of threatened and endangered sea turtle species, while the oceanic end point of the river debauches across the North East Brazil Shelf to the South West Atlantic Ocean. This entire area has been significantly modified by the regulation of the river upstream of the estuary and coastal zone (e.g., erosion of riverbanks, sedimentation, formation of islands in the delta, and erosion of the southern extreme of the delta). These modifications not only affect the estuary by altering flooding
cycles, but also impact the near-shore marine environment by modifying the nutrient and sediment content of the river water, affecting marine fauna, and the sediment and turbidity dynamics of the estuary with observed, although unquantified, changes in the aquatic fauna, flora and geomorphology of the river mouth.

The annual discharge of the Rio São Francisco at its mouth averages over 94,000,000-m³ per year. The natural flow in the reaches through the middle basin below the principal perennial tributaries average between 2,100 m³/second and 2,800 m³/second, with a natural flow of approximately 3,000 m³/second near the mouth of the river in the Lower Subbasin. Normal natural maximum flows occur during the month of March and average approximately 12,950 m³/second at Juazeiro near the boundary between the Middle and Sub-Middle Subbasins and 12,967 m³/second at Pão de Açucar, located near the mouth of the river. Normal minimum flows at these stations occur during the month of September and average 671 m³/second and 842 m³/second at these two locations, respectively. As the river is operated today, the natural flows of the river are highly regulated by extensive hydroelectric developments and the flows are regulated to optimize energy production and to control flooding of the river margins. Figure 1 shows the historical flows in the São Francisco at the location of Propriá.

Figure 1: Historical Flows in the São Francisco at Propriá

The São Francisco watershed has been subjected to intense economic development pressures, including extensive regulation by hydroelectric and irrigation water supply impoundments, which appear to be increasing. In recognition of these increasing developmental pressures, the Federal Government of Brazil has initiated several actions designed to protect the resources of the region and contribute to the sustainable development of the area. These actions have included the creation of a Senate Committee to investigate the status of the basin; the creation of a river basin development corporation; and more recently an interstate liaison committee. Each of these actions addresses some of the more pressing issues of concern within the basin.
Problems related to poorly quantified environmental impacts
Reported problems related to poorly quantified environmental impacts include the biological consequences of modified river flows as the result of river regulation; the contamination of reservoirs and modification of the near-shore marine nutrient balance due to river regulation; the changed character of the sources, sinks and composition of sediment loads throughout the basin as the result of interception and downstream scour arising from river regulation; modification of the water quality (and, thereby, the biological integrity of the system) as a result of human economic activities (e.g., mining, industrial development, and urbanization in the headwaters area of the river, and industrial development, agricultural development based on irrigated agriculture and urbanization in the lower portions of the basin) that discharge untreated or poorly-treated wastes to the system.

Problems related to stakeholder involvement
Problems related to stakeholder involvement historically have been related to the lack of an appropriate framework for encouraging stakeholder participation and the highly sectoral nature of development within the basin. In recent years, the efforts of the federal government to increase the living standards in the previously impoverished basin have focussed on a top-down style of implementation that has rarely recognized the wider context of social concerns other than economic development. Recently, a wider appreciation of the success of community-based, bottom-up development approaches, such as that embodied in Brazil’s federal water law 9433/97, have initiated the process of increasing stakeholder participation across traditional sectoral lines. This process, in a basin as diverse and complex as the Rio São Francisco Basin, will take some time to evolve and mature.

Problems related to economic development
Problems related to economic development include poorly regulated exploitation of lands and natural resources for commercial purposes, the highly sectoral nature of developments, and the development of large, single-purpose development areas generally managed (historically) by parastatal or state-owned corporations. In some cases, despite their geographic proximity, the sectoral nature of developments within the basin often create conflicts or the potential for conflicts over rates, timing, and types of water use, the prime example being the conflict between release of water for hydropower generation purposes and the natural flooding cycle of the lower reaches of the river system (at its seaward extent).

Problems related to institutions and human resources
Problems related to institutions, both legal and regulatory, and agency structures, have historically been related to a lack of appropriate laws and regulatory regimes for controlling environmental pollution, implementing and undertaking compliance monitoring, and policing of violators. Related to the lack of institutional capacity, problems related to human resources include a paucity of trained staff, lack of authority to control environmental problems, and fragmented and parochial jurisdictions that have failed to bring a comprehensive and cohesive approach to watershed management in the Rio São Francisco Basin. Initiatives set forth in federal law 9433/97 provide mechanisms to rectify many of these shortcomings. Funding, which has been in chronic short supply, has not allowed creation of laboratories, police forces, and other necessary appurtenances to control and regulate environmental pollution and degradation. Actions that could be undertaken were fragmented among agencies and between states, and consequently often resulted in less than effective management of the river and watershed. Currently, local and national initiatives are strengthening water resources institutions in the basin.
Problems related to lack of an holistic management approach
Problems related to the lack of a unified vision of the Rio São Francisco Basin as an integrated whole include intersectoral conflicts over water usage, competing rather than complementary demands for water and a piecemeal approach to water resources development in the basin. The Senate Committee on the São Francisco Valley identified this lack of an integrated, holistic management approach as the principal issue facing sustainable development in the basin.

Problems of land degradation
Problems related to land degradation include draining coastal wetlands, conversion of lands for agricultural purposes, and disruption of the land surface for mining and residential purposes. Industrial farming operations and land-clearing practices have disturbed large areas of land and have resulted in the deforestation of river banks and uplands. The water use regimes and the types of crops and livestock have aggravated the severity of land degradation in the basin.

Problems of fisheries
Problems related to fisheries include contamination of fishes by heavy metals and agrochemicals, and changes in species composition due to modification of river flow regime, constraints on migratory ranges, and harvesting pressures.

Problems of hydrology
Problems related to hydrological processes include alteration of flood regimes due to river regulation and altered land use practices, which modify the way in which water is applied to and lost from the land surface. Changes in hydrological processes create a cascade of sedimentological, chemical, and biological consequences throughout the system, which further modify the structure and functioning of the aquatic ecosystem that is the river. Likewise, the drainage of wetlands and the creation of polders in the estuarine reaches of the river have further altered river flow patterns often in negative ways.

Problems of urbanization and industrialization
Problems related to urbanization and industrialization include surface or open cast mining for many metals and minerals, irrigated agricultural development, agroindustrial product processing (alcohol, vegetable and sugar processing), and residential area encroachment without adequate waste-water treatment and solid waste management. Mining operations contribute to sedimentation and contamination in the river by disturbing the land surface and by direct and indirect runoff from slime dumps and slag heaps. Poorly regulated use of agrochemicals and the potential lack of irrigation scheduling (which affects the quantity and quality of irrigation water return flows) contribute to the eutrophication and salination of the river.

Problems of water quality
Problems related to water quality include contamination of surface and ground waters, including bacteriological contamination, heavy metal contamination, contamination by synthetic organic (agro-)chemicals, organic matter loading, and suspended sediment load modification, many of which have a significant anthropogenic component.

Root causes
Despite the apparent proliferation of problems in the Rio São Francisco Basin, there are relatively few root causes. The first one is anthropogenic, that is, people have contributed
almost exclusively to the degradation of the Rio São Francisco Basin. Although increased economic development in the basin has succeeded in improving the quality of life for many of the citizens of the basin (as intended), the rates of exploitation of the natural resource base have increased and primary extractive industries continue to deplete the reserves of minerals and metals that underlie these industries. In the first instance, the redistribution of population in the basin has led to increased urbanization throughout the basin, which in turn has contributed untreated human wastes and other contaminants to the system. These populations have also created an increased demand for foodstocks which have been met by overfishing and by cultivating marginal lands (through expansion of irrigation schemes and increasingly large additions of agrochemicals to maintain soil fertility). Superimposed on these causative factors are modifications of the natural hydrological regime of the river which – while contributing to the production of “clean” energy for use by the people and industries of the basin and throughout Brazil – have proven especially destructive to organisms that depend for reproduction and survival on the quantity, quality, timing and rate of water flows (especially in the estuarine and coastal marine end points of the basin), and to groundwater sources that depend for recharge upon surface water flows.

The second group of causes are legal and institutional. While human land use activities have contributed significantly to the degradation of the Rio São Francisco ecosystem, legal and institutional shortcomings have historically exacerbated these problems. Human actions in the watershed have not been controlled or regulated and existing mechanisms have failed to view the basin as a unit, in which actions taken at specific sites have a cumulative effect throughout the system. Most of these shortcomings have been rectified through state, federal and external interventions and initiatives or proposals are currently being made to rectify them. However, substantial and costly actions are needed to overcome the historic lack of regulation, and lack of an holistic approach to ecosystem and economic development.

2 Policy and Planning

The Rio São Francisco has been subjected to a significant degree of infrastructural modification as a consequence of public efforts to promote development. The principal Federal entities having responsibilities within the basin are CODEVASF (The Rio São Francisco Development Agency), CHESF (The São Francisco Power Company), and SUDENE, an organization created in 1959 for the purpose of comprehensive planning and supporting development in Northeastern Brazil. In 1984, the Executive Committee of Integrated Studies of the Basin (CEEIVASF) was created within the framework of the Special Commission for Integrated River Basin Studies in Brazil to undertake specific planning studies in the basin. This Committee was among the first to consider the São Francisco River Basin as a hydrologic unit, but the Committee was restricted by its mandate to the preparation of studies, and it lacked the institutional independence and financing to successfully implement a comprehensive program of river basin management. Other official organizations with interests in the São Francisco Basin include the Inter-State Parliamentary Commission for the Development of the Rio São Francisco (CIPE) composed of the Presidents of the Legislative Assemblies of the five riparian States, and UNIVALE, a Union of Municipal Authorities in the basin.

The valley of the São Francisco has been the subject of numerous planning and developmental efforts over the years. In 1989, a Master Plan for the Development of the São Francisco River Valley (PLANVASF) was completed by CODEVASF, with the assistance of the Organization of American States (OAS), and was designed to provide incentives to the public and private sectors for the development of the basin. This plan included proposals for the development of natural and water resources, increased food production through irrigated
agriculture, increased power generation supplying the National Network, increased water and sanitation services, improved river navigation, and enhanced environmental protection. This plan was adopted as a part of Federal Law 8851/94, as the Plan of Economic and Social Development of Northeastern Brazil. In relatively recent times, major planning studies were done by DNAEE (DNAEE 1993) and CHESF with regard to the hydroelectric potential of the river.

In 1995, the States of the Northeast, in cooperation with the National Secretariat of Water Resources, formed a group representing the water resources sectors of each state to foster legal and institutional cooperation on water resources throughout the Northeast, including the São Francisco Basin. The group was established formally with the signing of the “Carta de Natal” in Natal, State of Rio Grande do Norte. One of the major topics of this group was the São Francisco, including the potential impacts of the proposed “Transposição Project”, which would transfer water from the Rio São Francisco to the non-riparian Northeast States of Ceará, Rio Grande do Norte and Paraíba and to the Sertão region of Pernambuco. This committee continues to meet and discuss topics such as the legal and institutional framework for water and joint efforts to study integrated management of the São Francisco and other areas of potential cooperation between the States and the Federal Government in the water resources sector.

In January 1997, the Federal Government passed Law 9433/97, containing the National Policy on Water Resources and a system of public institutions (basin committees) for issuing water rights and implementing a charging scheme for water use. With the approval of the National Policy Committee on Water Resources, as established by the National Constitution, the Federal Government is promulgating criteria and guidelines to be followed by states in implementing federal law 9433/97. Presently, the States of Bahia, Pernambuco and Sergipe have passed legislation consistent with these objectives, principles and guidelines and are creating institutions to implement the new law at the State level. The States of Minas Gerais and Alagoas are presently modifying or creating water legislation in order to comply with federal regulations. Implementation of these laws will create a climate that should address many of the concerns identified by the Special Commission for Development of the São Francisco Valley.

The Special Commission for the Development of the São Francisco Valley was created by Act No. 480 of 1995 of the Federal Senate to promote discussion on strategies, policies, programs and priorities for the development of the Valley, both present and future. Included in its mandate was the alleviation of poverty and balancing of socio-economic development and the environment in the Rio São Francisco Basin, including rehabilitation of degraded lands. The Commission concluded its efforts with a final report in November 1995 that recommended actions to further the coordination of the development of the Basin.

States
The states have varying degrees of institutional development in the area of water resources, with the States of Bahia and Minas Gerais being most advanced. The State of Minas Gerais includes an agency with the responsibility of planning and management of water resources. This agency, the Department of Water Resources, is part of the Secretary of Minerals, Water and Energy. The State has begun a cooperative process of preparing a master plan for the management of water resources of the State. The State is also in the process of formulating a water law that will govern the issue of water rights and the administration and management of water resources. Various other entities, including Rural Minas, have been active in promoting the development and use of water within the State.

The State of Bahia passed a comprehensive water law in 1995 that created a Superintendence of Water Resources within the Secretariat of Water Resources. This law
clearly spells out the water resources policy of the State and provides for issuance of water rights, for permits for infrastructure construction, for dam safety, and for water tariffs. This law is one of the most comprehensive in Brazil. The State has also completed master plans for the majority of the significant river basins within the state and has recently contracted the development of a State Water Resources Master Plan.

The State of Pernambuco formed a Directorate of Water Resources within the Secretariat of Science, Technology and Environment. This agency is starting the preparation of water resources master plans for the State as well as work on a comprehensive water law. It is very active in the formulation water resource database for a Decision Support System that includes both superficial and underground water. The States of Alagoas and Sergipe are in the process of delineating water resources responsibility within the state and are beginning work on the planning and institutional structure to provide good water management within those states.

Coastal zone
Activities in the Brazilian Coastal zone are regulated by Federal Law No. 7661/88, the National Environment Program. This law, inter alia, establishes the National Coastal Management Plan, the principal objectives of which are the sustainable uses of natural resources in the Coastal Zone and the preservation, conservation and rehabilitation of ecosystems to promote sustainable development. The Government of Brazil completed in 1996 a coastal zone inventory and "macrodiagnostic", including the Rio São Francisco estuary, with support from The World Bank. This study identified in a mapping format the major human uses of the coastal zone of Brazil, environmentally sensitive sites, and conservation units and reserves, which, in the Rio São Francisco coastal zone, are related primarily to agricultural use and conservation of endangered species, including sea turtles.

3 Operational management

The principal federal entities with responsibility within the Basin are CEEIVASF, the Executive committee for Integrate Studies of the Hydrographic Basin of the Rio São Francisco; CODEVASF, the Rio São Francisco Development Agency; CHESF, the São Francisco Power Company, the major power agency of the basin; and SUDENE, an organization formed for the purpose of comprehensive planning in the Northeast.

CODEVASF

CODEVASF was created for the purpose of developing the economy of the São Francisco Basin. Historically it has principally been involved in the development of irrigated agriculture and agribusiness within the region. This has included some major successes such as the Nilo Coelho Project in the Petrolina /Juazeiro area with its successful high-value crops. It has also included some smaller projects of less success, where the efficiency of the irrigation systems is questionable and the cropping pattern continues to be low-value crops and subsistence farming. This has resulted in areas that are producing at a level of value far below that which would justify the extremely expensive Federal investments in the projects. As of December 1995, CODEVASF has implemented approximately 70,000 hectares of public perimeters. Now it is implementing perimeters, in Pernambuco, Bahia and Minas Gerais, totaling 140,000 hectares. It is also preparing feasibility studies for another 7 perimeters.

In recent years, there has been a movement within the CODEVASF projects toward greater user participation by means user-controlled water districts, responsible for the operation and maintenance of the system and for setting and collecting water user charges sufficient to maintain these projects at a sustainable level. This movement toward decentralization has improved the level of maintenance and the rate of collection of the water charges. It has also
resulted in a greater consciousness on the part of the user of the real cost of operation and maintenance of these systems.

Recent proposals by the Federal Government for a New Irrigation Model ("Novo Modelo de Irrigação") propose strong public/private sector cooperation in the development of the agricultural sector to its maximum potential. This will probably include emancipation or privatization of the existing Federal Projects as well as major joint efforts of the public and private sectors.

**SUDENE**

In 1959, the Superintendence for the Development of the Northeast (SUDENE) was created and given a wide range of responsibilities, including coordination of all ongoing activities and investments in the region, including the Drought Polygon of the São Francisco Basin. These efforts culminated in the mid-1970s in the creation of several new programs and financial mechanisms aimed primarily at settlement, land distribution, and agroindustrial modernization. This trend continued through the 1980s as the federal government created several additional programs for the rural Northeast. SUDENE’s influence in the comprehensive planning for the basin has diminished with the growing strength of the planning and development capabilities of the states of Northeast.

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Source: DNAEE (1994) and ELETROBRAS (1997)

**Table 1**: Major Hydroelectric systems in the São Francisco River

**CHESF and hydroelectric power**

CHESF is the agency that is responsible for the development, operation and maintenance of hydroelectric generation and the bulk energy distribution throughout the Northeast. CHESF operates plants with approximately 7,800 MW of installed capacity in the Rio São Francisco basin and its tributaries, with an additional 2,500 MW under construction and a planned total future capacity of over 26,000 MW. CHESF works in close cooperation with the State Electrical Companies in each state and in some instances has transferred generation responsibility to the states, i.e. the Três Marias power plant, transferred to CEMIG, the State Electrical Company of Minas Gerais. The major hydroelectric systems implemented in the São Francisco are listed in Table 1 and shown in Figure 4.
The installation of this hydroelectric system has not been without some problems. The Itaparica Hydroelectric Project, located in the center of a large concentration of indigenous people, was constructed and placed in operation without a good plan for the mitigation of the impact of the project on this population. The economic need to place the facility into operation immediately upon its completion caused the displaced population to be relocated without sufficient preparation of the area to receive them. As a result, the dislocation of these people has yet to be mitigated in a satisfactory manner.

This casts doubts on the ability of CHESF to continue the development of the hydroelectric potential of the basin in a socially and environmentally acceptable manner. In addition, the agency has been slow to accept the principle of multiple use of the river system and continues to operate its major facilities with little regard for the comprehensive management of the system to meet multipurpose needs. Future optimization of the use of the São Francisco river...
The Sao Francisco River Basin will require a major change in attitude and policy with regard to this problem of integrated management.

The present and future demands for electric energy within the basin continue to outstrip the available energy. It is estimated that the demand for electric energy will double within the next ten years. As in the case of the cities now developed on the river system, it can be assumed that further development of hydroelectric generation on this system will have an increasingly greater impact on both competing demands for the water supplies and the riparian environment as well as severe conflicts with the existing land use.

The Government of Brazil will be faced with major prioritization decisions and it can be expected that each development will face increased opposition from vested stakeholders and non-governmental organizations. Increasing need for energy for irrigation, industry and municipal use will necessitate tradeoffs between these uses and increase pressure from those interested in environmental preservation and instream uses such as fish production and navigation. Increasing pressures can also be expected for restoration and preservation of the Delta and Coastal wetlands that are dependent upon the flood flows of the Rio Sao Francisco.

In terms of navigation, historically the Sao Francisco was navigable during some parts of the year in the reaches from the location of the Três Marias reservoir in Minas Gerais to a point near Cabrobó, approximately 400 km downstream of the City of Juazeiro, Bahia (Figure 5). The primary cargo of the barges and shallow draft craft, operated by the Navigation Agency of the São Francisco (Companhia de Navegação do São Francisco, FRANAVE), was agricultural production, livestock and building materials. However, in recent years, commercial shipping on the river has decreased to a negligible amount. From a volume of 120,000 tons within Bahia in 1987, the volume has decreased to 26,000 tons in 1994 and continues to decrease at this time.

The function and existence of FRANAVE is presently under study. With the demitted flows due to hydroelectric generation and the obstruction of the river dams and reservoirs, major coordination and flow regulation would be required if extensive transportation on this waterway is to resume. It is estimated that, within the parameters of optimum hydroelectric generation, sufficient water could be maintained in the river to support a level of shipping that could approximate 4.5 million tons per year. Such levels would require close cooperation with CHESF for optimal management of the river flow, extensive dredging and port reconstruction, and extensive investment in barges and craft. It is estimated that this investment requirement would be on the order of US$9.5 billion.
Map 4: River depths for navigation in the São Francisco River
4 Analytical tools

CODEVASF has made some excellent progress in the development of the use of Geographic Information Systems (GIS) for the analysis of soil, cropping patterns, river morphology and land use within the irrigated areas of the basin. This system could provide a foundation for the analysis of the entire basin from the standpoint of potential development, environmental protection, watershed reclamation, water pollution control and navigation. CODEVASF has also been responsible for a number of successful innovations in the area of training and assistance to the small farmers and youth of the project areas. This has included a youth vocational training center in the Formoso A and H projects near Bom Jesus da Lapa in Bahia and a very successful revolving fund investment program to assist small farmers in beginning to produce high-value fruit crops and learning the technology for fruit production and new technology for localized irrigation systems. While this agency has its successes and its problems, the overall result of its activities within the São Francisco Basin has been very positive.

Some of the actions required include river basin and coastal zone environmental analysis; public and stakeholder participation (promotion of multisectoral and public participation in the process of basin management); organizational structure development (legal and institutional); quantification of water use, use conflicts and hydrological management; financial mechanisms for managing both water quantity and quality in the basin; and formulation of the watershed management program (including information sharing and dissemination).

To effect the sustainable management of the Rio São Francisco Basin and its coastal zone, it is necessary for the Federal Government of Brazil and the basin states to formulate a comprehensive program of coordinated actions. The federal water law and other legislation provide a sound basis for implementing the actions necessary for achieving sustainable management in the basin. The main risk is that the legal mechanisms provided under the water law are not fully implemented and that the basin committee will not manage to implement cross-sectoral integration activities that would benefit the river system and the coastal zone. However, recent moves toward adoption of complementary legislation by the basin states would suggest that this risk is small. Emphasis should be placed on strengthening the basin committee as a means of catalyzing and encouraging cross-sectoral management of water resources and related development in the basin and achieving sustainability.

Experience in other major river basins indicate that integrated management can increase benefits, reduce adverse impacts, and improve long-term resource development and management. Integrated management is difficult to achieve, however, due to the reluctance of existing agencies to cooperate and share institutional power. Incentives, resources, and demonstrations are needed that allow different interests to work together. A demonstration of effective integrated resource management would serve two purposes. First, individual agencies would be able to work out mutually beneficial approaches (i.e., new solutions to old problems that improve conditions for all participants). Second, relationships and joint goals would be developed that overcome fears and the reluctance to adopt new management approaches.

5 International donors and banks

The main threat to the sustainable development of the Rio São Francisco Basin is that continued development following current trends might result in serious undesirable environmental side effects. Internationally funded activities, in conjunction with state, national and internationally co-funded activities, can make a difference in the development of
this basin and its coastal zone by helping to promote actions that will contribute to the sustainable development of this important river and ocean system. Ongoing programs include:

**The Watershed Resources Management Project (PROAGUA)**
The 10.0 million USD São Francisco Watershed Component of this 198 million USD project attempts to change the paradigm for water resources management in the Northeast towards efficient and effective allocation and use of the region’s scarce water resources, which has to include a sound management plan for the São Francisco river basin. The project attempts to deal with a number of problems, including:

- The degradation of the upper basin, where over 75% of the river’s total water flow is generated
- Intensification of water conflicts within the basin, especially between hydropower and irrigation
- Significant potential regional conflicts, such as the proposal of a transbasin water diversion to supply water to other States (Paraiba, Ceará and Rio Grande do Norte), which continues to be the most controversial water issue in the Northeast.

Solutions to these complex problems require the creation of a basin committee and local WUAs (water user associations); participatory management of the basin’s water resources; the implementation of sound water resources management practices; the establishment of A,O&M (administration, operation and maintenance) plans for existing and new infrastructure; the development of a well-coordinated system for the allocation of water rights in the basin; and the strengthening of Federal, State and local institutions. In particular, solutions depend on political agreement on the principles that should guide the allocation of water rights by the Federal and State Governments, for users in the São Francisco river basin and for the eventual transbasin diversion. Such agreement may be reached through a National Water Resources Council, the establishment of which is stipulated in the National Water Resources Law, with participation of authorities of the highest possible level (ministers and Governors). One basic principle for negotiation is that of water as an economic good, as defined by the Water Law. This implies that more efficient uses of water, in economic terms, should be a high priority, while some financial compensation could be envisaged for the less efficient, lower priority uses of water. Depending on the magnitude of these compensations, Government subsidies aiming at social equity, currently implicit, could be reduced and become more explicit.

**Program of infrastructure improvement in the State of Minas Gerais**
The SRH/MMA is implementing this 3.5 million USD program.

**Basin-wide assessment of likely impacts of inter-basin transfer scheme on the coastal zone**
This 10 million USD project is executed by the Secretariat for Regional Policy (SEPRE).

**Watershed management program in the State of Sergipe**
This 1.5 million USD program is initiated by the Japanese Agency for International Cooperation (JICA) and has an emphasis on the part of the State lying in the Rio São Francisco Basin.

**Integrated Management of Land-based activities in the São Francisco Basin**
This project is implemented by GEF (Global Environmental Facility) through its implementing agency UNEP (United Nations Environmental Program), its executing agency OAS (Organization of American States), and its national executing agencies, the Ministerio do Meio Ambiente, dos Recursos Hidricos e da Amazonia Legal do Brasil (MMA) and the
The São Francisco River Basin

Secretaria de Recursos Hídricos (SRH). The purpose is to develop a watershed management program for the Rio São Francisco Basin. In Phase I a strategic program of action for the integrated and sustainable management of the basin and its coastal zone is to be formulated, addressing the physical, biological, chemical and institutional root causes of the progressive degradation which is affecting the basin and, particularly, the coastal ecosystems. The project will focus on the use of economic instruments, and in Phase II implementation activities will be designed to facilitate sustainable development within the basin and the coastal zone. These activities will complement basin-scale interventions by the Government of Brazil, financed in part from national sources and by The World Bank through the Program for Water Development (PROAGUA) and other donors. The project forms the Latin American demonstration project under the Global Program of Action for the Protection of the Marine Environment from Land-based Activities (GPA), GEF operational program element.

References


DNAEE. “Diagnóstico e planejamento da utilização dos recursos hídricos da bacia do rio São Francisco”. Brasília, DNAEE/CNCE, 1979, 3v.


ELETROBRÁS. Reunião específica de energia do Grupo de Trabalho São Francisco - programa de ações; Ata. Rio de Janeiro, 8 de abril, 1996.


THE COLORADO RIVER: HISTORY AND CONTEMPORARY ISSUES OF A COMPLEX SYSTEM

Robert W. Johnson

1 Introduction

This paper provides an overview of the Colorado River system, a historical presentation of the legal and institutional development of the river, a discussion of contemporary issues related to management of the river as well as programs to address those issues, and finally a brief section citing some broad lessons learned that may be applicable to other river basins.

2 Overview

The Colorado River (see map, next page) and its tributaries extend for over 2,173 kilometers in the southwestern United States, connecting parts of seven American states. The river drains the western slope of the Rocky Mountains, serving a basin of 626,780 square kilometers that comprises approximately one twelfth of the continental United States. The river extends an additional 80.5 km into the country of Mexico, where it historically drained into the Pacific Ocean via the Gulf of California. The river is the single most important economic and environmental resource of the region. In the two countries, its water serves a population of approximately 20 million people, irrigates nearly 800,000 hectares (ha) of farm land, generates in excess of 10 billion kilowatt hours of hydroelectric energy annually, provides over 30 million visitor days of recreation activity annually and nourishes habitat for thousands of species of plants and animals in an arid and semiarid environment. In short, the Colorado River is the life blood of the region.

The river’s natural flow is highly variable, both seasonally and annually. Historical seasonal flows range from a trickle in the late summer and fall months to in excess of 5,660 cubic meters per second during spring runoff periods. Historical annual flows, measured at Lee’s Ferry just before the river flows into the Grand Canyon, have ranged from as low as 6,173 million cubic meters (MCM), to as high as 30,850 MCM. The average annual flow over the 93 years of measured record is approximately 18,519 MCM.

With the high variability in flow, severe flooding and periodic drought hampered economic development in the United States and Mexico during the early part of the century. An extensive system of dams and reservoirs was developed in the United States by the Federal Government, in concert with the Basin States, from the 1920’s through the 1960’s, creating a reservoir system with 74,040 MCM of storage. Today floods are, for the most part, controlled and the significant carryover storage has prevented severe drought.

3 History of legal and institutional development

Management of the river is governed by a complex set of compacts, laws, court decrees, treaties, and contracts developed over a 75 year period. The development of this legal framework, known as the “Law of the River”, has been fraught with controversy among the entities and institutions involved. Much of this controversy still exists today. An understanding of the historical development of the river and its legal framework is important to understanding the contemporary issues.
Map 1: The Colorado River Basin

1922 Colorado River Compact

In the early 1900's, significant irrigation development with Colorado River water began in the Imperial Valley of California. Flooding and drought, however, severely hampered progress, and California began seeking Federal help to construct major dams that would allow development to proceed. States upstream of California, however, used their political power in Congress to block Federal assistance, fearing that California would develop and use all the available water supplies before the other Basin States could develop what they viewed as their fair share. The Western legal doctrine of "prior appropriation" recognized first uses of water as highest priority when supplies were limited. Hence the fear of the other Basin states was warranted.

The Basin States recognized the need for development of the Colorado River to allow economic development, and determined that an interstate compact regarding use of the river's waters was the best way to achieve this. In 1921, the states requested the Federal government's assistance in developing this compact to assure an equitable apportionment of the water. Secretary of Commerce Herbert Hoover (later President Herbert Hoover) was called on to facilitate the agreement. Hoover found consensus difficult, and was unable to achieve agreement on an allocation of water among the states. He was, however, ultimately able to fashion a compromise by dividing the river into two roughly equal basins, with an allocation of water to each basin (as opposed to each state). The Upper Basin, where most of the river's flow originates, was given the right to develop and use up to 9,255 MCM annually. In return, the Upper Basin, composed of the states of Colorado, Utah, Wyoming and New Mexico, agreed to deliver, on average, at least 9,255 MCM annually for use in the Lower Basin, composed of the states of Arizona, California, and Nevada.

It is useful to note that, at the time the compact was negotiated (1922), the 16 years of available measured river flow indicated the average annual flow at the compact point was approximately 22,212 MCM. The compact negotiators, therefore, thought the 9,255 MCM allocated to the two basins could be easily met and still leave adequate water supplies to meet...
anticipated deliveries to the country of Mexico through a yet-to-be-negotiated treaty. Subsequent measurement of flow on the river has shown that the 16 years of flow available in 1922 was unusually high, and that actual annual average flow at the compact point over the 93 years of measured record available today is closer to 18,519 MCM. Some hydrologists argue that, based on measurement of tree growth in the basin over a couple of centuries, the correlated longer term average annual flow is closer to 16,659 MCM. Many conclude that the Colorado River system has been over-allocated and that significant shortages of water will ultimately prevail on the system.

1928 Boulder Canyon Project Act
It wasn’t until 1928 that Congress was able to move forward with the passage of legislation authorizing the construction of infrastructure to control and develop the Colorado River. The delay was caused by strong disagreement among the Lower Basin States of Arizona and California over the allocation of the Lower Basin’s share of the river. The Arizona legislature refused to ratify the Compact and, through its representatives in Congress, Arizona was able to successfully slow progress. In 1928, after much delay and bickering between the two states, the Congress passed the Boulder Canyon Project Act. In addition to authorizing the Federal construction of Colorado River infrastructure (including Hoover Dam), the Boulder Canyon Project Act ratified the Compact (in spite of the Arizona Legislature’s refusal to concur), authorized the development of a Lower Basin compact if the states could reach agreement, suggested an allocation of water among the Lower Basin States if agreement on a compact could not be achieved, and authorized the Secretary of the Interior to implement the suggested allocation by contracting for permanent water service to individual entities in the Lower Basin.

Ultimately, the Lower Basin states did not agree on a compact and the Secretary implemented the suggested allocation by exercising his newly acquired contracting authority. This action, in essence, Federalized the Lower Basin of the Colorado River system. Normally, state law and administrators control the allocation of water in Western states. In this case, the interstate nature of the river, the bitter dispute among the states involved, and the need to move forward with development resulted in the Congress granting power to Federal administration.

The suggested allocation by Congress divided the Lower Basin’s entitlement of 9,255 MCM by apportioning 5,430 MCM to California, 3,455 MCM to Arizona, and 370 MCM to Nevada. At the time, the population of southern Nevada was quite small and Nevada had no arable land to support irrigation development. Nevada did not pursue a larger allocation and was given less than three percent of the Lower Basin entitlement. This contrasts with conditions today, with southern Nevada having a population of approximately 1.2 million and leading the nation in economic and population growth. The small allocation to Nevada is today inadequate to meet the needs of the area’s growing urban population, and other water supplies are not readily available.

1929 California Limitation Act and Subsequent Seven Party Agreement
In 1929 the California Legislature passed the California Limitation Act, which made it unlawful for California entities to utilize more than their allocated share of Colorado River water. The Limitation Act was required by Congress as a concession to the other six basin states, who wanted to ensure California would abide by the Compact and the allocation provided under the Boulder Canyon Project Act. The Limitation Act was a prerequisite to the initiation of construction of facilities authorized under the Boulder Canyon Project Act.

In 1931 the California entities entered into the Seven Party Agreement, which allocates California’s share of the river among the California entities. The agreement and subsequent
contracts allocated 4,751 MCM, the bulk of California's 5,430 MCM basic apportionment, to irrigation use, leaving the remaining 679 MCM for urban use on California's coastal southern plain (i.e., the Los Angeles metropolitan area).

Like the basin states, the entities within California found it difficult to agree on specific water allocations. Ultimately, the Seven Party Agreement allowed four agricultural entities to share the first 4,751 MCM of California's apportionment, but did not assign a specific allocation to each entity. The agreement only established a priority system in which the entities were given first, second, and third priority rights to beneficially use water within a specified service area. A subsequent agreement (known as the Compromise Agreement) between two entities sharing the third priority made the fourth entity (the Coachella Valley Water District) last in priority among the irrigation users. If the first three entities utilized all or most of the water, the fourth entity was responsible for adjusting its use to accommodate the increased uses of the other three entities.

The Seven Party Agreement also assigned Colorado River water rights beyond the 5,429 MCM basic apportionment. A fifth priority of 817 MCM was assigned to the Los Angeles metropolitan area, and any additional water that might be available was assigned to irrigation users under priorities 6 and 7. In essence, the Seven Party Agreement allocated 6,246 MCM to priorities 1 thru 5, with urban use having the lowest priority among the California users. California entities quickly developed and utilized water under the first five priorities of the Agreement, and today are still diverting in excess of 6,175 MCM from the river annually. The excess diversion by California entities has been allowed to occur because the allocated share of water to the other six basin states has not been fully developed and used. In essence, this has created extra water to accommodate California's water needs on a temporary basis.

1944 Mexican Water Treaty

In 1944, the United States and Mexico entered into the Mexican Water Treaty. The treaty defined international rights of use for three rivers flowing across the border between the two countries, including the Colorado River. The treaty calls for the annual delivery of 1,851 MCM of Colorado River water to the country of Mexico, to be scheduled on a monthly basis in accordance with orders submitted by Mexico. In addition, the Treaty calls for the scheduled delivery of an additional 247 MCM to Mexico in years when surplus water is available in amounts that are in excess to the amounts required to meet the needs of water users within the United States. The treaty also calls for Mexico to share on a pro-rata basis any shortages that may occur on the Colorado River system.

The allocation to Mexico was fully utilized shortly after the treaty was negotiated. While shortages have never occurred, 247 MCM of surplus has been made available to Mexico in many years when wet cycles created abundant water supplies. Shortages may occur at some point in the future when the United States, primarily the Upper Basin States, finally achieves full utilization of water reserved under the Compact. With the treaty commitment to Mexico, the 20,361 MCM of total allocation exceeds the 18,519 MCM of annual flow by 1,851 MCM.

1948 Upper Colorado River Basin Compact

Unlike the Lower Basin, the Upper Basin States were able to achieve consensus regarding the allocation of their Compact reserved entitlement, and created an Upper Basin Commission to oversee and coordinate matters among the Upper Basin states. The states maintain the traditional role of controlling the allocation and administration of water rights on the Colorado River and its tributaries in the Upper Basin.

Agreement among the Upper Basin States resulted in passage of the 1956 Colorado River Storage Act by Congress, ratifying the Upper Basin Compact and authorizing Federal construction of Glen Canyon Dam and many smaller projects. The dam was completed in
1964 and nearly doubled the storage capacity on the Colorado River system. In addition to providing over 1000 MW of hydroelectric generating capacity, the dam’s 30,850 MCM reservoir provides storage for the Upper Basin States to meet their compact obligation to the Lower Basin.

It is worth noting that the construction of Glen Canyon Dam was among the first environmental controversies in the history of water development in the western United States. Construction of the dam, which is located just above the Grand Canyon in the State of Arizona, was of concern to environmental interests because of its inundation of Glen Canyon, a significant historical site with important natural habitat. In addition, construction of the dam significantly altered the flow of the river through the Grand Canyon, eliminating the seasonal high and low flows of turbid water.

1964 Arizona v. California Supreme Court Decree
In the 1940’s and early 1950’s, the State of Arizona began efforts to develop the Central Arizona Project (CAP), a project to divert Arizona’s remaining unused mainstream Colorado River water into the central portions of the state. Like most large western water projects, Arizona needed the assistance of the Federal government to finance construction, and sought Congressional authorization. The state of California, however, objected and successfully blocked Arizona’s attempt to obtain authorization for many years. California was utilizing more than its share of the river and feared development of the CAP would limit its ability to continue its high use. Further, California argued that Arizona’s already full development of its Colorado River tributaries (i.e., the Gila River system) counted against its main stem entitlement allocated by the Boulder Canyon Project Act and, therefore, Arizona’s Colorado River allocation was already fully utilized and there was no water available for the CAP.

In 1951, Arizona filed suit against California in the United States Supreme Court, asking that the relative rights among the two states be clarified. The Court appointed a Special Master who gathered data and information over a 12 year period. The Court decided in Arizona’s favor, ruling in a 1963 decision that tributary use in the Lower Basin did not count against the mainstem entitlement apportioned under the Boulder Canyon Project Act. The Court left administration of tributary flows prior to commingling with the mainstem to control by the states, but strengthened the role of the Secretary of the Interior as Water Master of the mainstem in the Lower Basin. The Court also ruled that California could continue to utilize more than its mainstem entitlement of 5,430 MCM as long as there was unused apportionment available from the other Lower Basin states. The Court made clear, however, that California maintains no long-term right to the unused entitlement and must defer its use to the other states as their uses increase to the apportioned amounts.

The 1964 Decree enjoined the Secretary from delivering water outside the apportioned entitlements and directed the Secretary to prepare an annual accounting of water use in the Lower Basin. The Decree recognized, however, that periods of hydrologic surplus and shortage were likely to occur, and charged the Secretary with making such determinations on an annual basis. The court apportioned surplus supplies by giving 50 percent to California, 46 percent to Arizona, and 4 percent to Nevada. In the case of shortage, the Court left the assignment of reductions to the discretion of the Secretary subject to the prior satisfaction of those water entitlements established under state law prior to passage of the Boulder Canyon Project Act in 1928.

The Decree also established the reserved rights of five Indian tribes located along the river in the Lower Basin. The reserved rights of the five tribes totaled approximately 1,111 MCM and were included as part of the 9,255 MCM allocated to the Lower Basin States. Most of the Indian reserved rights have been utilized through irrigation development on reservation lands.
1968 Colorado River Basin Project Act
With Arizona and California's relative rights to mainstem water finally settled, Arizona pressed ahead for Congressional authorization of the CAP. That occurred with passage of the Colorado River Basin Project Act in 1968. True to form, however, passage of the act did not occur without additional skirmishes between California and Arizona. Arizona needed California's political support to obtain Congressional authorization, and California extracted a price for that support. The Act authorized the CAP, but also provided that the CAP water supply of approximately 1,851 MCM annually would have a lower priority to California's 5,430 MCM in times of shortage on the Colorado River system.

Recognizing the Secretary of the Interior's more completely defined role under the Decree, the Act also directed the Secretary to prepare Long Range Operating Criteria for Colorado River reservoirs. The criteria, to be prepared in consultation with representatives of the Governors of the seven basin states, would address such issues as release of water from the Upper to the Lower Basin and conditions under which normal, shortage and surplus conditions on the Colorado River occur. The Secretary adopted long range criteria shortly thereafter (in 1970) and has reviewed the criteria at five year intervals since. The criteria are quite broad, leaving considerable discretion to the Secretary in making annual operating decisions for the river.

1973 Mexican Treaty Amendments and 1974 Salinity Control Act
In the 1960's and early 1970's, the salinity level of Colorado River water delivered to Mexico increased substantially. The increases were caused primarily by irrigation return flows from new irrigation development in the Wellton Mohawk Irrigation District northeast of Yuma, Arizona. Diplomatic protests filed by Mexico with the American State Department resulted in an amendment to the Mexican water treaty in 1973 to address standards of water quality. The treaty amendment, known as Minute 242, required the United States to deliver water at Mexico's northern international border with a quality approximately equal (within 115 parts per million total dissolved solids) to that delivered to water users in the United States.

Congress supported the treaty amendment by passing the 1974 Colorado River Salinity Control Act, which authorized construction of facilities to collect and prevent highly saline drainage flows from returning to the river and commingling with Mexican deliveries. A drainage canal was constructed to bypass approximately 163 MCM of highly saline drainage water to the Santa Clara Slough in Mexico. The flows have been bypassed since the late 1970's, creating marsh habitat in the Colorado River delta in Mexico that is now viewed as a valuable environmental resource.

To protect the quantity of water supplies for United States users, the salinity control act also authorized construction of facilities to replace the bypassed flows, including the construction of a plant to desalt and return to the river up to 133 MCM of otherwise bypassed flow. Construction of the desalting plant was completed in 1992, but its operation has been held in abeyance because replacement water supplies from other sources have been available.
4 Contemporary issues

The primary force driving contemporary issues on the river is the increasing use of water. Completion of the Central Arizona Project has allowed Arizona to begin using its full apportionment. Significant population growth in Las Vegas has pushed Nevada's use close to its full entitlement, and with California's overuse, the Lower Basin has been exceeding its basic apportionment since 1996. For the first time, the Secretary of the Interior has been faced with the possibility of having to enforce limits on water use in the Lower Basin as required under the Supreme Court Decree in Arizona v. California. Fortunately, a wet cycle over the last four years has kept Colorado River reservoirs full and the Secretary has been able to declare that surplus conditions exist, allowing all lower basin needs to be met. In addition, Upper Basin development has still not fully materialized, with annual use approaching only 4,936 MCM of its apportionment. With the lack of Upper Basin development, total current use on the Colorado River system hovers around 17,276 MCM, still less than the long-term historical average flow.

California interests argue that, with less than full development of the Upper Basin, system water supplies are adequate to continue to meet the State's need, and the Secretary should continue to declare surplus so the water needs of the California urban users can continue to be met (under the Seven Party Agreement, the fifth priority urban use would be required to reduce use if surplus supplies were not available). California has petitioned the Secretary for the development of more specific criteria regarding surplus decisions so it can have more certainty regarding the availability of surplus water. Alternatively, the other basin states are concerned that California's appetite for Colorado River water will never be satisfied and its continued reliance on surplus for urban use is not conducive to good long-term water planning. The Upper Basin states are concerned that California's reliance on, in essence, their unused Compact apportionment may make it more difficult for them to ultimately develop their full share of the river. Arizona is concerned about potential dry cycles and the possibility that California's continued overuse could exacerbate the impacts of shortages on the Central Arizona Project, especially in light of the CAP's junior entitlement, which was imposed by California in exchange for political support for the project's authorization.

Other forces that are likely to place increasing demands for water from the river include: (1) the state of Nevada, which, like California, will soon have demand for more than its basic entitlement; (2) Mexico, which would also like more access to surplus water as allowed under the treaty; and (3) environmental needs, which are not recognized under the traditional "Law of the River," but are recognized through the National Environmental Protection Act of 1969 and the Endangered Species Act of 1973.

Finding solutions to these issues is a difficult task. The "Law of the River" creates a relatively inflexible framework that is not necessarily conducive to meeting the changing needs of the river basin. The river's contentious development history only makes the legal and institutional framework more inflexible. Nevertheless, population growth and new public values related to environmental protection dictate the need for flexibility.

Developing an approach to dealing with these issues is a work in progress. Some of the issues are better defined than others, and the approach to resolution more fully developed. Other issues are less defined, and there is still debate about how to resolve them. In general, however, significant progress is occurring. Following is a brief overview of the major programs and initiatives underway.

Development of a California 4.4 Plan

California's continued use of more than its 5,430 MCM basic apportionment is probably the single most talked about problem on the Colorado River today. The basin states and the
Secretary of the Interior fear that if California was forced to make a major reduction in use, that could have devastating impacts on the 16 million people in the southern California urban area who depend on this water. The political ramifications of such a reduction are of concern to the other six basin states as well as the Secretary. As a result, there is consensus, even among California interests, that a plan for gradual reduction in California’s use is needed. The development of such a plan is currently under way.

The primary focus of the plan is to provide for willing seller-to-buyer market transfers of water from the California agricultural users, which have the highest priority to Colorado River water, to the urban area, which has the lowest priority. Such transfers will allow the agricultural users to bear the burden of reducing California’s use in exchange for appropriate monetary compensation from the urban area.

The primary impediment to implementing water transfers has been the nature of the Seven Party Agreement, which does not assign specific entitlements to the four irrigation districts involved. Every time a transfer arrangement is proposed, the low priority irrigation user (i.e., the Coachella Valley Water District) brings litigation claiming rights to the transferred water via its intervening priority. The Secretary, as Lower Basin water master, recognized this problem and conditioned approval of pending transfers of approximately 494 MCM on a revision of the Seven Party Agreement to specifically quantify the rights of the irrigation users. To provide incentive for California to cooperate, the Secretary threatened to withhold the development of surplus guidelines until the California agencies could reach a quantification settlement. To further place emphasis on the need to make progress, Secretary Bruce Babbitt commissioned his top deputy, David Hayes, to facilitate settlement discussion among the California entities. The Governor of California similarly commissioned the state’s top water official to assist in the discussions. After nearly 18 months of contentious and complex negotiations, a settlement framework was approved by the entities on October 15, 1999. The agreement quantifies the third priority rights of the Seven Party Agreement and opens the door for the pending transfers to be approved. When implemented, the agreements will allow California to gradually reduce its use by roughly 494 MCM over the next couple of decades.

**Development of Surplus Guidelines**

As noted earlier, the Supreme Court, in Arizona v. California, made the Secretary of the Interior responsible for making annual hydrologic determinations regarding the amount of water available for use in the Lower Basin (i.e., normal, shortage or surplus). Until 1996, the demand for water in the Lower Basin had been less than the Basin’s normal year apportionment. With large amounts of reservoir storage, there was little need to consider anything but normal determinations. Now, with Lower Basin use exceeding the basic apportionment, there is significant focus on the Secretary’s annual decision. California desires more certainty regarding the annual determination and has requested that criteria or guidelines be developed to guide the decision making process. With California’s significant recent progress in developing a 4.4 plan, the Secretary has indicated his desire to move forward with development of the guidelines. The current schedule calls for the guidelines to be completed by December 2000.

The Secretary’s desire is to develop guidelines that represent the consensus view of the seven basin states. In accordance with the Colorado River Basin Project Act of 1968, the Secretary must consult with the seven states before adopting the guidelines. While progress on the California plan will placate some of the concerns of the other six basin states, it is currently unclear whether consensus can, in fact, be achieved. California will undoubtedly prefer a liberal set of guidelines that allow surplus declarations to occur even during dry cycles. California interests will argue that large carryover storage on the Colorado River
system will minimize the probability of shortages and not cause undue risk to the other basin states. The other states, however, will have an aversion to the risk of shortage and will undoubtedly prefer more conservative criteria that make surpluses available only when spills occur or are highly likely to occur. The other states will argue that any additional risk of shortage, however small, is unacceptable. The Secretary and his staff will likely find it a significant challenge to develop a set of surplus guidelines acceptable to all. At this point it is not clear what perspective the guidelines will take. It is thought, however, that they will be of limited duration, possibly 15 years, and will be contingent upon California’s successful implementation of its 4.4 plan.

**Interstate Transfers of Colorado River Water**

Historically, market transfers of Colorado River water have been limited to transfers between entities within a single state. Traditional interpretation of the state entitlement system defined under the Boulder Canyon Project Act and the Supreme Court Decree in Arizona v. California has been that interstate transfer is prohibited. Similarly, the 1922 Colorado River Compact has been interpreted to preclude interbasin transfers. In recent years, that interpretation has been questioned, primarily by the states of Nevada and California. These two states have near-term demands that exceed their apportionments and see the potential need for interstate cooperation through market-based transfers. In the Upper Basin, the State of Utah has expressed interest in being a seller of water to other states, primarily Nevada in the Lower Basin. The other four states - Wyoming, Colorado, New Mexico, and Arizona - are resistant to wholesale interstate marketing. Secretary of the Interior Babbitt has expressed strong support of interstate water marketing, seeing it as a win/win solution to meeting the changing demands for water throughout the basin. In 1994, the Secretary informally proposed regulations to allow interstate transfers in the lower basin. Because of strong objections from the state of Arizona, the proposal was withdrawn.

In 1994 and 1995, a technical committee of representatives of the Secretary, the Lower Basin States, and Lower Basin Indian Tribes explored various options for cooperation in facilitating Lower Basin interstate transfers. The results of that effort are reflected in a new set of federal regulations, published in October 1999, to facilitate the interstate banking and transfer of Colorado River water in the Lower Basin. Under these regulations, state authorized entities can utilize offstream storage facilities to divert and store surplus and unused Colorado River water. The water preserved in the storing state can then be sold to a consuming state. The storing state would transfer the water to the consuming state by withdrawing the water for local use at some future date and forbearing its diversion of Colorado River water, allowing the consuming state to directly divert water from the river. While this approach is somewhat more complicated than direct market based transfers, it provides a water management tool that can help meet some of the new demands on the river. Under this regulation, it is expected that the state of Arizona, with a very large groundwater basin, will serve as the primary storing state, while the states of Nevada and California will be the primary purchasing states. Nevada views this program as the primary tool for meeting its increasing water needs over the next 30 to 50 years. All of the basin states support this form of interstate water transfer.

**Glen Canyon Dam Adaptive Management Program**

Since its completion in 1964 and until recently, releases from Glen Canyon Dam were made to maximize the value of power produced at its power plant. Highly fluctuating flows were made to meet the peaking demand of the power market in the southwestern United States. Operation of the dam in this fashion totally altered the sediment and flow regime historically experienced in the section of the river flowing through the Grand Canyon. Beginning in 1992,
the impacts of this form of operation on the Grand Canyon’s ecosystem were cooperatively studied by all interested parties. The result was the development of the Glen Canyon Dam Adaptive Management Program, a science-based effort to manage the dam’s operations in a manner that considers impacts on downstream environmental resources. Today, the highly fluctuating releases that meet demands of the power market have been curtailed in favor of gradual and limited daily fluctuations that minimize sand bar and habitat erosion along the river. Periodic experimental floods to mimic the natural hydrograph are also part of the dam’s periodic operation.

The change in operational patterns of Glen Canyon Dam comes at significant expense and with considerable conflict. Power contractors reluctantly went along with the changes, in spite of power market losses literally in the millions of dollars. Changes made at Glen Canyon Dam represent the public’s focus and desire to protect environmental values, especially in areas of national significance such as the Grand Canyon.

**Lower Basin Multi-Species Conservation Program**

Under Section 7 of the Endangered Species Act (ESA), Federal agencies are required to consult with the U.S. Fish and Wildlife Service if their actions potentially affect species listed as endangered under the act. The Service must review the agency action to ensure that adverse affects to the species are avoided, and may prescribe appropriate reasonable and prudent actions to avoid jeopardizing the species. The Lower Basin of the Colorado River has four endangered fish species and two endangered birds occupying habitat in or near the river. Operational decisions of the Secretary require consultation, as do the diversion decisions of the water users. To comply with the Endangered Species Act, the Lower Basin States, the Bureau of Reclamation, and other affected parties have embarked on the development of a multi-species conservation plan (MSCP) with the Fish and Wildlife Service. The plan is aimed at developing aquatic and terrestrial habitat along the lower river that will move the listed species toward recovery and prevent other species from being listed. These actions will result in achieving ESA compliance and allow operational decisions that continue the water and power deliveries in the Lower Basin.

The MSCP is a work in progress. The current schedule calls for the plan to be selected in December 2000. Many controversial issues will have to be addressed before the plan is completed. Some of the issues include: establishing a formula for cost sharing; obtaining water supplies to support the development of new habitat; and providing assurances that additional compliance will not be required at a later date.

**International Cooperation With Mexico**

There are a number of ongoing international issues with the country of Mexico that are being addressed in collaboration with the U.S. Department of State’s International Boundary and Water Commission (IBWC). IBWC serves as the focal point for all communication with Mexico, hosting joint meetings between the technical staff of river management agencies of both countries. In general, the working relationship between the two countries on river management matters is good. Water deliveries and occasional flood operations between the two countries are coordinated in a routine manner. Ongoing areas of special consultation and cooperation include: (1) managing sediment loads in deliveries to Mexico; (2) maintaining salinity levels consistent with treaty requirements for deliveries at both the northern and southern international boundaries between the two countries; (3) addressing issues related to making surplus water supplies available to Mexico under the treaty; and (4) coordinating environmental study efforts of the Colorado River delta in Mexico.
Periodic flooding on the Colorado and its main Lower Basin tributary, the Gila River, has from time to time substantially increased the sediment load of water delivered to Mexico. Gila River floods in 1992 deposited more than 7.7 MCM of sediment in the section of the river just north of the major delivery point to Mexico. This has created recurring operation problems in Mexico, with sediment filling canals and restricting delivery capacity. After significant consultation, the Bureau of Reclamation agreed to dredge the sediment-laden section of the river between the Mexican diversion point and the confluence of the Gila and Colorado Rivers. The dredging program was initiated last year and will be completed in 2001 at an estimated cost of $15 million. (U.S. dollars)

As discussed earlier, salinity has been a long-standing issue between the two countries. Deliveries at the northern border, which constitute 90 percent of the Mexican delivery, are governed by the standard established in Minute 242. That standard is routinely met without controversy. The remaining 10 percent of the Mexican entitlement is met through deliveries at the southern international boundary, where the standard for salinity is to be maintained at levels that were customarily experienced just prior to the establishment of Minute 242. The United States believes this standard is being met. Mexico, however, has experienced changes in the crop mix served by south boundary deliveries and has found that new cropping patterns include crops that are less salt tolerant. Mexico, therefore, raised concerns with the quality of south boundary deliveries. As a matter of comity, the United States did studies to see if the quality of south boundary deliveries could be improved. The studies showed that the salinity of south boundary deliveries are particularly critical during certain months when crop germination occurs, and that salinity improvement during those periods would have the most impact. After consultation with Mexican and American interests, the United States agreed to substitute better quality groundwater for flows that would otherwise occur at the south boundary during those periods when salinity was high and crop germination was occurring. Variable speed pumps and a small bypass channel will have to be installed at American expense to implement the program over the next couple of years.

The Colorado River delta in Mexico also has become a focal point of interest between the United States and Mexico. Environmental interests in both countries have recognized the importance of habitat in the delta, and the two countries have agreed to work jointly to better understand the broad ecosystem implications for the river and the delta. In many years, the delta is dry, with the exception of American drainage flows to the Santa Clara Slough. If the desalting plant is operated, most of the drainage flows would be eliminated. Environmental interests would like to see a commitment of water supply to protect environmental values in the delta, but the river, in both countries, is already fully allocated. American and Mexican water interests are resistant to any consideration of restoration of the delta. The United States is interested in looking at offstream banking programs in Mexico or the United States to see if dry year water supplies for the delta might be provided without infringing on the rights of existing entitlement holders. Such an approach would be similar to the approach of Nevada and Arizona under the interstate offstream banking program. Final solutions however, are still undefined and will require significantly more study.

5 Lessons learned

In summary, the Colorado River has a contentious history with plenty of challenges still available to the contemporary managers of the river basin. An understanding and appreciation of the history is critical to successful resolution of today's issues. Significant progress is occurring on many fronts, but undoubtedly new issues will arise as old ones are resolved. While many of the problems and issues are unique to the Colorado, there are some general observations that might apply to all river basins:
1. Change is Difficult, Full of Conflict, but Necessary
River basin managers must not only have the technical skills to manage a complex river system, but also the human interaction skills to facilitate resolution of conflict-ridden issues. Good skills in mediation and facilitation are critical to finding solutions to river basin problems.

2. Leadership is Important
Good leadership from a neutral river basin manager is helpful in achieving success. In the case of the Colorado River, Secretary Babbitt’s willingness to use his role as water master has been critical in getting progress on the California Plan, interstate transfers and surplus guidelines. A willingness to make proposals, persuade, coax, cajole, and make difficult decisions are critical in making entrenched parties move toward consensus.

3. Progress is Slow and Comes One Step at a Time
Resolution of water issues takes years to occur and many times happens incrementally. River basin managers should appreciate even limited progress, always maintaining an optimistic outlook.
THE ROLE OF RIVER BASIN MANAGEMENT IN THE VISION PROCESS AND FRAMEWORK FOR ACTION UP TO NOW

Tony Allan\textsuperscript{1}, Khalid Motadullah\textsuperscript{2}, Alan Hall\textsuperscript{3}

Incorporating the text of a speech delivered in Stockholm in August by Kalid Motadullah, the head of GWP.

Summary

The paper will outline the approaches taken by the World Water Council Vision initiative and by the Global Water Partnership Framework for Action. A common feature of both these processes is the belief that the use, re-use and protection of water should be achieved, monitored and evaluated in an integrated way. Integrated water resources management (IWRM) is a grand but rather vague concept that de-emphasises the deeply political nature of integration. The first requirement of sustainable integrated water resources management is that the interests of the using sectors and communities are taken into account. Institutions that enable communication, contention and compromise are essential. Inputting hydrological and other scientific information is important but it is a relatively minor element in the process. Water managing outcomes are sometimes achieved without information and frequently through the political suppression of technical information. Simple (and popular) truths and vital lies (Goleman 1997) are the currency of contention. Political contention is not a medium in which technical information - hydrological, environmental and economic - will be given their proper due but it is the only medium there is.

A second requirement of effective IWRM is that the role of water be considered in wider hydrological, ecological, economic, trading and socio-political contexts than the river basin and its hydrology. Trading “virtual water” for example moves more water than engineers can possibly contemplate. By ignoring such intangible water rational debate on national and regional water priorities are flawed. The complexity of the task of improving IWRM is formidable. IWRM is a process that is as yet based on defective assumptions. It can only be as strong as the networks of consensus that the partial participation that is the rule can achieve. Just raising the awareness of the utility of comprehensive IWRM in such circumstances will be impressive.

1 Introduction

This paper will summarise the approaches taken by the World Water Council Vision initiative and by the Global Water Partnership Framework for Action with respect to river basins and draw attention to some important ideas which should be taken into account when addressing the central concept of IWRM – Integrated Water Resources Management – which underpins the work of these two initiatives. Both initiatives assume that the use, re-use and protection of water should be achieved, monitored and evaluated in an integrated way. Integrated water resources management (IWRM) is a grand but vague concept that de-emphasises the deeply political nature of integration. Integrating economies and institutions is to say the least very challenging indeed.

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The first requirement of sustainable IWRM is that the interests of the using sectors and communities are taken into account. Institutions that enable communication, contention and compromise are essential. Inputting hydrological and other scientific information is important but it is a relatively minor element in the process. Water managing outcomes are sometimes achieved without information and frequently through the political suppression of technical information. Simple (and popular) truths and vital lies (Goleman 1997) are the currency of contention. Political contention is not a medium in which technical information – hydrological, environmental and economic – will be given their proper due but it is the only medium there is. There is, therefore, a danger that in talking too enthusiastically about IWRM without mentioning the implicit political problems of implementation, its promise will never be achieved. It would be rather like recommending the good idea that ten communities using ten different currencies should, on technical grounds, adopt a single currency without realising that one was recommending a political process. Even when a form of political and administrative integration has been achieved the old cultures may be evident and operate informally within the new structure. Entities that adopt the name United often do it to contradict the underlying social divisions. The United Kingdom’s old divisions are re-emerging. Elsewhere unifications of the past look uneasy, viz. Spain and Italy. Members of the Framework for Action Unit are very aware of the impossibility of gaining the attention of those who use water and those in governments and institutions that influence its allocation at all levels without understanding their political circumstances.

A second requirement of effective IWRM is that the role of water be considered in wider hydrological, ecological, economic, trading and socio-political contexts than the river basin and its hydrology. Water resource planning inspired only by the hydrological cycle and the capacity of engineers to modify it is a lethally narrow inspiration and a very unsafe foundation for water resource planning and policy making.

Water is an environmental resource, an economic resource and a social resource. The mediation of these generally conflicting uses requires a comprehensiveness of approach which greatly complicates the process of policy making. While it is certain that particular levels of water do not determine economic outcomes, the converse is not true. High levels of development of a political economy – that is both its economic strength and diversity and its governance capacity – enable even a seriously water deficit economy to operate effectively. A strong and diverse political economy has numerous water managing options; a weak entity does not. Effective IWRM requires that the determining effect of political economy contexts be prominent in any water planning and policy making processes.

Those aiming at integrated water resource management must give as much consideration to the economic context which will determine potential levels of investment as to the hydrological context which merely determines the levels of water available. Water plus no investment means poverty. Water plus investment in environmentally and socially appropriate and politically feasible water using activities means jobs and prosperity. The integration of the management of water by its users is a political process that is subordinate to social, economic and environmental circumstances.

Another example of a non-hydrological operating system that can be a dominant factor in solving a water deficit problem is international trade. Trade in water intensive commodities such as grain is a very elegant example of how the economic concept of comparative

\[\text{\footnotesize \textsuperscript{4}} \text{ "Simple truths: vital lies." "(Governments and peoples) \ldots can protect themselves from painful realisations by diminishing awareness. \ldots This trade-off between anxiety and awareness creates blind-spots of self-deception."} \]
advantage can have real impacts. "Virtual water", that is water embedded in international trade in grain, moves more water than engineers can possibly contemplate. A tonne of grain requires about 1000 tonnes of water to produce it. By ignoring such water, rational debate on national and regional water priorities are flawed.

Such lack of awareness and complexity makes the task of improving IWRM formidable. It is a process that is based on defective assumptions and can only be as strong as the networks of consensus which partial participation can achieve. Shifting perceptions and raising the awareness of the utility of comprehensive IWRM in such a world will be impressive achievements.

2 Some underlying features of the Vision process

Shifting paradigms in the North
The Vision process has come to pass because of millennial paradigm shifts. The last quarter of the twentieth century saw the (over-) industrialised North abandon its hydraulic mission. The environmental movement had established during the 1960s and early 1970s that water had an environmental value and that many countries already had too many big dams. The green light of environmentalism was the first to inspire a new approach to water management. The second influence was the cold light of economic theory. By the 1990s the water sector was subject to the scrutiny of economists who had managed by the Dublin meeting to establish that "water is a social and an economic resource", which forms the acronym WISER (Turton 1999). The two ideas integrated become WISEER, or "water is a social, economic and environmental resource".

The political economies of the North have made substantial headway in recognising the environmental and economic value of water. Several economies located in semi-arid regions, Australia, California and Israel, changed policies in the 1970s and the 1980s and have made substantial re-allocations of water that are consistent with environmental and economic principles. Their political economies were robust enough to cope with the social impacts of the changes.

Different and predictable approaches in the South
Those managing water and making water policy in the political economies of the South have a different and predictable perspective. They find the insistence of professionals and scientists from the North very recently converted to WISEER principles that the South too should adopt the tough environmental and economic principles untimely and unrealistic. The first reason is that the spectacular achievements in food production and productivity of the past half century in East and South Asia need to be repeated in the first half century of the next millennium. Water, and the way it is allocated and managed, will continue to be a key factor determining levels of future strategically important food production. Secondly, many countries in the South have not reached the level of hydraulic works saturation of the industrialised North. Thirdly, and certainly very importantly, the economies of the South do not have the adaptive capacity, determined by economic diversity and strength, to adopt the new WISEER principles. Those bringing the new principles believing them to be solutions in practice bring political problems.

The Vision process has been careful to ensure that these contentions have been given expression. The consultative process had already involved over 10,000 professionals of diverse provenance by August 1999 and will have involved many more by March 2000. The workshops and seminars brought together a dozen groups from regions in all the continents and also focused on four major themes; water for people, water for food, water for nature and
water for rivers. The different views will be evident in the presentations that will be made at the World Water Forum in The Hague in March 2000.

Outcomes of the consultative processes and IWRM

With a process that evolved according to unpredictable inputs it has been impossible to anticipate or impose a profile. At the same time the trajectory traced by the Mar del Plata Conference in 1977 and by the conferences in Dublin (1992), Rio (1992) and Paris (1997) is discernible in both the discourse and the preliminary drafts of the Vision. There have been moments in the process when it has been pointed out that the majority of the 10,000 participants have been male, mainly older rather than younger, mainly from engineering and technical backgrounds, with economists punching more than their weight, and with few people from the political arms of government and even fewer from the private sector. At the August 1999 water symposium in Stockholm the Vision convenors were very responsive to the argument that the gender issue could not be properly addressed by the spectrum of ideas and approaches represented by the 10000. Meanwhile every effort has been made to ensure that the environmental value of water is considered and the water for rivers group has also been attentive regarding the environmental role of water.

It remains to be seen how the key issue of IWRM will be addressed and what will be recommended. As political and institutional circumstances, that is power structures, determine whether integration can be attempted and, once attempted, achieved, the political determinants aspect should certainly be given prominence. Political circumstances are unique to localities. Generalising about them is counter-intuitive. Assuming that they do not exist is worse and very dangerous because their nature arbitrates and translates what initiatives are taken and how these initiatives – visions and actions - are diffused. The Vision initiative and especially the framework for action are about identifying safe, secure and sustainable water initiatives and having them known about, wanted and ultimately implemented effectively. “Ultimately” may be quite a long time.

3 The Framework for Action process

A rite of passage for water

The present process of Vision to Action marks a rite of passage for water. The 1980s were a decade for drinking water, the 90s a decade of water debate, we are now crossing the Rubicon with commitment to two decades of water action. It is action that is so desperately demanded from all – from water professionals through to the poorest slum dweller.

The Framework for Action Unit (FAU) of the GWP has been working for six months to analyse the present situation and provide support to Regional groups to help them in their preparations and to ensure synergy. A set of guidance notes on preparing the Frameworks for Action (FFA) has been widely disseminated. Three background papers have been prepared for use by the regional groups and the FAU as a starting point for preparing the actions needed to achieve the Vision. A toolbox of options for water resources development and management has also been prepared as part of the analysis of information now available to help prepare for action. The process has shifted from an analysis to a formulation phase.
River Basin Management in the Vision Process and Framework for Action

Actions in a real already transforming world
Solutions are being sought for a less than utopian world. We should not expect it to be otherwise in the next 25 years. While the sound development and management of water resources depends on many external factors over which we have little control, there are clearly a lot of things that can be done and must be done that will make a real difference to sustainable water use and management. Some things of course will depend on major social and political issues that we would all like to see resolved - the elimination of slums and shantytowns, better governance, fairer trade, to name but a few - but we should avoid deviating too far from the water world. The very large community of water professionals and water scientists must put its own house in order and this alone will require some rethinking of the scope of the analytical frameworks which professionals deploy. Tough decisions will be required in new and unfamiliar conceptual circumstances, outlined in the section on the Vision process above.

There are many actions and initiatives already underway, in administrative departments, in villages and urban communities, in different water-related authorities, in the drafting of new laws and in planning and policy development. The World Bank has taken the lead throughout the 1990s in raising awareness of the water problems facing local, national and international communities. There is already evidence of a significant upturn in the volume of actions being taken at country level with many optimistic indications often from unlikely sources. Some of the more difficult tasks - implementing the accepted principles, enforcing the new laws and carrying out the needed institutional reforms - may still be paper rather than real achievements.

The need for heightened awareness of the need to re-vision and re-resource watersystems
The impressive participation achieved in the Vision Exercise indicates the need and the desire for a new approach to water in many parts of the world. It will require political leadership and lifestyle changes to make it happen. Action by the international water community must help the politicians to take the necessary decisions – as tough as they may be – to accelerate the rate of change. One important change is the recognition of the economic value of water – that its scarcity and the pressures upon it mean that we cannot squander it as if it was a limitless natural resource. Policy actions must reflect this principle. Actions must help both the politicians and the public to understand about the value of water – and face up to the implications and trade-offs needed to avert water problems, both for this generation and future generations.

Equally important are actions that promote sustainable financial management. A pricing mechanism will have to be created for all water services and a system for preventing the pollution of water resources. This will not be popular with either politicians or the public but is essential. Pricing mechanisms can be found that take into account the poorer members of humanity, who already suffer gross inequality in water-related services, so that they do not bear the brunt of future shortage. Actions must help governments develop the right institutions to manage the resource fairly and sustainably.

In preparing the actions we will aim at responses to the disease and not just the symptoms, responses to such issues as food security, ill health, environmental conservation, and to poverty itself. Poverty interconnects at a fundamental level with water scarcity and inadequate sanitation, affecting household productivity and death and disease rates especially among children.
Water service provision is part of the cure. Stimulating economic growth and enhancing livelihoods remain the development imperatives that will create a context where water policy reform can be considered and implemented. But only if we can get the right balance between caring for the resource and water service provision for livelihoods.

Over the last 25 years the pace of change has been slow and obtaining international agreement on approaches is difficult. But we are now in a very exciting and fortunate position. A lot of hard work has been done. Sufficient global consensus has emerged over the last few years to provide a mandate for action to apply the new approach. It now remains to apply it! Many countries, some among the poorest in the world, such as Uganda and Burkina Faso, are making valiant attempts to do this but lack the resources and need supporting actions from the international community. Actions are needed to expand the knowledge base and improve the capacity to put knowledge into practice.

Integrated water resource management – IWRM – conceptually sound but in implementation challenging

The concept of IWRM has been a major breakthrough but its practical implications are still poorly understood. The GWP is actively promoting this approach and will continue to give it priority. To put IWRM into practice actions are needed to develop Integrated Water Policies (just as our transport colleagues are developing integrated transport policies) and Integrated Water Use Planning (land use planning is taken for granted but strangely absent for water, even though the planning concept is well understood). Such policies and planning must be feasible and adaptable to local situations. Central governments and sub-regional bodies such as river basin agencies will have prime responsibility for IWRM actions. Much can also be done at the global level to support them in taking this new approach.

Some assumptions on the development of actions

We must be brave enough to avoid “fashion” or political correctness; we should also avoid mixing tools (that help to achieve objectives) with the objectives themselves. Private sector involvement, gender sensitivity, participatory frameworks, demand-responsive management, and community decision-making, are all tools, essential tools, but not objectives and need to be used to reach objectives and not applied for their own sake.

Similarly, we need to avoid diversions, for example calls for new UN Conventions on drinking water or water as a human right. This can stall progress and divert attention and resources from action. The establishment of new international standards in itself has no guaranteed impact at all; as we have seen time and again over the last decades. It is the translation of those standards into policy and programmatic action on the ground that matters in terms of improving human lives. We already have a body of agreed international principles on water resources. Moreover, we already have international standards asserting basic rights to clean drinking water, in - for example - the almost universally ratified Convention on the Rights of the Child. It is better to exert our energies in getting these applied and put appropriate policies, good legislation and strong institutions into place at every level – individual, household, community, national, international – in order to facilitate the exercise not only of rights to, but also of responsibilities for our precious supplies of freshwater.
The “From Vision to Action report”

In the view the Framework for Action Unit of the GWP the Commission’s Report should be an equal balance of Vision and Action (the title of the Forum “From Vision to Action” captures this). To attract a wide non-professional audience, it should not be too long or too technical.

Section one will be a powerful and short Declaration of Action. This would make a commitment to act to achieve the Vision and will include a call for others to address some of the external factors that impact on water.

Section two will outline the global Framework for Action. It would start with a link to the Global and Regional Frameworks for Action to demonstrate synergy and add emphasis to the all-important actions at the country level – where real change takes place. The actions proposed will be presented under a set of headings, avoiding the fragmentation of sectoral uses, as this does not promote the IWRM concept. The term “water sector” will be avoided throughout, as it is an inaccurate and confusing term; we will use just “water” or “the water domain”. It is too early to decide on specific actions but initial impressions suggest a sub-divisions of the global framework for action to address, inter alia, the type of actions discussed below.

Actions to facilitate integrated water resources management will be given the highest priority for the global FFA. We feel that Actions to raise awareness and understanding (water leadership, enabling change, getting the message across) will be of particular importance. The message has still not reached the parts that make a difference – the politicians and the public. Education to treat water with respect must be the key message. A massive and professional World Water Awareness Programme is proposed, using professional communicators to send the Vision message to everyone: politicians, the rich and the poorest communities. Other IWRM actions will relate to policy implementation (not just formulation) emphasising the importance of appropriate institutional mechanisms to enable the stakeholders to operate in integrating political systems.

Using the knowledge we already have (but ignore) and expanding knowledge (research, information dissemination, demonstration etc) will be important areas where global actions can have a major impact. Targeted research will be proposed with more emphasis on the uptake of research findings. The CGIAR system has to be strengthened and an equivalent body established for Water (a CGIWR?) that cuts across sectoral uses. We still need to do more work on finding out how much water is withdrawn from different systems and how much of that withdrawn is used and how much is available for reuse. Real demand is also not known. A particular black hole in knowledge is groundwater resources, and action is needed to better assess groundwater resources and groundwater pollution. Knowledge has to be applied and actions will be proposed for the global community to put more emphasis into human resources development, otherwise no actions will be sustainable.

It has been known for some time that institutional reform is a key element of any Framework for Action. The fragmentation of responsibility and lack of overall co-ordination places water at too low a level in the hierarchy of government priorities. There must be a voice for water at the highest political table: water resources must be an area where senior statesmen are active and informed, as they are when it comes to other natural resources of major significance to the national economy. Actions will be designed to help countries to establish a (central) Apex Water Body and (sub-regional) River Basin Agencies so that this obstacle can be overcome. The need is for better Water Use Planning, so the body must be within the administration but superior to the technical ministries. Global actions will be proposed that support government change to a legislative, regulatory and facilitating organisation with less operational responsibility.
Actions that balance services and resources (uses and the care of water) are needed. This will allow water to be used sustainably for livelihood enhancement whilst avoiding over-exploitation or pollution. We will target actions that aim at the users (such as food, health, industry etc.), but only for efficient and sustainable uses. For example, for food, actions will promote more crops for fewer drops. (A World Commission on Irrigation modelled on that for dams could be a way of formulating plans and overcoming the present perception of irrigation as a problem for water rather than a solution for food) For water supply and sanitation (WS&S) emphasis will be on dry sanitation (not wasting water on conveying waste) and for industry on recycling and closed systems. We will also identify specific actions that improve our knowledge of ecological needs so that this can be better understood. New technologies will be promoted and mechanisms found for their adoption (for example, to make desalination more cost effective).

Finally, a sub-section will be prepared on investing for a water future (financial flows and how to channel them into the priority areas). This will aim to establish new mechanisms for getting funds into water. To achieve the Vision, increased investment will be needed and funds presently allocated will have to be used more effectively. The donor response to the Vision should be increased allocations to water targeted at facilitating change. More judicious use of the huge domestic resources could make a significant difference - as Community based programmes have shown. Central governments should rethink policies to encourage cost recovery, introduce demand management, and promote local initiatives and private sector involvement as ways to generate more investment.

Section three of the Framework for Action will establish targets and milestones at an international level with a call to all countries to do the same for their own countries. These will be a broader set of targets than hitherto to try to capture the diverse nature of the water domain. Targets are needed that catch the imagination of non-technical, even non-water people, backed up by suitable indicators so that progress can be monitored. The OECD target of "halving absolute poverty by 2015" is an example. The targets should send a message: stressing reduction in resource use for increase in productivity eg "reducing agricultural water withdrawals by x% and increasing production by y% by 2010" would be the type of message to send through the targets.

The final section is especially important. It will cover in detail the next steps immediately after The Hague and on into the 21st century. It is important that the momentum is maintained so that the FFA becomes a detailed action programme (formulating implementable actions). The Vision to Action must stand out as the landmark event that transformed the decade of debate into the decades of action. This will indicate who does what in the year following the World Water Forum and give investment needs for preparing detailed plans. The GWP is expected to have a major role in this phase. It will work closely with the CSD (Commission on Sustainable Development) so that the Freshwater report is well prepared for the UNCED3 meeting in 2002. The longer term responsibilities for the future of the Vision to Action will also be outlined so that there is a clear mechanism for co-ordination, monitoring and reviewing the Vision to Action well into the 21st century and keeping up with new driving forces. The GWP, WWC and CSD all have important roles here. The World Water Council should consider a shift in focus for its tri-annual Forums, from one single event to a multiple of regional events all at the same time. There is a real need to move away from the international level towards the regional and country levels, as it is here that the difference is really made. The GWP regional partnerships can monitor the Regional Frameworks for Action and work with the WWC to host regional forums.
IWRM and river basin management: what integrates water resource management – IWRM?

A central inspiration which is misleadingly sensible to outsiders but unwelcome to those inside

As IWRM is the central inspiration of the Vision and the Action processes, it is essential to emphasise again what integration means before embarking on a review of the management of river basins. At the local level it means taking into account the interests of users within a single sector as well as those in other sectors; these could be irrigators and urban, domestic and industrial services users. It also means knowing the strengths and weaknesses of institutions that have the legitimacy to arbitrate between contending parties. In economies that have not developed legitimate central government institutions it will be local, often ancient, customary law that will be effective. For the local community a central government institution has no standing in affairs which have been subject to ancient local conventions especially if central institutions have intervened at some point to reduce the economic options of the local community.

Integration means developing the capacity to gather and disseminate transparently hydrological data that are gathered by methods of sufficient precision to be legitimate. Transparent hydrological information will be subject to interpretation by professionals from political entities with very different interests. Integration of these contending views will be brought about by a (political) process involving contention and compromise over how water is allocated. The allocation – the integration – may be between national entities where long experience shows that unprincipled agreements are the rule rather than those based on hydrological data or evidence of efficient use of water or the need for water. At the national level allocation – integration - is also a deeply political activity where traditional users are not persuaded by the economic case for re-allocation based on economic efficiency or environmental need. Re-allocation – the more realistic term for integration - becomes feasible when a political economy has the capacity to compensate those who will lose the water to which they have become accustomed.

Scale and integration

A major problem with integrated management is that outcomes will be different at different scales and therefore the water using entities being integrated may be winners at one level because there have been some losers at another. Achieving control over the seasonal flows of rivers, a classic measure to achieve the balanced integration of uses, may be achieved at the expense of upstream communities where infrastructure is constructed. The interests of the national economy and of downstream beneficiaries may be associated with the elimination of livelihoods of upstream communities. Draining wetlands to reclaim land may also have negative impacts on some communities and it will certainly change the environment and local ecology. If those managing the national economy cannot compensate the losers, then the “integrative” meetings and consultative processes will be unsatisfactory. Measures may be forced through, and have been on many occasions in the past century, but they will not then be integrating. Winners might want the integration; losers will not. The capacity to reduce the number of losers or to compensate losers so that they agree to the “integration” is a key issue. Integration requires resources and institutional frameworks through which contending interests can be expressed and accommodated. Participating individuals and communities must to want the outcomes of proposed integration if the measures are to be implemented. The overheads of facilitating the political circumstances that enable change cannot be avoided.
The socio-economic context of intergration
At the same time those responsible for innovation must be aware that water does not
determine economic outcomes. Economic circumstances on the other hand do determine the
options available to those managing the national economy including water use in the various
sectors of the economy. Poor economies have few options. Poor individuals have few options.
The process of developing integrated water management policies and practices requires that
water be considered not just in sectoral terms but also in terms of the status of the national
political economy as it is this status which will enable compensation and therefore integration.

5 Integrating the management of river basins in national and international economic
contexts

The role of hydrology and engineering in river basin IWRM
The theories and concepts of hydrology and engineering understandably dominate any
preliminary debate on the integration of water resource management in the river basin. If the
debate on integration is confined to the scientific and the engineering communities, the
chances of integrated water management taking place will be small. Water is allocated in a
political world where political logic prevails and water may “flow uphill to money and
power” (Reisner 1984) rather than downhill to the ocean. Any analysis seeking IWRM that
ignores the interests and forces that bring about the reversal of the gravity will be flawed.
Ignoring the hydrological imperatives is also a flawed approach, but if it makes sense in short-
term political terms, the ignoring mode will prevail. Reversing ignorance is not a hydrological
or engineering process. Different sorts of problem solvers are needed and they must gain the
ear of the politicians.

Those convinced that facts determine behaviour need only think of the individual and their
personal finances. It is unarguably the case that an individual should take an information-
based approach to their personal financial affairs. The fact that very few do and that there is
no relationship between those who seek comprehensive information about their financial
circumstances and the success or not of personal financial management means that the
information based approach is not a natural human inclination. At the other extreme the
nation state claims to take an integrated approach but the means of gathering information are
so assumption laden and imprecise that the numbers used are often more akin to accidental
constructions rather than accurate indicators for decision making. Banks are likewise afflicted.
The political process that allocates resources uses the numbers provided by imprecise
monitoring systems and they are incorporated into the political process that arrives at resource
allocating policies. These last are implemented or not according to what social theorists call
the networks of consensus which determine acceptable or feasible outcomes. None of the
contending parties is wholly satisfied; none is wholly dissatisfied.

Integrating the role of water in economies – the water balance statement

“Politics are real; economics are an illusion.” (Reisner 1984)

Economists also believe that they have informational approaches and principles that will
contribute to the process of integration. Comparative advantage and efficiency are profound
economic ideas of universal application. Except, one must conclude, in agriculture in both the
North and the South. Mighty global organisations such as the World Trade Organization are
struggling to get the forces of socially determined decisions to conform to those of economic
principle. (That is one version. That the WTO is protesting hard currently that the interests of
poor economies must be given priority means that it will be the political economy that
determines and not liberal free-trading principles.) Officials of the European Union
economies and the US Department of Agriculture are too familiar with the pressures that lead
to “networks of consensus”, expressed in the North in outcomes such as production and
export subsidies. These practices contradict the notions of comparative advantage. Or if they
do not contradict them they are just as likely to do the reverse by reinforcing them in a very
non-economic way. Both the EU and the USDA have been involved for decades in
subsidising the export of already cheap grain. Such policies appear particularly perverse to an
economist although not perhaps to a political economist. Just as water is a social and
economic resource, so agriculture, the dominant user of soilwater and freshwater, is also a
social and economic activity. The social dimension is clearly a more significant issue for
politicians who determine allocative and re-allocative processes than the notional economic
value of water. Users, inefficient by the light of an economist, may be so numerous that they
have a political weight in the political contention that results in their interests determining the
politically allocative outcome.

Neither the hydrologist, nor the engineer, nor the economist is unimportant. Nor are their
data and science irrelevant to the political process. They are just part of the political process
and gaining a privileged place for their information and ideas has to be played out in a
political world where different conventions prevail than those of science.

Who are the problem solvers in the political domain – the equivalent of the engineer in the
hydrological domain?
Water is viewed by its users as both a social and economic resource. Any attempt to introduce
measures that change the way water is perceived and used, for example according to
economic criteria, must take into account that users will also perceive the social value of
water. Social contexts are near determining. Yet bearers of new water knowledge coming
from the recently enlightened North advocating water policy reform ignore the social context
of the political economies being targeted for reform.

The analogy of the engineer ensuring the adequacy of foundations for a structure on a
soggy site with poor load bearing capacity is helpful. For the engineer the respectable and
proven problem solving remedy is to sink piles. The additional costs are unavoidable. By
contrast in the water policy sector we are still at the stage where we not only ignore the
condition of the actual social fundamentals but we have no social remedies, equivalent to
piling, with which to achieve and secure reforming structures.

Introducing unfamiliar reforms which are inspired by an outsider science and professional
practice will in these circumstances, almost always, appear to fail. It is difficult to contradict
the perceptive politician who feels that it is better to ignore the problem than endure failed
remedies. Taking no action avoids wasting resources and stressful politics. Local politicians
depend on their capacity to sense the socially and politically feasible. In this they are much
better equipped than the outsider to judge the wisdom and especially the timing of radical
reform.
6 Recommendations

"The right way, the wrong way and the only way"

In the social and political realities outlined briefly here, those advocating integrated water resource management as the central principle of the Vision and the Framework for Action for river basin management must demonstrate that they have political as well as scientific savvy. Integration being substantially a political process of gaining legitimacy for hydrological, economic and engineering information and principles, practitioners in these professional areas must assimilate the political or seek intermediaries who can translate for them the language of contention and politics and the languages used by the practitioners in the hydropolitical arenas.

In the light of this challenging analysis, how should the topics that this workshop on river basin management has as its agenda be approached? This question is addressed in the following paragraphs.

First, policy and planning and the organisational structures for river basin management. In the light of the foregoing analysis those with notions of ideal structures might be guided by the idea that there is a right way, a wrong way and an only way. The only way is the politically determined way. If the only way is to be shifted by new knowledge and new alien principles, then significant resources will have to be put into understanding the political circumstances that obtain. These matters are well understood by staff in international agencies and by professionals in private sector contracting companies working in unfamiliar political environments. The private sector professionals may be the most alert as the viability of a project will depend on initially understanding the political risk of becoming involved in a major project. The outcome of a project will also depend on their staff understanding the local politics in which they are operating even better than the national government of the country in which they are working. All of these precautionary measures are expensive and require highly effective individuals with political skills in addition to any technical skills that they may have.

Concerning the organisational structure for river basin management one can make the following statement:

An understanding of the political space in which rules for the game can be made and the capacity of the players to comply with them can be evaluated is essential. An approach that assumes that the process of innovation involves some generally recognised phases – knowing, wanting, having, operating/complying and effectively operating/effectively complying – will be helpful. The approach taken by those proposing innovation and change will adopt different strategies according whether those being asked to change are in the first or the fourth phase of innovation.

Secondly, innovative operational management is not just about reaching for “instruments”, and finance and building capacity. It is about deploying options that are politically feasible.

Thirdly, the analytical tools deployed are, as is suggested in the terms of reference for the authors of these papers, a question of “which tools to use?” The decision which tools to use will be not just hydrological science, engineering standards and economic principle driven. Those deployed will be politically feasible.

Fourthly, international co-operation within basins will be regarded as an innovative scheme that is generally known about but is almost universally not wanted according to legal principles. The articles of the UN International Law Commission Convention of May 1997 (McCaffrey 1997) were the result of a two decade long political process. The articles are therefore less rich in principle than some would like and much less precise than others are prepared to accept. Getting riparians to want the articles of the Convention, or something
equally well founded in another political process, is the initial political challenge of those wanting to promote river basin cooperation. Meanwhile there is much precedent indicating that bi-lateral treaties and agreements can be reached according to generally unprincipled approaches.

Fifthly, international north-south co-operation will be seen by the recipients as more of the same with impossible demands of pre-conditionality, or the unbearable consequences of debt. The discredited conditionality approach was a politically driven activity inspired by economic principles. The major donors have significantly softened their approach in the second half of the 1990s, which means that socio-political contexts cannot be ignored.

References

THE ROLE OF EXTERNAL SUPPORT AGENCIES (INTERNATIONAL DONORS) IN DEVELOPING COOPERATIVE ARRANGEMENTS

G.J. Alaerts

1 An institutional disconnect

Where water users managed to put their common longer-term interest ahead of their desire for quick personal gain, and thus engaged in collective action, ‘catchment based’ water management has been practiced in many places around the world. Bali’s subak system of wet rice terrace cultivation, and Spain’s medieval precursors of the confederaciones hidrográficas, are only two prominent examples. But the same principles of cooperation were applied for the management and distribution of stormwater run-off from wadi’s in Yemen, and for flood protection and navigation in western Flanders’ 12th century water councils and Holland’s 12-13th century water boards. Water-focused collective action arrangements have also been found in pre-columbian America, Ancient Middle East and in various places in Asia.

These cases feature an interesting convergence of typical dynamics: (i) by introducing infrastructure in a coherent hydraulic system, the supply of water is made to match a demand for it; (ii) a set of agreed rules defines each water user’s rights and duties, and at the same time organizes the water allocation and the contributions for system maintenance; and, importantly, (iii) a consensus exists that such agreement creates a ‘win-win’ situation, i.e. that the average benefit for each water user is larger if all users cooperate than if they compete.

The arguments for a ‘win-win’ situation are rationally convincing, and one would expect that the current dramatically increasing scarcity of water of good quality would only lead to a precipitous establishment of more basin institutions. Yet, this is not the case. Clearly, the broad introduction of river basin management hits a number of fundamental institutional constraints.

The fact that there exist examples of (sub-)basin water management may obscure the efforts required to achieve that goal. Many of the collective arrangements often had an exceedingly long and problematic development history. A paragon of modern-day river basin management, the Australian Murray-Darling Commission took almost 80 years and environmental scandals to be established as an effective institution, as the riparian States refused to relinquish power over their share of the water resources. Similarly, the Rhine had to become for half a century Europe’s sewer, endangering health and economy, before agreements were concluded between the riparian nations. In the US, it also took 50 years of intervention of Congress to have an agreement concluded in 1997 on the joint management of the Appalachicola-Coosa-Tallahapoa-Alabama-Chattahoochee-Flint (ACT-ACF) complex in the south east US.

In Indonesia, a comprehensive river basin was established in 1974 on the Citarum river basin near Jakarta (Jatiluhur Authority Corp.), styled after the Tennessee Valley Authority. However, as time progressed, the agency was gradually stripped from its powers, turning it in a debt-ridden regional dependency of the central Ministry of Public Works. Since the seventies the Philippines disposes of a very modern water legal framework including river basin institutions, but none have been actually set up except for the Laguna de Bay Development Authority, and this one has not been very effectual. In India, with some

1 The World Bank, Washington, DC, and International Institute for Infrastructural, Hydraulic and Environmental Engineering, Delft. The statements in this paper are those of the author and do not necessarily represent the policy of the International Bank for Reconstruction and Development.
exceptions such as the Damodar Valley Authority, no basin-wide integrated management occurs. Competitive demand among States for rivers that cross boundaries, such as the Cauvery and Krishna, must still be resolved by Tribunal award every decade or so, a cumbersome and ineffectual mechanism that penalizes cautious and economically wise use and encourages States to appropriate as much water as possible to strengthen their position by the time of the next award negotiation. China’s seven River Basin Commissions only coordinate major construction and flood mitigation, and don’t participate in the actual integrated water management. They report directly to the Ministry of Water Resources and generally fail to facilitate coherent joint action among Provinces and other major stakeholders.

In short, despite the demonstrable gains that can be obtained through river basin management, in most situations this cooperative mechanism does not develop automatically. An institutional disconnect appears to exist where ‘conservative’ forces manage to delay the establishment of institutions for collective action. In fact, often the water shortage or the visible dis-economies of the current water use only seem to strengthen the counter-arguments to integrated water management. We will discuss this further in the sections below.

2 A worthy cause for External Support Agencies (ESAs)

Most ESAs have articulated specific water policies and programs over the past decade. Some of these players are large, and take a broad development view on water. Others take a more sectoral perspective. Among these players, the five international development banks are of particular importance because they finance initiatives, have the governments as direct conversation partners and actually influence the sectors because of their sizeable contributions. Among these five, only the World Bank, the Asian Development Bank (ADB) and the Inter-American Development Bank (IDB) have elaborated water policies.

The UN Food and Agriculture Organization (FAO) has funded a number of water related studies and disposes of expertise on water for agricultural purposes, but does not explicitly engage in river basin approaches. The UN Environmental Program (UNEP) has developed basin approaches and management models (such as the EMINWA program in the eighties) but it tends to emphasize the qualitative, ecological and pollution aspects of water management. The UN Development Programme (UNDP) disposes of access to funds to support national cross-sectoral policy development within governments, and for the capacity building of professionals and institutions in the water sector. UNDP has a policy document on water (Alaerts et al. 1991, UNDP 1998, Alaerts et al. 1999). It is playing a key supportive role in several arenas where concerns for international peace and environmental sustainability create the need for integrated management, such as in the Aral Sea basin, the Palestine, Israel and Jordan triangle, the Mekong basin and its Secretariat, and the Nile basin initiative. The regional UN agencies such as ESCAP in East Asia, ECLAC in Latin America and UNECE in Europe also initiate and promote regional cooperation on water.

The rationale for the international development banks to take an increasing interest in integrated water management comprises several arguments. The World Bank, ADB and IDB now strongly emphasize their goal of reducing poverty by supporting equitable, efficient and sustainable economic development (World Bank 1993, ADB 1996, IDB 1997). Research over the past decade has demonstrated the strong correlation between poverty in countries, and their economic growth. Water is acknowledged to have a significant impact on the economic development potential of individuals, through agriculture, water supply and sanitation, public health, power generation, flood mitigation, etc. In addition, water sustains ecological systems which have economic value too, and in turn generate a healthy hydraulic system (ADB 1996). Poor people can improve their welfare by having access to water. In turn, people who are
wealthier and better educated are better able under stress conditions to make cautious use of water thus not pre-empting the next generation from having similar benefit from the same water system.

The banks always have recognized the productive role of water, but they treated it as an input to other sectors, as if it could be taken from an assumedly inexhaustible reservoir. Until the mid-1980s the banks treated the water ‘sub-sectors’ (water supply, irrigation, navigation, etc.) separately. The World Bank recognized inter-sectoral impacts but did not seek to optimize water allocations (World Bank 1998). Damage to aquatic ecosystems was treated by limited add-on corrective actions and not in a systemic holistic way. Virtually all investment supported water resources ‘development’ to increase the supply of water to one or more sub-sectors (IDB 1997).

Three factors contributed to revision of this fragmented approach. Firstly, the population growth, especially in urbanized areas, and the growth in income per capita, rapidly caused water demand (including demand for removal of pollution) to outstrip supply. Secondly, the implicit assumption that countries would automatically take corrective action and shift from resources development to integrated management, did not hold true. Most countries had organized their administration precisely to speed up infrastructure delivery, and the resulting engineering departments and contracting businesses felt little comfortable with, if not threatened by, more management and integration. Finally, may investment projects failed to achieve their development goals or the make impact on the ground, because of poor integrated planning and management. All three banks agree that institutional deficiencies in countries now are the main reason for lack of performance.

The banks incorporated the principles of the Dublin International Conference on Water and the Environment (1992) which specifically call for holistic approaches, better policies and administrative arrangements, and a more critical look at efficiency and effectiveness of investments. Over the past seven years, the banks have rapidly shifted from a pure ‘investment’ approach to one that stresses the need of sound policies and the building of institutional capacities. In its 1993 policy document the World Bank stated “through its economic and sector work, lending (...) will promote policy reforms, institutional adaptation and capacity building, environmental protection and restoration (...)” In its 1998 Review Paper, the Bank is much more specific and states “(...) Bank’s Policy has two functions. First, to encourage reforms in water management institutions (...). Second, to guide Bank staff in helping borrowers create incentives to promote these reforms and tools to implement them.” Apparently, despite the nicely worded 1993 principles, Bank staff had experienced that institutional change is less easy to implement than lending money for infrastructure. The ADB as well as the IDB have developed dedicated lending instruments to support institutional reform and capacity building in the water sector. This development has taken place simultaneously with the creation of the Global Water Partnership which advocates the same principles.

Water management responding to the physical characteristics of river basins is only one, albeit prominent, form of integrated water management (IWM). IWM aims at reconciling the provision of water and the demand for it, as well as the competing demands themselves, to make water use economically productive, socially equitable and environmentally sustainable. These goals can be achieved in principle in many ways, but the fact that the water system is characterized by important externalities and unusually high transaction costs (as compared to the power sector, for instance) limits the options for workable institutional arrangements. It is attractive to concentrate on a hydrographically coherent region such as a river basin, catchment, or drainage or polder area, as all key actors and all decision-making can be brought under one purview. This is likely to facilitate the execution of all activities related to water management (planning, consensus-seeking, cost recovery, etc.), and make them more
consistent. In addition, the consequences of decision-making and management are readily felt by those depending on the basin's water, and this increases the chances that this section of government will be more transparent and thus accountable.

Therefore, ESAs in general and the development banks in particular have strong interest in facilitating sector and institutional reform to arrive at more sophisticated forms of river basin management. However, though the concepts are stated in all three policies, only the ADB goes to great length to enunciate the advantages of river basin management, and make it an operational priority.

3 Initiatives to develop river basin institutions

3.1 Size of financial flows

The development banks lend substantial funds to the water sector, although this component in their portfolio has slowly decreased over the past 15 years, and in the case of ADB has even declined in real terms. The World Bank invested between 1985 and 1998 some 15% of its funds, or more than US$ 33 billion in water related projects. Since its Water Policy became operational in 1993 it invested US$ 16 billion in projects in 80 countries with an overall price tag of US$ 80 billion. At ADB, the water sector share has declined from 30% of total lending in 1981 to an average of 15% in the nineties. IDB lent approx. US$ 16.7 billion (in 1995 dollars) to the water sector in 1981-1995, or some 23% of total lending. It is unclear how much of this volume can actually be attributed to efforts to develop river basin management, but it is likely still a relatively small yet growing fraction. Typically infrastructure investments are now only approved if they are deemed sustainable, which normally implies fitting in a policy of IWM.

Though it may be clear that this lending volume offers a powerful opportunity to engage in a dialogue with governments over their priorities, this effort is still limited as globally approx. US$ 60 billion is invested annually in water projects. Only 10% is funded by external sources of which the World Bank contributes half.

3.2 Studies and policy support

The typical tasks of the development banks with respect to river basin management include studies on the incentive systems and the tools to institute basin management; sector and policy analysis and support, both at general level and at country level; capacity building of professionals and institutions to implement the reform; and lending for infrastructure and other investment (equipment, offices, etc.), to enable implementation of the sector reform. Of the three banks, the World Bank tends to spend the most on policy preparation and generic studies. Because of its size and this analytical interest it is commonly perceived as taking the lead. However, this is not to say that the World Bank would score best on all counts, and it in fact learns a lot from the work and experience of the other two banks and the other ESAs. To acquire and mobilize all the available knowledge, it increasingly engages in partnerships and knowledge networking.

The World Bank has published a number of relevant studies. Several of these analyze the economic and financial costs of the no-action alternative, i.e. the case of basins without cooperation among stakeholders. Usually these studies concentrate on the water quality to build the case for water quality management and pollution control (Sadoff 1996). Indeed, most people intuitively understand that abstracting water upstream deprives riparians downstream, but few decision-makers have insight in this type of externality and the associated costs caused by pollution. Other studies include case analysis ('what did work and
what didn’t? (Alaerts, forthcoming), the institutional arrangements at sub-basin level such as water user associations (Subramanian et al. 1997), and the correlation between sector attributes and sector performance as measured against a number of indicators (Lee and Dinar 1995, Saleth and Dinar 1999). International basins and water courses have attracted much attention (Rangeley et al. 1994, Salman and Boisson de Chazournes 1998).

In countries and, sometimes in regions, the banks support policy analysis and studies to identify the implications of better integrated water management, including river basin management. ADB has developed a water sector profile format (ADB 1996) that it then applied with the Government of Sri Lanka on the Mahaweli basin. The format offers the opportunity to gauge the institutional strengths and weaknesses. Similarly, IDB launched similar efforts to develop an analytical framework for institutional development including river basin management (van Hofwegen and Jaspers 1999).

3.3 Initiating and supporting basin management

The banks have a particular interest in support to regional initiatives for basin-wide water management. In many instances such cooperation platform contributes to regional stability which in turn facilitates economic growth. The first such successful initiative concerned the World Bank’s mediation to conclude the Treaty between Pakistan and India regarding water allocation quota of the Indus (1960). The World Bank was also very active starting up the ‘water agenda’ for the Israel-Palestine peace negotiations (including Jordan, and Lebanon, and to some extent Syria) where the shared use of the aquifers and the scarce surface water (Yarmuk, Jordan river and Lake Tiberias) remains a very contentious issue. Similarly, the Bank took the lead in a multi-donor effort to resolve competition and conflict on the Amu and Syr Darya in Central Asia, and try to avert ecological disaster in the Aral Sea region. Other efforts concerned, i.a., the Incomati basin shared by, i.a., South Africa, Swaziland and Mozambique, the Senegal in west Africa, and the Danube and the Black Sea in Eastern Europe. Currently, a major initiative is underway to develop cooperative institutions between the Nile riparians. ADB on its side has provided leadership, with UNDP and the Dutch Government, in the development and maintenance of the Mekong Secretariat.

At country level, numerous programs have been initiated and supported to develop basin institutions, or at least cooperative arrangements among existing agencies. Very often these programs concern broader water agendas and infrastructure financing, within which the basin approach is only one component. The World Bank and IDB, for example, have provided strong conceptual and financial support to the reform in Mexico which prominently featured basin institutions (Comisión Nacional de Agua). Indonesia launched in 1998 a profound water sector reform which receives policy as well as financial support from the World Bank as well as ADB and other ESAs. This reform comprises reform of the legal, regulatory and administrative frameworks before mid-2000, after which long-term capacity building and investment programs should follow. A major component concerns setting up 6 new semi-autonomous river basin corporations which will work like franchises for the operation and management of the infrastructure, and for the bulk water supply to large users against quasi-commercial terms. The old Jatiluhur Authority Corp. will be re-organized along the same lines. It is considered to also mandate these corporations over time with asset ownership, so that they start operating like concessionaires (Fig. 1).
In China, several initiatives are underway to institute more integrated water management. The World Bank has just completed a groundbreaking effort to assist in the re-organization of the monolithic Water Bureau of the Xinjiang Autonomous Region in order to set up a series of decentralized, semi-autonomous and more dedicated and accountable organizations to manage to water of the Tarim river. UNDP, ADB and the Bank are also involved in testing new
in institutional arrangements notably in the China North Plain and in the Huaihe basin. The Huaihe, China’s third largest river, features particular difficulties, as it crosses four Provinces, and suffers from exceptional drought periods, intensive pollution, and massive floods. Despite that ‘rational’ arguments for cooperation abound, little political interest has emerged.

As can be deduced from the above, the development banks have particular advantages to engage in these roles:

- The banks encapsulate a substantial amount of specialist knowledge, both regarding the sector, modern insights, and the region and country.
- Because they work across the region and in the case of the World Bank worldwide, they can quickly absorb newly learnt lessons and make them available elsewhere in the world.
- The banks converse both with the sector ministries and, at least as important, with the Ministry of Finance. Often, the Ministry of Finance is more concerned with efficient use of resources and capital than the sector agencies. The banks typically put sectoral investments in the context of economic development and poverty alleviation, and stress environmental and institutional (i.a. financial) sustainability.
- They can engage in larger scale efforts, simultaneously providing finance.
- In cases where international cooperation is required, the banks can often take initiatives as they are considered impartial. The banks can start and facilitate a process of confidence building and negotiation.

4 An approach to institutional development

4.1 Toward a conceptual framework

In its operational work on water management the banks operate according to certain concepts shared among its professional staff. Although there exists consensus with respect to the fact that integrated water management is a desired goal and that the success of sustainable water management hinges on sound institutional design, it is obvious that much further work and discussion is required on the institutional design format or model that is ‘optimal’ for a given local situation, and on the process question how to facilitate local developments among stakeholders to arrive at that format. The process question is equally difficult given the experience that many institutional constraints exist that delay or thwart appropriate institutional development or reform.

The World Bank has an active internal and external dialogue on these questions in order to learn from the experiences from its own staff as well from others. This has led i.a. to a number of workshops and preliminary case study analysis. From this a still preliminary concept with design principles has emerged which is currently under internal development (Alaerts, forthcoming). However, a brief review is presented below.

River basin management institutions can take many forms. In order to draw lessons from international experience, it should be recognized that currently several hundred ‘basin agencies’ are operational worldwide for sufficiently long periods and with sufficient performance to consider them more performing than the no-action alternative. These agencies are organized according to institutional models that show a surprising variation in their tasks and structure. Possibly more than twenty different types of arrangements are currently being applied. On the other hand, these models share a number of characteristics or components, and design principles. These appear to be prerequisites for good operation.

For the purpose here, a general analytical overview is offered of a representative series of typical or at least well-known ‘basin agencies’ (Annex). The analysis does not pretend at this stage to be scientifically corroborated. The differences between agency organization can be
demonstrated by two extremes: the Mexican ‘Water Councils’ under the federal ‘National Water Commission’ (Comisión Nacional de Agua), and the Australian Murray-Darling Basin Commission. In the first, central government has an important stake in the management of the basin agencies (councils), and these agencies have a substantial project implementation task; in the second, the agency is essentially autonomous and a cooperative agreement among the riparian States, and it leaves all technical implementation to the State governments.

4.2 Management functions and institutional design components

It is considered that the basin agency has to be able to perform a set of management functions, and that the institutional arrangement has a number of institutional design components (characteristics) and design principles. The functions commonly encompass coordination and planning at basin level, financing, and project (infrastructure) implementation.

Importantly, river basin management is only one tool to achieve IWM. Therefore, the desired arrangement, and the functions it has to fulfil, need to be designed as a function of the other arrangements in the sector. The river basin arrangement, in other words, should complement other agencies. This is not to say that existing arrangements should be left untouched when a river basin institution is set up. Commonly, this development requires a reform across the sector. However, some other agencies may have prevailing arguments to remain active in the sector and assume particular functions. For example, many basin agencies of the ‘Secretariat’ type (see below) assume only the coordination, and sometimes a financing function, whilst the infrastructure development and operation remain in the hands of local government departments of public works.

The key goal of the basin agency consists of helping in the execution of:

• Allocating water, and managing demand and supply.
• Developing the resource through infrastructure.
• Negotiate conflict among users, riparians, and upstream and downstream stakeholders.
• Enhance the financial and resource sustainability.
• Strengthen the public commitment to water management by information, transparency and accountability.

The ‘optimal’ arrangement depends on country and time period. ‘Models’ don’t exist in the sense that they usually can’t be transplanted as a whole to a different region or time juncture. England and Wales have gone through three fundamentally different arrangements between 1965 and 1990. Also France has introduced important changes several times during that period.

The appropriate arrangement in a particular region depends notably on:

• The physical and morphological characteristics of the water system, its expected changes, and its opportunities for development through infrastructure.
• The structure of the demand, its expected changes, and notably its capacity and willingness to pay.
• The administrative, legal, regulatory, and law enforcement structures; and the expected changes thereof (e.g., in Europe and the US, from a ‘state interventionist’ political consensus in the 30s through the 50s, to a ‘market based’ political consensus after the 70s. In China, from a plan economy until the eighties, to a market economy thereafter).
• The historical experiences and culturally defined preferences with respect to governance, collective action, conflict negotiation, etc.
• The existence of synergies, both in the institutional and the physical arenas.

In addition, appropriate institutional design should draw from the small but growing body of scientific literature on institutional development. For example, Israel (1989) points out that institutions have the best chances of being effective if they are specific, i.e. have a clear set of
not too many goals (for example, see the ‘split-up’ of the large hierarchical Water Bureau of
the Tarim basin into smaller, better targeted and more accountable organizations – Fig. 2).
Ostrom et al. (1994) defined a number of rules for ‘crafting’ institutions, related to
accountability and scale. Management science, increasingly applied to public administration,
has demonstrated that effective organizations need to be flexible in structure, not monolithic
or overly hierarchic, and not containing too many layers (see, e.g., Mintzberg 1993). For
complex situations like in river basin management, it is clear that the art is in building the new
institutions around a few overriding priorities, but fully accounting for the lesser priorities.
Revealing competition and conflict, negotiating conflicts, and instituting acceptable
compensation mechanisms, thus are essential functions. It should be appreciated that all these
behavioral dynamics are in addition very culture-specific.

An essential design principle concerns the separation of powers. Though the application of
checks and balances sounds an obvious concept, it has been traditionally neglected in public
administration because it was considered in the management science of the first half of this
century that large hierarchical organizations have considerable economies of scale that prevail
over the advantages of (regulated) competition in a market. In the modern economic and
social environment, it is recognized to be overall more efficient to separate the regulatory
from the operational function. It has been suggested that one reason for the dysfunctionality
of the English Water (river) Authorities in the 70s was the decreased confidence in the
organization that was both operator and regulator, or the ‘gamekeeper’ and the ‘poacher’.
The basin agency preferably should be entrusted only with those functions that it can
perform better, more efficiently, more effectively and in a more sustainable way than any
other institutional agency in the country. Thus, the other institutional agencies will necessarily
also have to perform their share of the functions in the overall water management.

Though whole ‘models’ cannot be transplanted, the key functions and institutional design
components are generic. Some other functions and components can be added or applied when
appropriate.

It may be clear that a successful institutional arrangement should be composed of several
complementary structural components:

- Organization(s). (The ‘real’ basin commission or agency).
- Incentive systems (subsidy rules, prices, restraining regulations, etc.).
- Regulatory systems (the formal and informal sets of regulations and rules).
- Capacities and skills as incorporated in the professionals, scientists, and in the way the
  organizations manage to employ and develop these capacities.
- Confidence of the stakeholders and of society at large.

4.3 Organizational typology

Depending on the external variables, the basin agency could assume a minimal set of
functions, or a maximal one. Most existing basin arrangements fall broadly into two
categories: (i) those where the agency has a small staff complement (50 to 100) and is
concerned primarily with policy, planning, and coordination; and (ii) those where the agency
in addition assumes substantial executive and (infrastructure) operational tasks, and disposes
of a large technical staff.

The terminology for naming basin agencies can be misleading. Agencies with wide-
ranging executive tasks are sometimes called ‘Commissions’ or ‘Councils’, such as the
Mexican Water Councils and National Water Commission, or ‘Boards’, such as the Dutch
Water Boards. In the Annex here, the agencies without extensive infrastructure operations are
called ‘Secretariats’, whereas those that have such functions are called ‘Authorities’ (these
names are given arbitrarily).
In a comparatively small number of cases, no special new agency is set up to ensure the integration of the basin’s water management (category “Other types” in Annex). In these cases, it was found that adequate basin management could be achieved by voluntary cooperation procedures between existing regular technical departments, or through dedicated departments within one central organization. Such arrangements seem adequate if the basins concerned are small or not particularly sensitive; if strong administrative and other cooperative procedures are already in place; and/or if a separate agency would not offer a competitive advantage for the additional effort to set up such agency.

The simplest but least efficient form of basin ‘management’ is the fixed allocation, which sets the amount of water that each user can withdraw. This is typically the product of political negotiation (e.g., the Indus Treaty in 1960 between India and Pakistan, and the renewed Farakka Agreement between India and Bangladesh of 1996). Tribunal or judicial awards also often take this form which is unresponsive and hard to implement, and usually can be monitored only a posteriori.

4.4 Comparative analysis

The comparative analysis suggests the following conclusions regarding key factors that are important to ensure success, and those that seem not essential.

Important factors

Fundamental characteristics appear to be (i) a win-win vision among the stakeholders, (ii) the application of checks and balances (see higher), and (iii) the application of sticks and carrots to encourage stakeholders and water users to subscribe to the collective action agreement. Sticks and carrots include notably regulation (that is to be effectively enforced) and subsidies, respectively. It is general experience across the world that people or organizations react against what they perceive as coercion and what they see as unfair deals in which other parties make greater gains than they themselves. Compensation measures, often of financial nature, can help to reduce this perception. People typically appreciate positive incentives more than negative ones.

Important characteristics for success include notably:

1. Strong stakeholder participation and broad confidence in the validity and support of the agreement. In some cases this extends into the availability of full democratic representation (like in the Water Boards in The Netherlands, and in the ‘Water Parliaments’ in France and in similar representative organs in Mexico).

2. Broad awareness among many groups in civil society and in government of the importance of good water management, and of the benefits that will accrue through river management.

3. Subsidiarity of tasks. The basin agency should not necessarily attempt to take over all water related or other functions that were carried out by other agencies (such as local government). The basin agency should preferably assume only these tasks which it can execute better than other agencies.
Figure 2: The landlocked Tarim basin is situated in the western part of China (Xinjiang Autonomous Region). Fed by snowmelt it used to water large forest tracts in its lower reaches. High upstream water abstraction, however, caused progressing desertification downstream. The institutional arrangement before the Government/World Bank project (1994-1999) (above) was a conventional pyramidal structure, geared at infrastructure construction. The separation of the Bureaux made conjunctive use difficult of surface and groundwater (both in large supply, but each in a different season). Now (below), a policy and planning body is established which recognizes the downstream forests as a "user". The following tasks were "unbundled", which were accorded to organizations with more specific mandates: construction of major infrastructure; maintenance of river infrastructure and sales of bulk water; and local water allocation and operation and maintenance of small infrastructure (irrigation districts, and urban distribution networks).
4. Initiative and supervision role for central and local government, respectively. Central government generally retains the task of setting the national policy and guidelines. In all countries, the basin plans need to meet these, as well as the annual national plans on resource management. In addition, in all countries central government finances substantial parts of the infrastructure investment, whereas, typically, at least the operational costs are borne by locally generated finance. In all countries, central government at least must enact laws that facilitate the development of the basin agencies, and entrust them with the required authority (for example, to raise funds). In several instances, central government, or a similarly empowered central authority (such as the US Supreme Court in the case of the Delaware River Commission) had to take the initiative to launch the basin agency, and bring the stakeholders together to have them cooperate in the agency (broker's role). Notwithstanding, in most successful cases central government retreated fully from the actual management of the basin agency. Only in the Mexican Water Councils, central government is explicitly present through the overseeing National Water Commission, and through its appointees, amongst whom the Chairman, in the basin Councils. However, in Mexico too the trend is towards more complete devolution of power. The Tennessee Valley Authority (TVA) is still a paragon of central government intervention: the US Congress still appoints its administrator, and in principle TVA only responds to the federal government. However, this form of basin agency was very much the product of the interventionist approach in the 30s, at a time when state departments responsible for water were comparatively weak.

5. Coordination. The most obvious advantage of the basin agency is that it will help integrate water management across the water using sectors.

6. Water allocation. The essential basin agency characteristic. However, rather than working through prescriptions, the agency should operate through, and enforce, more flexible allocative arrangements such as pricing, water markets, etc. which allow to allocate the water to the user that can give the highest economic value.

7. Conflict resolution.

8. Power to use stick (develop and enforce regulation) and carrot (provide subsidies, easements, tax breaks, and other compensatory measures).

Unimportant, or less important factors

1. Fits a ‘standard’. In fact, a great diversity exists.

2. Large size – operates and builds. This concerns notably the extent of the operational tasks with respect to infrastructure. The extent of the tasks regarding infrastructure construction and operation among the ‘Authority’-type of agencies is not a decisive difference for success between the models, but is guided by considerations of local nature. These tasks may include irrigation where this is a priority activity in the basin (Mexico), hydropower (Tennessee Valley Authority), or wastewater treatment (Dutch Water Boards). It can be argued that the basin agency preferably is of the non-executive, 'compact/cooperation agreement' type, provided that adequate technical implementing capacity is available elsewhere, for instance, in the technical departments of local governments, in irrigation districts, or in other agencies such as the federal Bureau of Reclamation in the USA. The agency should assume those executive tasks that can be carried out more efficiently at a centralized level, for example, those of a highly specialist nature. The demise of the British Water Authorities (1973-1988) can be partly attributed to the fact that of all basin agency models, they had the largest operational tasks. These covered not only flood control, drainage, reservoir operation, etc., but also all water supply and wastewater operations, as well as wastewater discharge licensing. The weakness of this model included i.a. a technically very complex organization with consequent poor
responsiveness to local demands. The TVA, on the other hand, has developed into primarily a public power utility, whose main assets now comprise nuclear power plants. Because of this, and because of the absence of local representation in its supervisory board, this model is likely to be the least replicable for basin water management.

3. 'Makes sense' to water experts. Very often water professionals are unaware of the economic and behavioral implications of institutional arrangements. Many water professionals have advocated large top-down water organizations with the argument that 'all water should be kept in one hand'. Although this may make sense *prima facie*, it should be clear that water management is not only about the physical attributes of the resource.

*Characteristic functions with different contents*

The above discussions lead to the following identification of functions, or tasks, that, however, can be given different contents depending on the institutional requirements for that particular basin agency model. This list refers to the Annex.

1. Initiation and degree of control by 'higher authority', and authority derived from a mandate issued by central government. In all countries, and in most models, central government had to play substantive roles in the initiation and facilitation of the basin agencies. In most countries a national council at ministerial level brings together the relevant Ministries, which assists in creating a consistent policy framework in which the basin agencies can operate (see higher).

2. Stakeholders participate and/or supervise.

3. Awareness raising and community involvement. In all cases the basin agencies deem it essential to conduct extensive awareness raising and education among the citizens, farmers and industries in the basin. These activities serve to (i) instill a water conservation and pollution prevention attitude; (ii) ensure that the functions and achievements of the agency are understood; and (iii) ensure broad transparency regarding decision-making and financial management by the agency. Importantly, this education often is also designed as a two-way communication mechanism, and is used to bring important policy issues into public debate. This helps to adjust decision-making, and broaden the support for the agency's policies, and for the financial contribution required from the water users.

4. Task: policy and coordination.

5. Task: planning and allocation.

6. Operational task: revenue generation and financing. In nearly all cases, the agency is the main channel for the distribution of funds for operation and maintenance of main infrastructure, for investments and for the related initiatives at local level (such as the construction of wastewater treatment plants). In some cases the funds were new central-government funds and came with the installation of the agency (for instance, the Murray-Darling Commission), whilst in others the basin agency was allowed to appropriate central government funds that used to be disbursed directly to local governments (for instance, the French Water Agencies). In all cases, the agency has the power to raise local funds to manage the resource and the related infrastructure. Typically, the fund raising is coupled to the function of the agency to issue licenses for water abstraction, wastewater discharge, and resource management. Often a charge on distributed potable water is applied. This financing prerogative is one of the main power bases for the basin agency. In those cases where the initiative to cooperate in basin management has issued from the individual governments and not from a higher authority, as is the case in international arrangements and often in the USA, the financing remains in the hands of the those governments, and the agency plans the expenditures for the joint activities.

7. Operational task: infrastructure and operations (see higher).
4.5 Facilitating a development process

When facing a particular local situation of not-yet integrated water management, it is obviously essential to have a concept about the desired new institutional arrangement and the organizational formats for the river basin. This may already require a lot of study and institutional analysis, but the next question is how to initiate and facilitate the process of development towards that arrangement. As described in Section 1, collective action arrangements are rational, but they usually fail to materialize. This occurs because of two main reasons: (i) a lack of insight and, hence, of confidence among the stakeholders and decision-makers, and (ii) resistance from vested interests, i.e. from the ‘elites’ or quarters who gain from the existing arrangement. Existing gains may include, for instance, the political patronage that is possible when politicians or senior decision-makers can decide allocations of water or infrastructure; rent-seeking behavior of managers or operators who are to pass on the services to ‘beneficiaries’; and all sorts of bribes, nepotism and collusion that occurs notably between engineering departments, political parties and powerful interested parties such as contractors. ‘Conventional’ water management is driven by hardware and a ‘supply approach’, which favors the construction lobbies, whereas integrated water management typically leads to sharing arrangements, price hikes, shifts of decision-making and budgetary powers to lower-level governments, and less investments.

A careful and impartial process is essential to rally stakeholders behind a common vision, assist in ‘educating’ the stakeholders about the options and their respective benefits and costs, and, importantly, ensure that the consensus has broad support. External parties whose expertise and impartiality is acknowledged by all stakeholders can play an important mediating role in this process. This holds especially true where the main stakeholders are all of the same hierarchical level and have no higher or supervising authority above them. This is typically the case with international waters.

The key characteristics of successful processes include:

- The win-win vision must be made visible, which implies that parties who stand to lose from change should be compensated.
- All stakeholders, also those that are often invisible in conventional sectoral water management (nature, fishermen, people depending on wetlands, etc.) must be heard and have the perception that their voice counts.
- ‘Sticks and carrots’ can be applied to coax stakeholders in giving up privileges, and in accepting new collective arrangements.
- ‘Trigger events’ are often necessary to suddenly speed up the negotiation process. Typically, rational arguments for integrated management fail to deliver the conclusive impact. However, once a theoretical case is built and disseminated, and a predicted accident occurs, or a new opportunity for institutional rearrangement occurs, reluctant parties can be put under pressure to accept the new arrangement. In the Murray-Darling Commission in Australia, for example, two events triggered rapid consensus building after decades of stalemate. First in 1988 and 1989 serious pollution caused toxic algal blooms which killed cattle and closed down urban water supplies. Then, in 1992, the national government imposed a de-regulation of the economic system removing monopoly constraints in the transport, power and utility sectors. This allowed the ‘champions’ for basin management to include water resources, reducing the powers of the states over their territorial water shares in the basin, and to get access to additional national funds. (For the Rhine Commission, see Huisman et al. 1999). ESAs, and especially development banks are very well positioned to play such mediating roles.
5 Conclusions

River basin agencies are important tools to achieve integrated water management. Their functions should be carefully identified to those areas where the agency can add value and complements the tasks of other agencies and departments.

Although the basin management arrangement is in principle a win-win proposition, it appears that existing institutional constraints (vested interests) and lack of confidence often hinder development of such arrangements.

In a world with more competition for scarce water, water management organizations shift from a top-down hierarchic bureaucracy model into clusters of complementary flexible task-specific organizations that are managed like enterprises aiming at achieving pseudo-commercial goals, and that are more demand-responsive. The market forces are important management and allocation instruments. Inspiration for this institutional engineering can be drawn from the way water supply enterprises are set up.

The External Support Agencies (ESAs) and especially the international development banks have a pronounced interest in more sustainable water resource management, and this is increasingly reflected in their policies, studies and operational work.

The framework that World Bank staff employs is not yet sufficiently elaborated, but basic design principles for river basin agencies can be deduced from comparative analysis, and from literature. Basin agencies appear to derive their legitimacy and power primarily from their coordination and water allocation functions, from their public and stakeholder support, and from the financing capabilities.

References

International Workshop on River Basin Management

**ANNEX.** Comparison of key functions and characteristics of selected basin agencies. (Note: ‘Pumps’ stands for pumping stations and similar complex infrastructure).

<table>
<thead>
<tr>
<th></th>
<th>HIGHER AUTHORITY ROLE</th>
<th>TASK: POLICY AND COORDIN.</th>
<th>TASK: PLANNING</th>
<th>OPERATION TASK: FINANCING</th>
<th>OPERATION TASK: INFRASTRUCTURE OPERATIONS</th>
<th>STAKEHOLDERS PARTICIPATE/SUPERVISE</th>
<th>AWARENESS RAISING IN BASIN</th>
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<tbody>
<tr>
<td>&quot;SECRETARIAT-TYPE&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International: Rhine Commission</td>
<td>No</td>
<td>Yes</td>
<td>Minor</td>
<td>No</td>
<td>No</td>
<td>Representatives from Nat. Govts.</td>
<td>Strong</td>
</tr>
<tr>
<td>France: Agences de l'eau</td>
<td>Minor</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Basin Parliament</td>
<td>Very strong</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Local Govt. representatives</td>
<td></td>
</tr>
<tr>
<td>Australia: Murray-Darling Commission</td>
<td>Minor</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Minor</td>
<td>State Govt. representatives</td>
<td>Very strong</td>
</tr>
<tr>
<td>USA: Western USA, various</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes or delegated to federal agencies²</td>
<td>Local Govt. representatives</td>
<td>Strong</td>
</tr>
<tr>
<td>USA: Delaware River Comm.</td>
<td>Minor³</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Local Govt. representatives</td>
<td>Strong</td>
</tr>
<tr>
<td>USA: ACT-ACF Compact⁴</td>
<td>Minor³</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>State Govt. representatives</td>
<td>Yes</td>
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¹ Includes most important functions.
² Excludes operation and maintenance functions.
³ Includes significant functions.
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<tr>
<td>Netherlands: Water Boards</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Very strong</td>
</tr>
<tr>
<td>Germany: Emsch Cooperative Wahnbach Association Ruhr Association</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Reservoirs. Flood control.. Pumps. Wastewater trt.</td>
<td>Local Govt. Is in charge</td>
</tr>
<tr>
<td>Mexico: Comision Nacional de Agua and local Water Councils</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Canals. Reservoirs. Pumps</td>
<td>State Govt. representatives</td>
</tr>
<tr>
<td>USA: Tennessee Valley Authority</td>
<td>Yes³</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Power generation Reservoirs Dikes</td>
<td>No</td>
</tr>
<tr>
<td>United Kingdom (’73-’88): Water Authorities</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>WATER SUPPLY. WASTEWATER TRT. Reservoirs. Dikes</td>
<td>Local Govt. representatives</td>
</tr>
</tbody>
</table>

| OTHER TYPES |  |  |  |  |  |  |
| England, Wales (after ’88): National River Authority/ (after ’95): Environmental Agency | Yes. All basin planning in one Nation Govt. organization | Yes | Yes | Yes | MINOR. Much delegated to privatized basin-based water industry | No | Very strong |
| Germany: various | Yes. Cooperation between State Environm. Depts. | Yes | Yes | Yes | MINOR. Much delegated to Local Govt. Techn. Depts. | Local Govt. participates | Strong |
Notes:
1. International arrangement: Rhine Commission: The Commission is a voluntary association of sovereign Governments, which do not have an authority above them. National arrangements: National Govt. always retains the task of setting national policy and guidelines. In all countries, basin plans need to meet these, and annual national plans. In all countries, National Govt. finances (part of) the infrastructure: typically, at least the operational costs are borne by locally generated finance. In all countries, National Govt. at least must enact laws that promote the development of the basin agencies.
2. Executive federal agencies are notably the US Bureau of Reclamation, and the US Army Corps of Engineers. Both are primarily financed by federal funds, and will often assume a regional planning and initiating role.
3. In many cases, the National (or, in the USA Federal) Govt. also actively stimulated the development of the basin agencies or the local cooperative arrangements. For example, in the USA this was the case with the ACT-ACF compact, which was successfully concluded in 1997 after several earlier attempts initiated by Congress. The Delaware River Commission is a regional cooperative compact initiated by a ruling of the US Supreme Court after a deposition lodged by a citizen concerned with the deteriorating state of the catchment. The Commission must report annually to the Court. The Tennessee Valley Authority is a-typical in many respects: it was set up in the 1930’s by Congress to combat floods and industrialize the Valley by generating hydropower. Its current main business is (nuclear) power generation. As the American electric power business goes through a deregulation phase in the 1990’s, it is possible that TVA will continue as a power generator and distributor, spinning off its water and environmental management tasks to the Valley’s States. Although TVA is the only arrangement without direct supervision by Local or State Governments, the TVA recognizes the value of intensive ties with Local Government and with the local citizens.
4. ACT-ACF: the basin comprising the Apalachicola, Coosa, Tallapoosa, Alabama, Chattahoochee and Flint rivers, straddling the States of Alabama, Georgia and Florida.
SELECTED CONTRIBUTIONS

Upstream Perspectives on River Basin Management in the Himalayas
    M. Banskota

Integrated River Basin Management; A Reminder of Some Basic Concepts
    Jean Burton

River Basin Management in the Aral Sea Basin
    Prof. V. Dukhovny, Mr. U. Ruziev

The Portuguese-Spanish Convention on Shared River Basins
    António Gonçalves Henriques

A River Basin Management Model for Sri Lanka - Potential in Mahaweli River Basin
    Ariyaratna Hewage

The Main Outputs of the North Caucasus Region Water Resources Conservation and Management; Sub-component Implementation
    Vladimir V. Khlobystov

River Basin Management of Tsurumi River, Japan
    Toshio Okazumi, Yutaka Hosomi

An Overview of River Basin Management in Nigeria - Development Option
    Orji, O.A.C.

Mekong River Commission
    MRC Secretariat, Phnom Penh, Cambodia

The River Nile Basin: A Vision for Development
    M. B. A. Saad

Some Aspects of River Basin Management in Vietnam
    Prof. Ngo Dinh Tuan, Dr. Le Dinh Thanh

Water Uses Management in Mexico
    A. F. Villavicencio, S. M. Mejia

Flood / Discharge Management; Rhine Action Plan on Flood Defence
    Drs. J. Worm, Jhr. mr. C.H.V. de Villeneuve

Finding the Useful Levers: Policy Connections to Responsive Parts of the Biophysical System
    R J Wasson

Some Thoughts about River Basin Management
    Johannes Wessel
UPSTREAM PERSPECTIVES ON RIVER BASIN MANAGEMENT IN THE HIMALAYAS

M. Banskota

Contents:

1. Introduction
2. Neglected Upstream
3. Changing Upstream Conditions and Implications for River Basin Management
4. Fragmentation of Water Management
5. Regional Dimensions

1 Introduction

The Himalayas are the sources of the five great rivers in Asia, the Indus, the Ganges, the Brahmaputra, the Mekong and the Yangtze. Each of these river basins has been an important cradle of human civilization in the past and is also a highly vibrant area of human activities at the present. In the past River Basin Management (RBM) as pursued in these areas has focussed on flood control, irrigation and the development of hydropower for urban areas downstream. Much of the thinking about RBM has been dominated by the needs and priorities of downstream areas. Obviously these downstream areas also had large populations and sizable urban areas and RBM decisions could easily be justified on economic, financial and political grounds. Overtime, however, the failure to address the changing upstream environment and the needs of upstream people has generated its own set of problems and issues.

Countries in the Himalayan Region are slowly finding out that implementing RBM decisions in upstream areas is no longer as smooth sailing as in the past and increasingly upstream areas are beginning to voice their concerns and demand their share in RB development. This is quite evident from the discussions surrounding the Three Gorges in the Yangtze, the Tehri Dam in Western Himalayas in India, and the ARUN III in Nepal. There are many projects beginning to come under careful scrutiny and the earlier practice of anything good for downstream areas being also good for upstream areas in RB development is no longer tenable. RBM is slowly recognizing the existence of multiple stakeholders in the basin and the need for proper consultations and participation in all decision making process regarding RB development.

This paper is an attempt to bring together some of the ongoing discussions in the Himalayas regarding water and river basin management. Some of the points raised are still quite tentative in terms of the limited nature of evidence. However this emphasizes the need for further review and analysis in the future.

The next section describes some of the prevailing practices in RBM in the Himalaya Region. This is followed by a discussion of the past neglect of upstream areas in the context of RBM. For a long time a downstream view has dominated the upstream – downstream hydrological linkages. Some of the new evidence in this respect is calling for a re-examination of these earlier notions. The discussion moves to the issue of water management and it is argued that so long as water management remains fragmented sectorally, it will be difficult to integrate all the stakeholders including upstream concerns. Some of the regional issues are raised as questions for the future of RBM.

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2 Neglected Upstream

It is very easy to get balked down in a discussion of what constitutes upstream and downstream. For instance in the case of some of the Himalayan rivers, India is upstream with respect to Bangladesh, but is downstream with regards to Nepal. Similarly, Nepal is a downstream country to China with regards to some of the rivers. As rivers do not recognize political boundaries, countries and regions have to resolve their differences in order to make the most efficient use of available water resources. In this paper, the term upstream is used primarily to refer to headwater areas, which are the sources of these rivers. In the Himalayan countries, RBM in the past has basically meant building dams for flood control, irrigation and the development of hydropower. Dams have been built at points where the river begins to leave the mountains. Some of these include the Tarbela, the Mangala, the Bhakra, the Gandak and the Kosi in southern parts of the Himalayas. There are thousands of dams along the middle and lower reaches of the Yangtze including many in Tibet (23).

Dams built during the fifties and sixties were primarily oriented to serving the needs of the plains so much so that in many areas where the dams were built the local people were not even provided the electricity until very recently. Little attention was given to the needs of upstream people. River training and watershed management activities were also limited to protecting the immediate structures around the dam. There has been a lot of talk about integrated approaches, sometimes in the context of watersheds, at other times about river valleys. However, in most instances this has meant the addition of new activities in response to a new problems that has emerged in hydroelectricity or irrigation or flood control projects.

If integrated management has been so difficult within one project, the problem gets even more complicated between countries sharing the same river system. The most curious dimension of this problem was the manner in which hydrological data was controlled and made extremely difficult to access. Fortunately, some of this is changing and there are hopeful signs that inter-country RBM will become more important in the coming decades (5).

The increase in environmental awareness throughout the world and also across the Himalayas has resulted in a growing recognition of the upstream problems (2,3,4). Upstream voices are getting stronger and are being heard in strategic organizations such as the World Bank. Sometimes the upstream demands may be to prevent the huge dislocations of settlements created by some of these projects (1). At other times the demands may be for a greater share in the benefits. In a few instances the pressures may be against the project itself. It is becoming far more difficult to overlook the demands of the upstream areas and many different channels of communication and participation have been developing for upstream people to play a role in the decision-making process. It may not be uniformly similar throughout the region but it is certainly changing as compared to the past. There are instances where some RBM decisions have been taken to courts. Some see this as unnecessary setback to development decisions. But many others see this broad-based participation in decision making as an integral part of sustainable development.

A number of issues have dominated the upstream-downstream debate. In the past the upstream areas have been faulted for much of the flood and sedimentation problems in downstream areas. The argument has been that because people in the upstream areas are cutting down all the forests, there is greater erosion of topsoil, less infiltration, greater runoff and downstream flooding. The problem becomes aggravated by increasing soil erosion, which raises riverbeds, causing rivers to overflow its banks and triggering widespread flooding. The reasons behind the deforestation in the upstream areas was the need for agricultural land for a rapidly rising population. As all good land was already under the plough, the only alternative is to clear the forests in mountain slopes. As not all farmers practice conservation farming, there is increasing soil erosion, which further affects productivity of agriculture and increases
the pressure for finding new lands. This vicious cycle can only be broken by a strong program to control population growth, improve agricultural productivity and provide gainful employment to the growing number of unemployed and semi-employed. Poverty is still considered as the biggest threat to the upstream environment and the prevention of floods in downstream areas.

There is some merit in this scenario of the strong linkages between population, agriculture and environment. The linkages with downstream flooding, however, are being questioned by some of the recent studies.

(i) **Study of Flood Events**
Recent studies have shown that rainfall in the Himalayas is not always the reason behind the floods in Bangladesh. Floods in Bangladesh have more to do with rainfall inside Bangladesh and in the immediate neighborhood, i.e. Assam (15). In the Himalayas sudden floods are very common but these are more the result of special weather events such as cloud bursts (16). Human activities appear to be only one among a whole host of factors. Apart from extreme weather events, there are glacial lake outburst floods and landslide damming that are also equally devastating.

Another important reason behind downstream flooding is the development activities such as unsound construction of roads, irrigation canals, railway lines, and settlements in the flood plains and poorly designed structures. In upstream areas many landslides are triggered by improperly carried out construction activities and inadequately considered parameters of hydrology, geomorphology, seismicity, etc. related with hazard and vulnerability.

It is also becoming clear that the rainfall pattern within a river basin is not uniform and disaggregated data and analysis have become essential to understand the behavior of natural events over time (15). This is not an easy task and emphasizes the need for strong cooperation between different partners in the river basin. The loss in the traditional storage space in downstream areas in lakes, wetlands and the flood plain (23) in general may be playing a greater role in the duration of downstream floods. The role of high tides in keeping the flood waters inland has also been identified (15).

The important point is that while previously the entire blame for downstream floods was put on the activities of the upstream people, today many new and equally important factors have been identified that need to be systematically looked into.

(ii) **Forest Cover Soil Loss and Downstream Sedimentation**
It has been widely believed that there is a direct relationship between loss of forest cover soil erosion and downstream sedimentation. It is this argument that results in strong calls for banning the cutting of trees in mountain areas. Siltation of reservoirs in many Himalayan rivers has also been attributed to the large-scale deforestation across the Himalayas (14).

Various studies from different parts of the Himalayas are beginning to question some of these widely held positions. First, there are examples of well-forested areas being subject to landslides and soil erosion. This has depended more on the duration, timing and intensity of rainfall. Strikes by lightening has also resulted in trees falling and generating landslides (16), particularly when soils are fully soaked in water after a prolonged rainy season. Studies in some micro watersheds have suggested that most of the flood events are caused by one or two rainfall incidents of high intensity, particularly when the soil is saturated at the latter part of the rainy season (6, 16).

There is also no proper record to suggest that soil erosion from upper reaches has in fact been increasing consistently. Loose materials on account of various geological processes abound in many areas and special weather events can easily trigger their movement
downstream. There is also reported to be fairly significant mass wasting along Himalayan rivers in the downstream areas which is contributing to the sediment load (12).

3 The Changing Upstream Conditions and Implications For RBM

Upstream areas are beginning to experience rapid changes. Population of upstream areas has also grown significantly over the years. Increasing access by roads and airlinks and communications have provided a new surge in mobility of the people. New markets and urban centers have suddenly mushroomed all over the mountains. All of these changes have produced a huge increase in local demand for water and energy. Traditional practices in water harvesting and conservation have become inadequate. While their own growing needs of water remain relatively unattended, they see big water projects planned essentially to cater to the needs of downstream areas.

The supply side has also not remained unchanged. Probably changes in supply side are warranting changes in RBM. The seasonality aspects of mountain hydrological cycles in the Himalayan areas are quite well known, but more recently there are reports of even greater fluctuations with a more rapid runoff and lesser infiltration; more water is being lost (6). Areas like the Kathmandu valley are facing major water problems almost throughout the year while a few decades ago the problems would be only for a few months (6). Cases of water shortage throughout the Himalayas are a common experience. There are many factors at work here and these changes are not well understood (4).

Another important problem has been reported recently. Many Himalayan glaciers have been identified to be receding (7). It should be noted that while the summer discharge is mainly on account of the monsoon, the discharge for almost eight months in most of the Himalayan rivers is from the melting of glaciers. Many glacial lakes that were not considered dangerous are now beginning to pose serious downstream threats as thick layers of ice melt away every year, adding to the growth of glacial lakes (10). The effect of global warming on this process has to be systematically studied in order to ensure a steady supply of fresh water downstream, it is necessary to better understand what has been happening in the headwaters region in the high mountains (7).

Although mountain areas are the sources of the mighty rivers, many upstream communities are facing serious shortages of water. Women and children have to carry water long distances uphill on a daily basis. Lack of water for irrigation has made much of mountain agriculture rainfed. There are reports that springs are drying up and other water bodies are damaged by landslides (9).

Mountain communities have evolved various mechanisms to share limited water resources for irrigation. The more limited the supply and the planting season, the more elaborate have been the mechanisms to ensure maximum irrigation (11). However, much of this is also beginning to change as outside influence introduces new off-season crops, new technologies to harvest water and market linkages. Many of the conservation values that were an integral part of local water management systems are fast losing place to commercial relationships that neglect conservation practices (11). Extraction of groundwater has resulted in rapid decline in water tables in Baluchistan and Kathmandu in a very short period of time (6).

4 Fragmentation of Water Management

Although frequently reference is made to integrated development of river basins and watersheds, the practice has been more sectoral and project oriented. Even when different sectors are brought under one roof, there continues to be a lack of adequate coordination, and competition between different units for limited resources remains high (18). There is a strong
domination of construction related engineering solutions (21, 22). Various aspects that were completely neglected were people's participation, biological methods for slope stabilization and runoff control, use of local materials and indigenous knowledge and impacts on the local economy and environment. However, far greater problems were faced in terms of meeting the high maintenance costs of these projects and the need to find alternative means of management that were more sustainable. This has naturally resulted in greater awareness towards the need to look at all the various aspects that were neglected in the past.

A number of areas where stronger efforts are needed in the future to ensure greater integration are the following.

(i) **Better linkages between sectoral organizations**

This is still one of the major issues in River Basin Management. As different organizations in the government inherit a very strong history of sectoral thinking and working, inter-sectoral coordination has not been easy (21). This is not only a problem with infrastructure related organizations, but also between other development units. In many areas where sectoral organizations have failed to work together, local and community organizations have been mobilized to take a greater role in the management of some of the rivers valley development activities.

(ii) **Coordination between sectoral and local organizations**

Local organisations have been overlooked in the past. However, as central and sectoral organisations find it increasingly difficult to meet the spiraling costs of many of their activities, they have been forced to look for alternative models of development. This has led to a rethinking of many aspects regarding the choice of technology, choice of materials, cost and benefit sharing and management roles. Investing in the development capacity of local organizations is being seen as a very cost-effective approach to sustainable management of development activities in RB development in the future.

(iii) **Integration of Upstream Environment and Economic Considerations.**

Upstream environment and economic considerations have raised a host of difficult issues neglected in the past. These range from biodiversity and cultural preservation to intellectual property rights of indigenous people (21). Valuation of many of these aspects in cost-benefit calculations has not been easy and quite often issues are resolved only after prolonged and difficult negotiations between different parties. Recognizing environmental problems raises many issues of economic incentives for conservation. New legal liability rules need to be formulated to ensure that protection is actually implemented (20). The experience so far does not suggest an easy road ahead, although significant progress is being made in terms of protecting various endangered species in the river basin and addressing adverse impacts on upstream people on account of RB development activities.

5 **Regional Dimensions in River Basin Management**

Although the history of regional cooperation in River Basin Management in the Himalayas is still relatively limited, increasing attention is being paid recently to this aspect. Firstly, despite some of the earlier myths about upstream-downstream linkages, there are important consequences of past decisions where cooperation between countries has not been easy but has become very essential. Secondly, there are also new opportunities provided by increasing liberalization in the region.

A number of important areas for the future can be identified as follows:
(i) Sharing of available information and data
(ii) Studying the impacts of past RBM and development activities
(iii) Reviewing of new opportunities in RBM on a regional basis
(iv) Review of upstream environmental impacts of new river basin development
(v) Review of Global Warming on Himalayan Rivers

The main argument of this paper has been that an upstream perspective on river basin management mandates a fresh look at many of the ongoing river basin development activities. In the past an upstream perspective was basically lacking. Adapting an upstream perspective has implications on a broad spectrum of activities, including improved understanding of natural processes, technology, sectoral development organizational roles, economic incentives, environmental priorities and many others, such as regional cooperation.

References

INTEGRATED RIVER BASIN MANAGEMENT; A REMINDER OF SOME BASIC CONCEPTS

Jean Burton

I thought my contribution to the International Workshop on Integrated River Basin Management could be this simple but useful "check-list." There are a few basic concepts that we tend to leave behind when a group of people gather to develop vision statements or policy papers. The following list is certainly not exhaustive; rather, it is based on the results of several workshops, seminars and other forums of discussion with program and project managers who deal with water-related issues, both at the national and regional levels. When we discuss the best ways to resolve the conflicts that arise among users of river basins, we find strong similarities among them. Large or small, flowing within industrialized or developing countries, all rivers pose challenges which can be grouped under some common themes. These shared issues, the ones most frequently mentioned by managers, are what I have attempted to present in the following pages. It is, I think, much more than a wish list, and a certain understanding can be derived from it.

The very nature of river-basin management is open to debate and, as such, there is no single best approach to resolving the whole range of complex issues involved. This, then, is the purpose of this workshop: to expound upon the most interesting approaches, based on a wide range of experiences from around the world.

1 The River Basin System

- The system is very complex. Water, one of the system's many components, is limited both in terms of quantity and quality.
- The system is open and influenced by outside forces that must be taken into account: climate change, long-range transport of pollutants, international markets, etc.
- It is a dynamic system; changes have and will occur over time and space.
- All components of the river system are interdependent; humans and their activities are part of the system, along with its natural functions, which have to be maintained.
- River basin resources include:

  Natural resources: water, soil, plants and animal species arranged in a wide variety of self-sustained ecosystems.

  Human resources: people, technical skills, cultural values, institutions and organisations.

  Artificial resources: dams, roads, cities, hospitals and schools, industrial complexes and farm lands, historical sites.

\[1\] St. Lawrence Centre, Environment Canada.
2 River Basin Management

- We do not nor can we manage the river system itself; we can only manage the human activities that take place within this natural system. The "magic pill" of technology has already done enough damage; we should take a more cautious approach.
- The contours of natural watersheds do not match the political boundaries.
- To manage means to allocate scarce resources among competing users, in an optimized fashion, both for now and for the future.
- Management is a dynamic process that requires continual updating; it must be flexible and account for uncertainties.
- Problems arise at different levels and the timing of the management response is crucial.
- Management is multisectoral in nature and implies strong partnerships among all parties concerned.
- Management requires the participation of users at the grass-roots level.
- Management is based on multidisciplinary knowledge, not on science alone.

3 Information Management

- Information includes science-based data, as well as local knowledge and expertise.
- Information is maintained by numerous institutions, whose first reaction is to hold it back; information is power.
- Existing information is often sufficient to get started, but difficult to assemble and integrate; the first step may be to bring together experienced managers to assess what is available versus what new information is really needed.
- Information sharing is a must; new information is costly to acquire. Information sharing is also the first step to positive partnerships.
- Management needs should define the requirements of an information management system, not the other way around; technological dumping (GIS, expert systems, mathematical models) is useless for managers unless they can use these tools properly.

4 Institutional Arrangements and Partnership

- No single institution can be all things to all people—that is, to manage all the human activities related to water resources within a basin.
- River basin planning cannot be a "stand-alone" process; harmonization with other planning activities and cooperation are critical.
- Several planning processes are already in place that will interfere (e.g. economic plans, sectoral and local plans, land-use planning, special-area planning [national parks]).
- The first step is to paint an overall portrait of those involved in water-related issues (i.e. the respective mandates and responsibilities of organizations, their interest or reluctance to participate in any form of institutional arrangement).
- Develop the right arguments to get other institutions involved; this is a people issue more than an administrative or legal issue.
- Better to start with an existing institution than to build a new one.
- Agree first on a common vision and shared goals before defining specific mandates for and responsibilities of each partner.
- The whole process is based on mutual respect and trust, which need time to mature.
5 Legal Framework

- There already exists a wide range of laws and regulations that apply to water-related activities.
- First assemble and review existing legislation.
- Compare to similar contexts in other countries within a given basin or internationally.
- Recommend how existing legislation can be better adapted.
- Enforcement is key to ensuring that the legal framework provides a dependable means by which to manage conflicts among users.

6 User Participation

- Individuals and organizations with a vested interest in the allocation of basin resources should have their say.
- Determine how people will be affected or will benefit from the projects; gather information from local sources and build a broad-based constituency within the population.
- Well-defined goals and clear implementation processes must be shared in a language people can understand.
- Those most affected by a given project should play the leading role in its planning and implementation.
- They should be involved as early as possible in the planning process; this is an investment in the future success of a project.
- Public consultation is a powerful tool; do not use it if you are not willing to take into account people’s views and to modify the plans accordingly.
- Public consultation is deeply rooted in the cultural context; there is no single best approach to public consultation.
- Whom to consult depends on the issues involved and on the planning process under way.
- Explain your reasons for consulting, and the use to which the results of the consultation process will be put.
- To consult, first share a common informational base, and be willing to listen and facilitate access to information.

7 Conflict Resolution

- There is a long list of problems to be resolved and a limited amount of resources (natural, human, technological, financial): difficult choices have to be made.
- The process of setting priorities is a challenging management task, but an essential one; it must be recognized early on and addressed systematically within the planning process.
- How to identify priorities? Ask a wide range of parties what they consider most important.
- A crude ranking method can be used at first. Draw up a list of issues and ask people to rank them. Then compile the results, assigning different weightings to reflect top and low ranks.
- This simple approach will produce interesting results at a low cost, and participants will recognize the overall selection of priorities as being valid.
- The priority list is only one step in resolving conflicts; a common understanding of the problems, with all parties identifying their particular part in the solution, is the next step.
- Managers have developed solutions to local issues that could be adapted and applied in other parts of a basin. Showing what has worked somewhere else is an effective way to resolve conflicts.
8 Action Plans

- By definition, action plans are multisectoral when applied to river-basin management.
- Goals and objectives need to be clearly presented: they have to be measurable, realistic and easily understood.
- An action plan is made up of a list of projects related to one another in a defined spatial pattern and following a chronological order.
- An action plan has to allow for changes over time and space; it has to be revisited periodically and allow for political, economic or environmental changes.
- It is easier to implement an action plan in phases, using demonstration projects along the way to show tangible results and to test solutions at a more manageable scale.
- Monitoring of actual results is essential; information must be delivered in a timely manner in order for management to evaluate progress.
- Monitoring should include certain effects on the river system, not only on the project components; otherwise, the project may well be detrimental to other uses or natural functions of the system and no one will notice.
- Sharing lessons learned from experience with all partners is part of the adaptative approach required for integrated river-basin management.

9 Conclusion: Key Ingredients for Successful River-Basin Management

**Political will:**
- At the highest possible level
- Clearly expressed and tangible (legal framework, institutional arrangements, budgets)
- Sustained over time, past elected terms of politicians.

**Knowledge:**
- Not science alone, but the proper use of all available sources of information
- Information has to be shared and made easily accessible
- Integration of information is key to sensible decision making
- Information technologies need to be adapted to managers' needs; these are
- Management tools that need to be properly understood to be useful.

**Sustainable Technologies**
- Start small to validate the most appropriate technology
- Learn from the mistakes of others: technology transfer is essential
- Be ready to innovate, as technology dumping may do a lot of damage.

**Institutional Arrangements**
- Water is a responsibility shared by a wide variety of institutions
- Start with existing institutions, but redefine mandates
- Informal arrangements are useful to start with: begin with working groups
- Or task forces to bring people together
- This is a people issue; be mindful of personal expectations.

**Building on Existing Expertise**
- There is a solid capital of existing expertise to build upon
- This capital needs to be put to better use
Integrated River Basin Management; A Reminder of Some Basic Concepts

- Capacity development is the key.

**Community Involvement**
- Takes time to put in place; is a long-term investment
- Once trust is established, it needs to be nurtured over time
- Strong component of any natural resource project

**Economic Prosperity**
- Difficult to manage without any financial support
- More than just direct project funding: a whole range of governmental incentives
- Create the favourable context in which initiatives flourish
- Explore new sources of funding; local partnerships can provide a lot of support

**The Right Timing**
- All of the above do not have to occur simultaneously, but, there does exist a successful combination of these elements that requires some of them to be present, in the right mix and at the right time
1 Background: the Aral Sea Basin, General Summary

Geography

The area of the Aral Sea Basin exceeds 700,000 km$^2$ and is shared by five countries of the former Soviet Union: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Small parts of the Basin are located in Afghanistan, Iran and China (map 1).

Map 1: The Aral Sea Basin

Several transboundary rivers cross the Aral Sea Basin. The main transboundary rivers are the Amu Darya and the Syr Darya, and they play a fundamental role in international relations regarding water resources in Central Asia. These rivers flow into the Aral Sea, but most of their tributaries – the Zeravshan, Kashkadarya, Murgab, Tedjen (Gerirud) rivers (the Amu Darya river), the Sanzar, Kattasay, Aris, Akhangaran and other rivers (the Syr Darya river) – have lost their connection with major rivers. The active tributaries of these rivers are now the Vakhsh, Pyandzh, Surhandarya, Sairam (the Amu Darya river basin), and the Naryn, Karadarya, Soch Chirchik and some other rivers (the Syr Darya river basin).

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1 SIC ICWC
2 Ph.D, GEF Agency IFAS
The region, located between the two major rivers, known as the Oxus and the Jaxsartes in ancient times, has been inhabited since 5500 B.C. This region is the most remote from oceans on the Earth. Archaeological research has shown that extensive irrigation systems were developed as early as 3000 B.C. nearby Khiva, Samarcand and the Fergana Valley in Uzbekistan. These cities became a part of the famous Silk Road between Asia and Europe and were discovered by Chinese General Chang Chen in 138 BC and re-discovered by Marco Polo in the 14th Century.

Demography
The total population of the Aral Sea Basin was about 38.5 million people in 1998, almost 61.8% of which is living in rural areas. About 3.5 million of them live in the disaster Aral Sea coastal area and directly suffer from the lack of potable water, inadequate health facilities, a depressed economy, lack of employment opportunities, and adverse effects of sand and salt storms. During 1993-1997, average annual population growth was 1.5% in the countries of the Aral Sea Basin, ranging from 2.2% in Uzbekistan to 0.4% in Kazakhstan. The previous population growth (1980-1990) reached 2.5-3.2% per year. This decline is caused mainly by the lowered birth rates due to the deteriorating socio-economic conditions prevailing in the countries since their independence from the former Soviet Union. The average population density in the Aral Sea Basin is 24.2 inhabitants per km².

Economy
Traditionally, Central Asian economy was based on stock-breeding, agriculture (particularly cotton production) and fishing in the Aral Sea. Agriculture production has a leading role and provides about 35% of GNP. The water sector therefore plays a significant role in national economies and makes the largest contribution to GNP of the Central Asian States. During the last 30 years (1960-1990), irrigated agriculture and the sectors of economy connected with water management (hydropower production, hydrotechnical construction) contributed more than 50% of GNP.

During the ongoing process of gradual transition to a market-oriented economy, the region is experiencing a decline in production. Macro-economic situation in Central Asian countries is different. During 1990-1994, the GNP decreased by 44.1% in Kazakhstan, 46.2% in the Kyrgyz Republic, 55.6% in Tajikistan, 11.9% in Turkmenistan and 11.4% in Uzbekistan. The decrease of GNP per capita was even more impressive. Differences among states are primarily due to the various degrees of transition to the market economy. Political instability is a key factor influencing Tajik economy. In Kazakhstan and Kyrgyz Republic, shock therapy has led to complications. Turkmenistan and Uzbekistan manifested a much smaller decline, due to a gradual transition to the free market and the tapping of large petrol-chemical reserves.

As a result of the collapse of the regional economy and the disintegration of national markets and suppliers of fertilizers, seeds and spare parts, many agricultural enterprises have been forced to scale down their production. As a result, an increasing amount of domestically consumed food is now grown in private gardens and small plots.

However, the entire Aral Sea Basin is rich in minerals, both ferrous and non-ferrous, as well as oil and gas. It also has significant resources of copper, lead, tin, tungsten, molybdenum, antimony, lithium, gold, silver and iron ore.

Despite of the mineral resources of the region, investments are needed to rehabilitate factories and processing plants. For this purpose extensive infrastructure improvements are required. Meanwhile, all the five Aral Sea Basin States are placing increasing emphasis on agricultural diversification.

More than 80 storage reservoirs were constructed in the Aral Sea Basin, with a capacity of over 10 million m³ each. In order to modify natural river flow patterns to those needed for water
supply, water storage reservoirs were constructed either on rivers (off-stream and river-channel reservoirs) or on main canals (compensation reservoirs). The total capacity of these storage reservoirs exceeds 60 km³, about 44 km³ of which is useable (17 km³ in the Amu Darya river basin and 27 km³ in the Syr Darya river basin).

There are 45 hydropower plants in the Aral Sea Basin with a total capacity of about 34.5 GW, ranging from 50 to 2,700 MW. The biggest hydropower plants are the Nurek plant (in Tajikistan on the Vakhsh river), with a capacity 2,700 MW, and the Toktogul plant (in Kyrgyz Republic on the Narun river), with a capacity 1,200 MW. Hydropower constitutes 27.3% of the average energy consumption in the Aral Sea Basin. The contribution of hydropower to general energy consumption is the biggest in Tajikistan (about 98%) and in the Kyrgyz Republic (about 75%), and lowest in Turkmenistan (about 1%). In the region as a whole hydropower can contribute 71%, which economic feasible potential is estimated as 150 Gwh.

2 River Basin Management: Institutional, Information and Legal issues

Introduction
Water resources have always been limited in the region. Water has therefore become the principal factor for the development of this region and is called “The Liquid Gold”. In the past water management was the responsibility of each village and was administrated by village committees that set strict laws governing water use and controlling access according to the Muslim traditions.

These traditional extensive ways of water management were lost once the Soviet Union took over in the beginning of the 20th century and replaced regional, largely small-scale, sustainable irrigation systems with larger ones, designed to put far more arid land under irrigation. The irrigation systems were expanded considerably.

The fate of the region was sealed in the late 1950s when Soviet central planners decided to turn vast areas of Central Asia into cotton fields. By the late 1970s, the Aral Sea Basin was producing 90 percent of the cotton in the Soviet Union. Expansion of irrigation and cotton production gave major economic benefits but with huge unfavorable social and environmental impacts.

In 1960, the Aral Sea was the fourth largest inland lake in the world. But since then, it has shrunk because of the total cutoff of inflow from the Amu Darya and Syr Darya rivers as a result of extensive water diversion for irrigation. Desiccation of the Aral Sea resulted in the loss of its fishing industry, degradation of the ecosystem of the Sea and its deltas, transportation of salts from the exposed seabed – toxic for humans and deleterious for crops – and a depressed economy of the areas close to the Sea. Inefficient irrigation practices, excessive use of chemicals for growing cotton and rice crops and lack of adequate drainage caused salinity of soils, pollution, and reduced drainage inflows into the rivers and the Sea.

Many international organizations and experts have been working on the Aral Sea crisis for some time and there is no doubt that the Aral Sea is dying. By 1995, the Sea had lost nearly three-quarters of its water volume, its surface area had shrunk from 64,500 km² to 30,000 km², and its surface level had fallen by 19 meters.

Institutional issues
In Soviet times the institutional structure and water management system were strictly centralized and based on the general administration. Water management was headed by the Ministry of Land Reclamation and Water Resources of the USSR (MWR). In direct subordination there were the following institutions: All-Union, inter-republic construction, design, research and specialized organizations, and respective ministries in each republic, which carried out management at the national level and had double subordination - sectoral
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and republican. At the inter-provincial level, Administrations for Large Structures were responsible for water management; they reported directly to the MWR in each republic. At the oblast (provincial) level Oblast water administrations (Oblvodkhoz) were responsible for water management; they provided water allocation and water sector development in the province and reported to the MWR of each republic. At the inter-district level management was carried out by bodies, which reported to the Oblvodkhozes. Moreover, there was the Administration of the Inter-District Canals (AIC), Provincial Administration of Pump Stations (APS), and Provincial Reservoir Administration (PRA). Reclamation services were provided by the Collector-Drainage System Administration (CDSA) and Hydrogeological and Reclamation Expeditions (HGES), which interacted at oblast and district levels with agricultural producers and reported to Oblvodkhozes.

After the collapse of the Soviet Union, the national governments of the five Central Asian States immediately organized joint management (figure 2). The *Interstate Commission for Water Coordination (ICWC)* was established as an executive body by the Central Asian States, responsible for transboundary water resources management. The board of the ICWC consists of the first leaders of water management organizations. The main goal of the ICWC is the approval of principles of collective decision making on water related questions as well as measures to implement jointly approved programs on the basis of mutually respected interests. The main functions of the ICWC are as follows:

- Definition of the common water management policy, development of its main directions with respect to the interests of population and economies of CA States.
- Efficient use of water resources, water conservation, and programs on increasing water availability in the basin.
- Development and observation of annual water consumption limits for each CA state, large storage reservoirs operation regime, water allocation management based on the actual water availability and water-economic situation.
- Working out and executing ecological programs related to the Aral Sea desiccation and water sources depletion, establishing the annual water supply volume in the river deltas and Aral Sea as well as sanitary releases to rivers and canals.
- Development of recommendations for governments on common price policy and compensations for possible losses connected with joint water resources use, as well as the legal base of water use.
- Coordination of implementation of large projects and joint use of existing water potential.
- Creation of a common database on water use, irrigated lands monitoring and common environmental monitoring.
- Coordination of joint research of regional water related issues and master-plans preparation.

For development of ecological programs and improvement of water use within the Syr Darya and Amu Darya basins, ICWC attracts relevant organizations:

- Facilitating development of cooperative links on the introduction of water saving technologies, as well as irrigation methods and techniques providing improvement of the irrigation systems and water use.
- Development of joint programs for awareness of and combating emergency situations and natural disasters.
Within the structure of ICWC there are the following executive and supervision organizations: the Scientific-Information Center (SIC ICWC), two River Basin Authorities (BWO Amu Darya and BWO Syr Darya), and ICWC Secretariat. The Secretariat is a permanently acting working entity of the ICWC. Its tasks are to:

- organize meetings of the ICWC;
- prepare, together with the two BWOs, program measures and projects according to the decisions made at ICWC meetings;
- prepare cost estimates for the BWOs of operation and capital investments;
- accounting and reporting on operation and capital construction; and
- control of BWOs funds for operation, capital construction and other works.

The Basin River Authorities (BWO's) Syr Darya and Amu Darya are executive inter-branch and control bodies of the ICWC and function on the basis of interstate agreements on the Amu Darya and Syr Darya basin. BWOs function in accordance with the relevant laws of the States/ ICWC members, agreements, protocols, and ICWC decisions. The BWOs' main functions are the following:

- Observance of timely guaranteed water supply to water users in accordance with the limits established by the ICWC, for water intake from interstate water sources. Supervision of releases to the deltas and the Aral Sea according to established volumes, as well as operational control of limits observance, interstate reservoirs operation, and water quality.
- Development of plans for water diversion by the main water intakes, reservoirs and cascade operation regime; preparation and coordination with the ICWC of water resources limits for all water consumers in the Amu Darya and Syr Darya basin.
- Creation of an automatic water management system in the Amu Darya and Syr Darya basin, water accounting and measurement organization on the main water intakes, their equipment by means of the necessary devices.
- Performance, together with Hydromet services, of control measurements on border sites using balanced methods of river flow control.
- Reconstruction, operation and maintenance of hydrostructures, head water intakes, inter-republican canals and automatic systems of water resources management.
- Providing water services to consumers by means of scientific researches, design, new water structures construction and reconstruction of existing structures that are under the BWOs' administration.
The Interstate Scientific-Information Center (SIC ICWC), as ICWC executive entity, is in charge of preparing the ICWC's draft decisions on prospective developments, water policy, the perfection of water management and utilization, and the improvement of the ecological situation in the Aral Sea Basin, including the preparation of:

- A water and economic policy, development of its main provisions with respect to the interests of the population and industries of Central Asian States.
- A program for water saving in the region and water consumption increases in the Amu Darya and Syr Darya basin and measures for its implementation.
- Improvements in the ecological situation in the region and mitigation of the consequences of the Aral Sea desiccation.
- A set of measures for improving water measurements and control, and the creation of new effective mechanisms.
- Economic assessment of the water-economic and water protection measures.
- Creation of a common information system on water resources use and water and irrigated lands monitoring.

Besides, SIC ICWC is in charge of the following:

- Preparation of publications and providing the States with information about scientific-technical innovations, know-how, production in CIS countries, etc.
- Organization of a reference library with respect to peculiarities of the economic situation in Central Asia and its development on the basis of a common plan; accumulation of foreign technical literature, etc., including reference-information service and literature exchange.
- Coordination and expertise on all international projects on water related problems and the development of the “Specific Action Program for Improvement of Environmental Stabilization in the Aral Sea Basin”.
- Establishment of joint ventures of regional importance.
- Organization of regional training courses for water sector experts.

The International Fund for Saving the Aral Sea (IFAS) was established by interstate agreements with the purpose of program coordination, accumulation and management of funds, and involving international organizations, donors, ecological and other funds to develop activities in addressing environmental problems. The main principles of IFAS are agreed by the Central Asian Heads of State and are development and implementation of regional and national programs in the Aral Sea Basin. IFAS is financed by the World Bank, UNDP, international organizations, donor countries, grants and charity donations.

**Institutional Management**

In Soviet times the most powerful asset management was created, operated by the federal government with the participation of regional organizations and the general operational, financial, legal and technical framework. This framework includes the most complex engineering buildings with unique dams, hydropower stations, channels, pumping stations, water reservoirs and modern drainage systems. After the collapse of the USSR and creation of the five independent river basin states, the earlier developed principles of water sharing and water management framework were saved, but accompanied with weakening economic basis and financial possibilities, a sharp reduction in efficiency of irrigated husbandry (more than 50% per hectare) and increasing centrifugal efforts, especially by the upstream countries, transforming water into a market product (economic good) like oil, gas and other mineral resources.

Political independence of the countries and economic difficulties result, besides in new governments, in other priorities, and the water factor has suffered from reassessment by the politicians. This has caused a revision of the structure of water management at the national
level – Ministries of Water Resources and its local bodies were liquidated everywhere, except Tajikistan; they were merged with Ministries of Agriculture. Independence of financing of all these elements and financial support of the water sector as a whole were lost. In Soviet time annual capital investments and field-performance costs were subsidized by the government, at least $US220 per hectare, but now these subsidies do not exceed US$15-20 per ha, including O&M of interstate and interbranch organizations. The result is degradation of the main structures and funds and absence of reconstruction, repair and O&M of drainage systems. Another problem is that the staff is becoming older and younger specialists do not come to the sector.

Water Users Associations (WUA) and privatized farms have no facilities for sufficient financial support and efficient own funds. This was also caused by reduction of the world prices for cotton – a main export product in Central Asia – by 40 % in the last 7 years since independence.

Low living standards of rural population can have far-reaching political consequences and can lead to social tension.

Riparian and institutional issues
After the collapse of the former Soviet Union, most state institutions found themselves with no budget, no clear mandates and – most importantly – with no strategies for reorganization and rebirth. Command management, including transboundary water resources management, was simply replaced with centralized control by the newly independent states.

Unprepared for the consequences of independence, Central Asian States encountered many difficulties in trying to create effective management bodies in the vacuum left behind by seven decades of the soviet regime, but it should be mentioned that there were no “misunderstandings” between Central Asian water decision-makers and professionals. They know about future way of cooperation because they have worked all this time very closely.

Legal issues
Water relations needed a new legal basis because the rivers in the region became transboundary. This required a new approach to inter-state negotiations in the sphere of water allocation and water use. Appropriate inter-state agreements and procedures should be developed in accordance with the international law and taking into account local traditions and experience.

Central Asian States responded quickly to the need for a new legal basis for water allocation and management. On September 12, 1991, the water ministries of these countries jointly declared that joint water resources management would be established on the basis of equity and mutual benefit. On February 18, 1992, the five Central Asian countries signed the interstate “Agreement on Water Resources Management in the Aral Sea Basin” to overcome inherited inter-regional water problems and minimize ethnic tensions. According to this agreement, water allocation should be based on existing uses of water resources and the two river basin authorities should continue to perform basin management under the control of the ICWC. All water resources of the region (surface, underground, drainage) are divided into transboundary (interstate) ones, situated on the territories of two or more states, and national ones, situated on the territory of one country and not bound up with transboundary waters.

Each state has the right to manage on its territory its own national resources and part of the transboundary water within the limits agreed with other countries and without causing damage to them. The Aral Sea and its deltas have been defined as an independent water consumer and have its own water limit. Transboundary water is the object of common ownership of the states and their development, protection and usage should be carried out on
the basis of interstate agreements by the inter-regional bodies according to the national requests and regional interests.

The Heads of Central Asian States deiced that the 1992 agreement should remain in force until a Regional Water Resources Management Strategy is formulated. Alternative criteria that might be adopted for water allocation between the riparian countries will be reviewed and evaluated in the light of international practice and experience, and recognizing that social, economic, and environmental issues need to be considered. These alternatives could include, but may not be limited to, the following clauses of the "Helsinki Rules" and the draft of the "Law on the Uses of International Waters for Non-Navigation Purposes":

a) The principle of "prior rights", including (i) historical allocation and actual use before and after 1960 (when the environmental impacts of water resources development can be said to have started); (ii) historical allocation before and after the signing the 1992 agreement; and (iii) any other considerations that may have a bearing on prior rights.

b) The principle of "equitable rights", including the adoption of (i) specific water consumption indicators and standards (e.g. water use per hectare, per unit of output, per capita etc.); (ii) measures of efficiency in water use and disposal; (iii) measures of maximum economic and/or environmental impact; (iv) measures for minimizing and/or equalizing risk; and (v) measures related to equalizing socio-economic opportunities and conditions in differing areas, zones and countries in the basin.

c) The principle "no significant harm", including the adoption of: (i) specific water quality indicators and standards (e.g. relating to salinity, pollution etc.); (ii) measures relating to equal responsibility for the sustainable conservation and preservation of the ecosystems of the basin; and (iii) measures relating to the use of water for different economic purposes, including drinking water, industry, fishing and irrigation.

3 Improvement of institutional management

The transition to a market-oriented economy clearly highlighted all disadvantages of the former and current institutional structure of the national systems in the water sector and irrigated agriculture.

Restructuring the Water Sector and Irrigated Agriculture

- The water sector in its present form represents the interests of agriculture only, not of all sectors.
- The national organization of agriculture must be changed in order to represent equally the interests of irrigation and hydropower (particularly), keep priorities of water supply, water storage, etc.
- The administrative principle in the water sector and irrigation creates certain local pressure by provincial and district administrations on the principle of equal water supply for all water consumers.
- Beginning from the initiation of water management and irrigation projects till their implementation, at all the levels of hierarchy all decisions were made only upon approval of state agencies without participation of current and future water users. As a result, there is very often a situation where the costs of irrigation systems and water structures, the responsibility for which is transferred (in full or partially) to the water users, cannot be covered through their activities. Such a situation is observed both in salinized lands and large irrigation systems of water lift, where the costs of drainage maintenance and water lift can not be covered by the income from irrigated agriculture.
- The policy towards maximum transfer of irrigation network O&M costs to water users will cause a breach of the maintenance system and simultaneously complicate the solution
of issues related to the development, rehabilitation and upgrading of irrigation systems. The operation period of the previously technically most advanced systems (coated canals, flumes, subsurface and vertical drains) has expired. However, the issue of their renovation under current conditions lies between water users, who do not feel themselves responsible for this, and state agencies, which do not solve the issue either, pleading a lack of finances.

- Nevertheless, in legislative and financial respects, the issue of the distribution of responsibilities between the water users and the state budget in all the countries is vague and unclear – here prevails the aspiration of increasing the financial burden on the government, neglecting the fact that the decrease in irrigation system efficiency and water saving can cause irrigated agriculture productivity losses, great reduction of combined effects of agricultural product processors as well as social losses, which fraught with big shock for the states from the view of decrease of national income and tax return and even possibility of social burst.
- We will not repeat the disadvantages connected with water manageability of losses at former on-farm and presently inter-farm level. However, as a whole this reduces sharply the cost effectiveness of the state for water resources, due to the growth of unproductive losses.

Main Directions of Prospective Changes in Institutional Water Management Structure

Naturally, it is impossible to foresee and develop general directions for future improvement in water management and irrigation in all the countries of the region. First, this way will be different enough, depending on the implementation of market reforms, government policy in the water and agricultural sector, degree of democratization, geographic location and economic priorities and potentials. However, certain desirable common directions of the reforms can be outlined. According to national reports these are the following:

- Rehabilitation of common public management of water resources formation, development and conservation at country level, which will implement government policy both in the interests of irrigation and the whole society.
- Transition to water management at the local level, for the integrated system established on the basin (hydrographic diversion) principle, with equal involvement of interested state and local agencies and representatives of all water users.
- As a result of the above: transition from a district hierarchy to a system one, according to the modification and structure of irrigation systems closely connected with the basin (hydrographic) management bodies.
- Establishment of water users associations with gradual increase of their involvement in maintenance, management and reconstruction of irrigation network upon growth of farms’ profitability.
- Organization of contract service for repair and reconstruction of irrigation and drainage systems.
- Organization of extension and innovation service in irrigated agriculture.
THE PORTUGUESE-SPANISH CONVENTION ON SHARED RIVER BASINS

António Gonçalves Henriques

Summary

The Convention on Co-operation for the Protection and Sustainable Use of the Waters of the Portuguese-Spanish River Basins, signed by the Portuguese and Spanish Governments at the Albufeira Summit on 30th November 1998, represents a landmark in Portuguese-Spanish relations over the waters of their shared river basins, within the context of friendship and neighbourliness between the peoples of the two countries. The Convention establishes a framework for co-operation on the protection of the waters of shared hydrographic basins and their aquatic and associated terrestrial ecosystems, and for mutual assistance in the extreme situations of flood, drought and accidental pollution incidents, while respecting each State's sovereignty, particularly in mutually recognising the right of each Party to the sustainable use within its own territory of the waters of these river basins. The regime established by the Convention is founded on relevant international law, in particular on the ECE Helsinki and Espoo Conventions, and on European law on water, notably the EU Water Framework Directive, which is in its final stages for adoption by EU institutions. The Convention should not, therefore, be interpreted in isolation; rather, it needs to be considered within the framework of the regime established, especially in those standard-setting documents.

1 Introduction

The Convention on Co-operation for the Protection and Sustainable Use of the Waters of the Portuguese-Spanish River Basins, signed by the Portuguese and Spanish Governments at the Albufeira Summit on 30th November 1998, represents a historic step in the Portuguese-Spanish relations on the waters of shared river basins, in the context of the spirit of friendship and good neighbourliness which unites the peoples of the two countries. It is also a landmark in the application of the principles established in EU and international law with respect to transboundary waters.

The Convention is not simply a contract-agreement between the Parties for apportioning the waters of shared river basins, like the 1964 and 1968 Conventions signed between Portugal and Spain for partitioning the hydro-electric potential of the border river stretches. The Convention establishes, above all, a framework for co-operation on the protection of the waters of shared river basins and their aquatic and associated terrestrial ecosystems, and for mutual assistance in the extreme situations of floods, droughts and accidental pollution incidents, while respecting the sovereignty of each of the neighbour States, both of them members of the European Union, and mutually recognising the right of each Party to the sustainable use of the waters of these river basins within its own territory.

Unlike an ordinary contract, which expires once its material objective is achieved, a framework for co-operation instituted by the Convention establishes the basis for a lasting relationship between the Parties, particularly in the following areas:

- Systematic exchange of information about the condition of the waters of the shared river basins, particularly about flows, volumes stored in reservoirs, volumes stored in aquifers,
water usage, abstractions and diversions of water, discharges of waste water, quality of the waters and of aquatic and associated terrestrial ecosystems, and about plans and projects for new water installations and programmes of measures to improve and protect water quality.

- Co-ordination of water management, particularly in the extreme hydrological situations of floods, droughts and accidental pollution incidents.
- Evaluation of the transboundary impacts of new projects in the shared river basins prior to their approval, evaluation of the transboundary impact of plans and programmes (strategic evaluation of transboundary impact) and *a posteriori* evaluation of the transboundary effects of projects and activities.
- Preparation of joint studies on transboundary waters, examples of which include the studies on the Environmental Condition of the Guadiana Estuary, the Programme to improve and control the water quality of the Guadiana river basin, and the Safeguarding of the Environmental Conditions of the International Stretch of the River Minho, already under way.
- Co-ordinated participation in European and international programmes of joint interest.

The regulatory arrangements adopted in the Convention are based on the recent international law on water and on the EU law, by which both States are bound. In form, the Convention represents the application and *fleshing-out* of applicable international and Community law, in its pursuit of the objectives of the protection and sustainable use of the waters of shared river basins.

2 International Law

The framework of international law on which the Portuguese-Spanish Convention is based comprises, essentially, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, signed in Helsinki in March 1992 (the Helsinki Convention) and the Convention on Environmental Impact Assessment in a Transboundary Context, signed in Espoo in February 1991 (the Espoo Convention), both agreed under the auspices of the United Nations Economic Commission for Europe, which came into force in 1997 and 1998 respectively. The Helsinki Convention has already been ratified by Portugal, but not by Spain, while the Espoo Convention has been ratified by Spain, but not yet by Portugal.

The Helsinki Convention aims to ensure that the national water policies of signatory States *safeguard* the protection and ecologically balanced management of transboundary surface and groundwaters. It imposes an obligation on signatory States to implement measures for the prevention, control and reduction of water-borne pollution resulting from both point and non-point sources. In addition, it establishes standards for monitoring, research and development, warning and alert systems, mutual assistance in critical situations, the exchange and protection of information, access to information, and procedures for dispute resolution.

The Espoo Convention imposes an obligation on signatory States to evaluate the transboundary environmental impact of certain activities before they are authorised or begun. It also obliges signatory States to notify and consult one another about projects that are liable to cause significant adverse transboundary environmental impacts, and establishes procedures

2 The United Nations Convention on the Law on the Navigational Uses of International Watercourses, signed 1997, is not yet in force and is in any case not recognised by Spain, which abstained in the voting. For this reason, it is only a reference document in the Portuguese-Spanish Convention.

3 The complete text of the Helsinki Convention can be found at [http://www.unece.org/env/water.htm](http://www.unece.org/env/water.htm)

4 The complete text of the Espoo Convention can be found at [http://www.unece.org/env/eia.htm](http://www.unece.org/env/eia.htm)
for evaluating the transboundary environmental impact of plans and programmes, and for the
\textit{a posteriori} analysis of transboundary environmental impacts, and dispute resolution
procedures.

Rather than merely incorporating the law created by the Helsinki and Espoo Conventions,
the Portuguese-Spanish Convention develops this law within the framework of Portuguese-
Spanish bilateral relations, taking account of the geographical, economic and administrative
factors that influence the waters of the shared river basins.

3 EU Water Framework Directive

In parallel with the drafting of the Convention, work has been proceeding on preparation of
the European Union's Water Framework Directive, which is now awaiting consideration by
the European Parliament. The Directive, in the preparation of which Portugal and Spain have
been actively involved on many the issues related to the protection and sustainable use of
waters in the particular geographical and climatic conditions of the Iberian Peninsula (which
are very different from those of other European regions) institutes a thorough revision and
updating of Community law on water, which is currently scattered, fragmented and
inconsistent.

The body of EU law on water, by which Portugal and Spain are bound as members of the
European Union, is complex and scattered among a large number of Directives adopted since
the mid-1970s, as shown in Table 1. Many of these Directives set emission limit values for
waste water discharges and water quality standards, which are uniform, regardless of the
natural conditions of different regions of the European Union, a fact which naturally makes
application in some difficult. Most of these Directives call for the preparation and
implementation of programmes of measures aimed at reducing, and in some cases,
eliminating pollution in order to meet the standards set for water quality.

The purpose of the Water Framework Directive is to establish a framework in order to
achieve the following main objectives of sustainable Water policy:
- sufficient provision of drinking water
- sufficient provision of water for other socio-economic activities
- protection of the environment
- alleviation of adverse impacts of floods and droughts

The Water Framework Directive basically addresses the following matters:
- Bringing together and updating all the Community legislation on water in a consistent
  manner, leading to the repeal of several of the Directives currently in force.
- Co-ordinating the water quality standards for different sectors (waters for drinking water
  abstraction, bathing water, fish water, shellfish water, special habitats) and plugging
  existing loopholes
- Co-ordinating the various programmes of measures, in order to meet sectoral water
  quality standards, and establishing the necessary links between emission limit values for
  discharges and water quality standards.
- Encouraging the public to participate in water policy, so as to achieve greater openness
  and facilitate the implementation of those policies.
Table 1: European Directives on Water

According to the Water Framework Directive, the geographical units for co-ordinating water management measures are river basins and not regions defined by administrative or political boundaries. Initiatives taken by the riparian States of the rivers Meuse, Scheldt, Rhine and Danube (to quote only the European cases) have demonstrated many positive examples of both the joint establishment of water quality standards for these river basins and the co-ordination of measures for the protection of these waters, regardless of each State’s frontiers. The Water Framework Directive provides for the drafting of joint management plans on a river basin basis or, where that is not possible, the co-ordination of the management plans drawn up by each riparian State for that part of the hydrographic basin situated on its territory.

In compliance with Article 174, paragraph 2 of the European Union Treaty (the Amsterdam Treaty)\(^5\) – “The objective of the Community’s policy on the environment shall be to achieve a high level of protection, while taking account of the diversity of situations that exist in the different regions of the Community” –, the Water Framework Directive sets, as a general objective, the attainment of the good status of all inland surface waters and groundwater and coastal waters, interpreted as:

- good ecological status (for surface waters)
- good quantitative status (for groundwater)
- good chemical status (for all waters)

Good ecological status is defined in terms of hydro-morphological, and chemical characteristics and of the biologic conditions of different water types, similar to the condition corresponding to a small deviation from the conditions which would be observed in a situation of minimal anthropogenic impact. In contrast to the Directives currently in force,
good ecological status is not standardised for all waters in the Community; on the contrary, taking into account the diversity of bio-geographical conditions in different regions of the European Union, good ecological status is defined in terms of standards based on morphological, hydrological and chemical characteristics and the biotic communities of different water types expected in a situation of minimal anthropogenic impact. For certain types of waters, such as reservoirs, which have no parallel with natural water bodies, and as such are designated as artificial or heavily modified water bodies, the objective is defined as good ecological potential.

The good quantitative condition of groundwater is defined in terms of the hydrological balance in aquifer systems. In order to maintain the good quantitative status, part of the recharge volume of aquifer systems must be reserved for meeting the water requirements both of aquatic ecosystems (of the water bodies which are fed by those aquifer systems), so as to maintain those waters in good ecological status; and the ecosystems of associated wet zones. Only the volume of recharge in excess of that may be extracted from the aquifer, so that the use of groundwater is sustainable.

Chemical quality status is defined in accordance with EU legislation relating to the reduction, and for some substances, the elimination of pollution of the aquatic environment caused by hazardous substances. For surface waters, the Water Framework Directive establishes mechanisms both for reviewing emission limit values and water quality standards in respect of currently regulated hazardous substances, and for setting new emission limit values and water quality standards for additional hazardous substances selected according to priority criteria, which are also defined. A mechanism involving a combined approach is established, requiring emission limit values and water quality standards to be met jointly, thereby correcting some inconsistencies in Community regulations.

For groundwater, in addition to the standards defined in EU Directive for certain substances (nitrates, pesticides and biocides), all discharges are prohibited and there is an obligation of groundwater monitoring, in order to substantiate the need to take measures to reverse any rising trend in pollution from non-point sources. The aim here is to ensure the protection of groundwater from any kind of contamination, in accordance with the principle of minimal anthropogenic impact.

In addition to these general objectives, specific objectives are defined for certain types of surface waters. This is the case with waters designated for the production of drinking water, waters designated as bathing waters, and waters that constitute ecosystems that are special, unique or of particular conservation value. Additional quality standards have to be set for these waters in order to safeguard their uses and protect nature.

The main innovative aspect, therefore, of the Water Framework Directive lies in establishing a framework for integrated water management, which is demanding in its objectives and matched to the specific situations of different regions of the European Union.

In order to achieve these objectives within a defined timescale, programmes of measures must be implemented, including structural measures (for example, waste water treatment plants or reclamation works on river stretches) and non-structural measures (for example, the use of best available technologies for reducing pollution by point sources, best environmental practices for reducing pollution by non-point sources, regulatory measures, administrative measures, and financial and fiscal measures). The Water Framework Directive sets as a general rule a timescale of 16 years for achieving these objectives. It is expected, however, that in special, properly justified situations, this timescale may be extended by up to three periods of six years.
The programs of measures must be established in a consistent and integrated form, within a management plan for each river basin, covering all types of waters. The management plan defines the objectives for each water type and specifies the programmes of measures which must be adopted to achieve those objectives. Obviously, in the case of river basins shared by two or more Member States, as is the case with the rivers Minho, Lima, Douro, Tejo (Tagus) and Guadiana, the water quality objectives set by each Member State for the part of the river basin situated on its territory and the programmes of measures must be consistent between States in order to achieve those objectives.

4 Implementation of the Portuguese-Spanish Convention

The Convention on Co-operation for the Protection and Sustainable Use of the Waters of the Portuguese-Spanish River Basins develops and applies the regime established in the Water Framework Directive and the Helsinki and Espoo Conventions to the hydrographic basins shared by Portugal and Spain (Minho, Lima, Douro, Tejo (Tagus) and Guadiana, see map 1).

![Portuguese-Spanish River Basins](image)

**Figure 1:** Portuguese-Spanish River Basins

The Convention comprises, in addition to the main body, an Additional Protocol on the Flow Regimes, two Annexes and an Annex to the Additional Protocol. The main body of the Convention consists of a Preamble and 35 Articles, grouped into six parts: Part I (Articles 1 to 4), *General Provisions*, sets out the definitions, purpose and objectives of the Convention and the forms of co-operation; Part II (Articles 5 to 12), *Co-operation between the Parties*, details the various areas of co-operation, including exchange of information, information to the

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6 Small hydrographic basins may be grouped into a single hydrographic region, or combined with a larger neighbouring hydrographic basin.
The Portuguese-Spanish Convention on Shared River Basins

public, consultation mechanisms on transboundary impacts, evaluation of transboundary impacts, and other areas of co-operation; Part III (Articles 13 to 16), Protection and Sustainable Use, specifies the co-operation measures for normal situations - measures for ensuring water quality, for preventing and controlling pollution, for the sustainable uses of water and the flow regime; Part IV (Articles 17 to 19), Exceptional Situations, defines the co-operation measures for pollution accidents and the extreme hydrological situations of floods and droughts; Part V (Articles 20 to 23), Institutional Provisions, defines the bodies which will implement and develop the co-operation activities, together with their structure, duties and powers; Part VI (Articles 24 to 35), Final Provisions, deals with a variety of issues, particularly mechanisms for the resolution of disputes, the regime of the preceding Conventions (of 1964 and 1968), and the validity and abrogation of the Convention.

The Additional Protocol to the Convention and its Annex develop the flow regime set out in Article 16 of the Convention, and define the provisional flow regime. Annex I develops the issues relating to the exchange of information set out in Article 5, and Annex II develops the regime for the evaluation of transboundary impacts referred to in Article 9.

There would be no point - because it would be superfluous - in repeating in the Convention the regime established under EU law (since both States are bound by it and it is incorporated into their respective domestic legislation), or the regime instituted by the Helsinki and Espoo Conventions, which, once ratified, will become part of the domestic legislation of both States (in Portugal by virtue of Article 8, paragraph 2 of the Constitution of the Portuguese Republic, while there is similar provision in the Constitution of the Kingdom of Spain). The purpose of the Convention is to develop and put this body of law into practice. Thus, the Convention should not be viewed in isolation, outside the framework of international law accepted by both Parties and EU law.

The Preamble to the main text of the Convention presents the principal aspects of co-operation, which are later developed in a group of Articles. The following deserve to be emphasised:

- The balance between protection of waters and aquatic and dependent terrestrial ecosystems on the one hand, and the uses of water resources on the other, which constitute the two terms of the policy of sustainable development
- The joint prevention of risks that could affect the waters of the Portuguese-Spanish river basins, together with the risks that could result from them
- The co-ordination of measures to improve knowledge and management of the waters of the Portuguese-Spanish river basins

The key concept in the Convention in relation to co-operation on the management of the waters of the shared river basins is co-ordination of the management exercised by each State within its own territory on a basis of mutual respect for sovereignty, not shared or co-management of water. Thus, the independent management of the development and use of water by each State within its own territory is co-ordinated via the mechanisms laid down in the Convention to promote and protect the good status of the waters of the shared river basins - which results naturally from the principle of the efficiency of water management measures promoted by each State -, and is restricted in all situations which would cause or might cause, transboundary impacts - which results from the principle of good relations between neighbouring peoples. This key concept matches perfectly with the provisions of the Water Framework Directive and with the Helsinki and Espoo Conventions.

The geographical scope - the shared river basins of the rivers Minho, Lima, Douro, Tejo (Tagus) and Guadiana; the term "river basin", as defined in the Convention (Article 1, para. 1, sub-para. b), embracing inland surface and groundwater and transitional waters, including estuarine waters -, is identical to a "river basin district" according to the Water Framework Directive for (Article 2, para. 15), which in turn corresponds to the definition in the United

Protection of *coastal and marine waters* is also provided for in the Convention, particularly the duty to prevent, eliminate, mitigate and control land-based pollution of these waters, in accordance with Article 14, para. 2 of the Convention, which is consistent with the provisions in the Water Framework Directive, namely Article 1.

The terms "transboundary waters" and "transboundary impact", as defined in the Convention (Article 1, para. 1, sub-para. c and d, respectively), and which are not used in the Water Framework Directive although they are instrumental in the application of its regime, are identical to the terms used in the Helsinki Convention (Article 1, paras. 1 and 2) and are consistent with the definitions in the Espoo Convention (Article 1, para. viii).

The central objective laid down in the Convention - the promotion and protection of the "good status of waters" - is interpreted, according to Article 1, para. 2 of the Convention, in accordance with the provisions of the Water Framework Directive, namely Article 1 and Article 4, para. 1.

For international river basins covering the territory of two or more Member States of the European Union, the Water Framework Directive lays down, in Article 3, para. 3, the forms of co-operation between the Member States concerned, which comprise the co-ordination of programmes of measures to achieve the objectives of promoting and protecting the "good status of waters" set out in Article 4. This form of co-operation is set out in Article 4, para. 1, of the Convention and further developed in para. 2 of the same Article, and throughout Parts II and III. In practice, co-ordination is to be conducted via a co-operative mechanism that establishes:

a. The regular and systematic exchange of information;
b. The provision of information to the public;
c. The carrying-out of consultations exercises and other activities by the bodies established under the Convention (to which reference is made below); and
d. The adoption of technical, legal, administrative and other measures in applying and developing the Convention.

The regular and systematic exchange of information is described in Articles 5 and 7 of the Convention and in Annex 1, which applies and develops the provisions of Article 15 of the Water Framework Directive and Article 6 of the Helsinki Convention.

The provision of information to the public, the subject of Article 6 of the Convention, applies and develops the provisions of Article 14 of the Water Framework Directive and Article 16 of the Helsinki Convention.

The arrangements for consultation and for evaluation of transboundary impacts, set out in Articles 8 and 9 of the Convention, apply and develop the provisions of Directive 85/337/EEC, as amended by Directive 97/11/EC (environmental impact assessment; arrangements which are also reflected in the Water Framework Directive), and Articles 3 to 6 of the Espoo Convention (whose regime is also reflected in Directive 97/11/EC). Further, it should be emphasised that the provisions of Article 9, para. 1, on the evaluation of the transboundary impact of plans and programmes (strategic evaluation of transboundary impacts), goes beyond the evaluation of the transboundary impact of projects and works provided for in Directive 97/11/EC, and anticipates the application of the Draft Directive to Strategic Environmental Impact Assessment, which is still under discussion by European Union institutions. It is also worth noting the provisions of Article 9, para. 4 on the monitoring of the transboundary effects of projects and activities following their implementation – *a posteriori* assessment of environmental impact – along the lines of the provisions of Article 7 and Annex V of the Espoo Convention.
The implementation of measures to achieve good status of waters, prevent water degradation and control pollution, and ensure the sustainable uses of water resources of the Portuguese-Spanish river basins, provided for in Article 10 of the Convention, develops the provisions in Article 11 of the Water Framework Directive (reflecting in turn the provisions of Articles 7, 9, 10 and 16) and the provisions of Articles 3 and 9 of the Helsinki Convention. In particular:

- The co-ordination of river basin management plans and programmes of measures, laid down in Article 10, para. 2, of the Convention, implements the provisions of Article 3, para. 3, and Article 16, para. 1, of the Water Framework Directive.
- The application of the principle of non-regression in the level of protection of the status of transboundary waters, and the conditions for derogation from this principle, provided for in Article 10, para. 3, of the Convention, need to be interpreted in terms of Article 13, para. 2, of the Water Framework Directive, paras. 5, 6 and 7 of which set out the conditions for derogation.
- The provision of information to the European Commission, to which Article 10, para. 4, of the Convention refers, implements the provisions of Article 12 of the Water Framework Directive.

The establishment of communication, emergency and warning systems to prevent, eliminate, mitigate or control the effects of floods, droughts and accidental pollution, and of infra-structure safety programmes are the subject of Articles II and 12 of the Convention, applying and developing the provisions of Article 3, para. I, sub-para, j, and Article 14 of the Helsinki Convention.

The arrangements for water quality protection and pollution prevention and control are set out, in Articles 13 and 14 of the Convention respectively, as follows:

- The objectives and standards for water quality referred to in Article 13, para. 1, are the same as those set out in Article 4, para. 1, of the Water Framework Directive.
- The inventorying, evaluation and classification of transboundary waters and others susceptible to reciprocal alteration, to which Article 13, para. 1, of the Convention refers, implements the provisions of Articles 5, 6 and 7 of the Water Framework Directive for such waters, as the basis for the co-ordinated implementation of management plans and programmes of measures by both Parties.
- The implementation of river basin management plans and programmes of measures to prevent the degradation of the status of surface waters and improve their quality in order to achieve good status or, in the case of artificial or heavily modified water bodies, to achieve good ecological potential, to which Article 13, para. 2, of the Convention refers, implements the provisions of Article 11 of the Water Framework Directive, so as to achieve the objectives set out in Article 4, para. 1, a).
- Similarly, the implementation of river basin management plans and programmes of measures to prevent the degradation of the status of groundwater and improve its quality in order to ensure its good condition, to which Article 13, para. 2, sub-para. b, of the Convention refers, implements the provisions of Article 11 of the Water Framework Directive, in particular para. 3, sub-para. g, so as to achieve the objectives set out in Article 4, para. 1, b).
- The protection of areas with special protection status (waters for the abstraction of drinking water, fish waters, shellfish waters, bathing waters, vulnerable areas so designated in accordance with the Directive on nitrates – 91/676/EEC –; sensitive areas so designated in accordance with the Directive on urban wastewaters – 91/271/EEC –; and protected areas so designated in accordance with the Directive on habitats – 92/43/EEC – and with the Directive on birds – 79/409/EEC), laid down in Articles 6, 7 and Annex IV of the Water Framework Directive, making reference to the relevant Directives, is covered
by Article 13, para.2, c) of the Convention, which implements the provisions of Article 11 of the Water Framework Directive for such areas.

- The conditions under which the defined objectives for water quality and their respective timescales must be achieved, referred to in Article 13, para. 3 of the Convention, implement the provisions of Article 4 of the Water Framework Directive 7.

- Pollution prevention and control, referred to in Article 14, para. 1, of the Convention, implements the provisions of Article 10 of the Water Framework Directive and Article 3 of the Helsinki Convention.

- The protection of marine, and estuarine and coastal, waters is set out in Article 14, para. 2, of the Convention, which implements the provisions of Article 11, para. 6, of the Water Framework Directive with respect to marine waters.

Articles 15, 16 and 19 of the Convention set out, jointly with the Additional Protocol, the regime for the use of water and flows, both under normal conditions and in situations of drought and scarcity. Article 15 provides for:

- Mutual recognition of the right of both Parties to the sustainable use of the water resources of the shared river basins within their own territory (which is provided for in the Water Framework Directive, in Article 4, para.6).

- The duty of each Party to protect transboundary waters through the implementation, within its own territory, of measures designed to prevent, eliminate, mitigate and control transboundary impacts (which accords with Article 3°, para. 3a, of the Water Framework Directive, which also envisages that the European Commission might act as mediator for such implementing measures).

- The recognition that the sustainable use of water resources should be effected, as a rule, on the basis of river basins, with exceptions governed by the Convention (referring to inter-basin water transfers).

- The duty of each Party to implement conservation and economy measures in the development of the uses of water resources (which presupposes, in particular, the economic analysis of water uses provided for in Article 5 of the Water Framework Directive, and the progressive application of the principle of cost recovery of water services, provided for in Article 9 of the Water Framework Directive).

- The exchange of information about new uses of the water of shared river basins which are liable to modify their hydrological regime.

Article 16 of the Convention refers to the flow regime under normal conditions and provides that this shall be instituted in such a way as to:

- ensure good water status (complying with the objectives established in Article 4 of the Water Framework Directive);

- guarantee current and foreseeable water uses;

- comply with the regime instituted by the 1964 and 1968 Conventions.

In accordance with paras. 3 and 4 of Article 16, each Party must ensure that the management of water infrastructures and water abstractions (including, obviously, inter-basin water transfers) comply with the established flow regime.

Special measures apply in the exceptional conditions of drought and scarcity, in order to prevent and mitigate the effects of such situations, which are defined in Article 19 of the Convention, together with the conditions under which a drought situation is to be declared, which is also provided for in the Water Framework Directive, namely in Article 4, para. 5.

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7 These timescales and the conditions for derogation constitute one of the main areas of divergence with the European Parliament, and are still undefined in the Water Framework Directive, with the result that it is pointless to define them in any other form in the Convention.
Articles 2 to 5 of the Additional Protocol provisionally define the minimum rules for establishing the flow regime, until the detailed studies referred to in Articles 16 and 19, and which are to be carried out in accordance with Article 1, para. 1, of the Additional Protocol, are concluded and the flows regime due to come into force, in compliance with the other conditions in the Convention.

The measures to prevent pollution accidents referred to in Article 17 of the Convention implement the provisions of Article 3, para. 1, sub- paras. j and l, and Article 14 of the Helsinki Convention.

Where protection against and mitigation of the effects of flooding are concerned, Article 18 of the Convention institutes and strengthens the regime which has been applied in recent years by Portugal and Spain, emphasising the experience of co-operation over the floods in the Tejo (Tagus) river basin from which Portugal has particularly benefited. This experience, however, needs to be widened. In so doing, Article 18 also implements the regime established by Articles 14 and 15 of the Helsinki Convention. The Water Framework Directive does not address this subject.

Co-operation in drought situations is formalised and strengthened in Article 19, which also reflects the recent experience of co-operation between Portugal and Spain and incorporates the provisions of Article 13, para. 5, of the Water Framework Directive and Articles 14 and 15 of the Helsinki Convention.

The Convention’s institutional arrangements are set out in Articles 20 to 23. From what has been said, it can be concluded that the co-operation arrangements between the Parties need to be developed and applied assiduously and permanently. To achieve this, a “Commission for the Implementation and Development of the Convention” is created, which is in essence the working body which will be responsible for carrying out studies; collecting, processing, exchanging and managing information; recognising the occurrence of conditions that trigger exceptional regimes (floods or droughts); implementing the technical and administrative procedures for co-operation under both normal and exceptional conditions, and developing those procedures, in particular through the preparation of additional regulatory instruments and proposals for amendments to the Convention. The Commission may also discharge the functions of the body responsible for the co-ordination of programmes of measures for promoting and protecting the good status of water envisaged in Article 3, paras. 3 and 3a of the Water Framework Directive. So, rather than being merely a body charged with interpreting the application of the Convention and resolving disputes, like the Commission on International Rivers set up under the 1968 Convention, the Commission for the Implementation and Development of the Convention created by Article 20 of the Convention, with the structure, duties and powers as defined in Article 22 and modus operandi as defined in Article 23, is first and foremost a working body with a set of clearly defined responsibilities, which need to be carried out in perpetuity by its own specialised technical team. These responsibilities have to be regulated by the Commission itself, as is stated in Article 23, para. 6.

Political issues arising from the application and development of the Convention are to be remitted to a different body at a higher level, the “Conference of Parties”, also created by Article 20, with very wide powers and presided over by a Minister from each of the Parties, in accordance with Article 21.

Part VI of the Convention defines and develops a whole set of further issues necessary to the application of the Convention, particularly the mechanisms for resolving disputes (Article 26, along the lines of Article 22 and Annex IV of the Helsinki Convention, and Article 15 and Appendix VII of the Espoo Convention), the regime instituted by the 1964 and 1968 Conventions, whose provisions remain in force where they do not conflict with those of the Convention (Articles 27 and 28), the mechanisms for tabling and adopting amendments to the

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5 Conclusions

The Convention on Co-operation for the Protection and Sustainable Use of the Waters of the Portuguese-Spanish River Basins creates the basic framework required for co-operation between Portugal and Spain in managing the waters of their shared river basins. This basic framework is founded on international law accepted by both countries, and on relevant Community law. In particular, as has been demonstrated, the Convention implements and develops the provisions of the EU Water Framework Directive, which is still in the last stages of security by Community institutions. Thus, the Convention should not be read in isolation, outside the context of international and relevant EU law.

Taking into account the scope of the objectives for co-operation and the specific nature of the particular issues which this co-operation involves, the regime instituted by the Convention needs to be further developed and progressively adjusted in the light of experience. The Commission for the Implementation and Development of the Convention will therefore assume a crucial role in the implementation and development of that regime.
A RIVER BASIN MANAGEMENT MODEL FOR SRI LANKA -
POTENTIAL IN MAHAWELI RIVER BASIN

Ariyaratna Hewage

1 Introduction

Sri Lanka is an island situated in the Indian Ocean with a total land area is 65,525 km² and 103 recognized river basins. It is a country with a long history of hydraulic civilization developed in the river basins. Early settlers around the 5th Century BC began developing their irrigated agriculture in several river basins in the Country. Some of the major rivers used by them are: Malwathu, Mahaweli, Deduru, Kelani, Kalu, Walawe, Kirindi, Menik and Kumbukkan. It is ironical that many of these rivers originate in the Central highlands and flow towards plateaus in the other parts of the Country providing opportunities for irrigated agriculture. Several rivers had been diverted and large reservoirs have been constructed to store water with inter-linkages joining large and small reservoirs into an efficient network.

An eminent historian, R.L. Brohier, who wrote extensively on ancient irrigation thus said: “Several authorities aver that in Pre-Christian times Ceylon had attained the idea of controlling the waters of streams formed by Nature, to satisfy the ample needs of the unfertile regions through which they passed. Extensive works of irrigation, secured with an immense amount of labor, skill and science, had transformed arid plains into areas of plentiful prosperity at a period when agriculture in Europe was in the rudest and most primitive state.” (Brohier 1934). The water was managed not only for agriculture, but also for domestic purposes, for wildlife etc., thereby developing rich eco-systems in the Country.

Water, land and other natural resources have to be shared by the population in any Country for their living. Interestingly, the population of Sri Lanka, which was 3.566 million at the turn of the 20th century, has reached to 18.9 million today. It is projected to increase to 23.1 million in the year 2025.

A study conducted by the International Water Management Institute (IWME) has revealed that there will be wide temporal and spatial variations of available water resources in Sri Lanka. However, Sri Lanka as a whole will not face serious water scarcity in future. According to Amarasinghe et al., “demand projections for 2025 show that the dry zone will again account for more that 90 percent of the total water withdrawals. With an increased irrigation efficiency scenario, the total withdrawal demand in the country (and especially in the dry zone) can be reduced by almost half. According to most scarcity criteria, the national statistics indeed show no serious present or future water scarcity. However, a different picture emerges at the district level. Five districts (25% of the total land area) in the Maha season, and nine districts (43% of the total land area) in the Yala season withdrew more than 50 percent of their water resources in 1991. These districts already have absolute water-scarce conditions according to some criteria. A few more districts will enter into the absolute water-scarce category in 2025 under scenario 1.” (Amarasinghe et al. 1999).

It is very vital that the natural resources, particularly water should be managed properly for the benefit of future generations.

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Mahaweli Programme

Mahaweli is the longest river in the Country (330 km) and originates from the central highlands, flows through the Central, Uva, North-Central and Eastern Provinces, and discharges into Indian Ocean at Trincomalee on the East Coast. The basin is 10,327 km², which is one sixth of the Country’s land area, while the river basin falling within Mahaweli Development Programme is about 40% of the Country. The Mahaweli Development Programme is the largest multi-purpose development programme launched in Sri Lanka.

The major components of the programme are: generation of hydroelectric power, providing irrigation facilities for Dry Zone cultivation’s, settlement of landless and unemployed families by constructing and developing physical and social infrastructure required for human habitation, by harnessing the waters of the Mahaweli Ganga, the longest river in the country. Besides, further attempts were made to increase food production and to create employment opportunities for the settlers through this programme (Wanigaratne 1997).

Mahaweli Authority of Sri Lanka (MASL) was established by an Act of Parliament (MASL Act No. 23 of 1979) to manage this large multi-purpose development program. “MASL incorporated in its structure a much broader concept of basin development. Mainly, it had three new features: (1) a strong legal framework enabling the coverage of areas beyond the Mahaweli river basin; (2) an integrated approach to the management of irrigated agriculture; and (3) a management effort extending beyond the usually observed irrigation system boundaries.” (Bandaragoda 1999). MASL activities thus did not confine to developing irrigated agriculture and providing infrastructure to generate hydropower, but extended to several other areas such as land administration, marketing, enterprise development, social/community development and environmental management, by establishing an integrated approach to project area development in river basins.

Although major components of construction phase have been completed to a great extent, still the MASL is managing a large Volume of infrastructure with a high cost of maintenance. Table 1 below depicts the magnitude of infrastructure and resources currently managed by the MASL.

<table>
<thead>
<tr>
<th>Mahaweli Resources volume/extent</th>
<th>1997</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Land Area (Sys. B, C, G, H &amp; UW)</td>
<td>3499 km²</td>
<td></td>
</tr>
<tr>
<td>Water Bodies (Reservoirs) (including Uda Walawa)</td>
<td></td>
<td>2842 M m³</td>
</tr>
<tr>
<td>Irrigation Canals (lengths)</td>
<td>1997</td>
<td>8148 km.</td>
</tr>
<tr>
<td>Roads</td>
<td>1997</td>
<td>1298 km.</td>
</tr>
<tr>
<td>Buildings (Schools, Health Centres, Post Offices, Cooperatives)</td>
<td>1997</td>
<td>853</td>
</tr>
</tbody>
</table>

Table 1: Infrastructure and Resources of Mahaweli (Source: Mahaweli Statistical Handbook - 1997)
3 Current Status and Role of MASL

The Mahaweli programme extended all welfare and community development assistance to settlers in Mahaweli areas who have been settled in newly opened up lands. These assistance include irrigation, housing, agricultural extension, water management training, marketing, education, water supply, land administration etc. At present Mahaweli programme offers a considerable share of contribution to the national economy. The Table 2 presents the Mahaweli share in the national economy.

<table>
<thead>
<tr>
<th>Type of Contribution</th>
<th>As a Percentage of National Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population -</td>
<td>0.643 million</td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
</tr>
<tr>
<td>Paddy Cultivated area</td>
<td></td>
</tr>
<tr>
<td>98/99 Maha</td>
<td>80,816 ha.</td>
</tr>
<tr>
<td>Paddy (Production)</td>
<td>1999 Yala</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>267,582 Mt.</td>
</tr>
<tr>
<td>Other Food Crops</td>
<td></td>
</tr>
<tr>
<td>1999 Yala</td>
<td>G’gram 384 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Cowpea 497 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Chilies 3,924 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Ground Nuts 529 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Big Onion 22,770 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Black Gram 355 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Maize 484 Mt.</td>
</tr>
<tr>
<td>1999 Yala</td>
<td>Soya Beans 1,360 Mt.</td>
</tr>
<tr>
<td>Power Generation</td>
<td>1995</td>
</tr>
<tr>
<td></td>
<td>2,661 GWH</td>
</tr>
</tbody>
</table>

Table 2: Mahaweli Economic Indicators (Source: Mahaweli Statistical Handbook - 1997)

20 years after the launching of Mahaweli Accelerated Development Programme, today the MASL is faced with the question of consolidating its activities in respect of efficient economic, social and environmental development.

4 Planned Changes

MASL, with the assistance of the World Bank has planned to restructure its organization in line with current challenges and trends. Some of the major activities so planned are as follows;

- Right sizing the MASL Cadre (6,000 employees out of 11,000 have been granted golden handshake and sent on Voluntary Retirement).
- Handing over of operation and maintenance responsibilities of some irrigation Systems (distributory and field canals) to the farmer Organizations.
- Transferring of identified activities of MASL to relevant line agencies.
- Implementing Integrated Water Resource Management in Mahaweli Basin Areas in line with the proposed National Water Resources Policy.
- Transforming MASL into a river basin management agency.
5 Strengths of Mahaweli Systems

MASL has been able to develop a strong organizational capacity over the 20 years of its existence as a leading development agency. Some of the key strengths of MASL are given below:

- Comprehensive legal framework for integrated resource management on the basis of river basin areas.
- Integrated approach to development including agriculture, providing infrastructure for power generation, value added economic activities, enterprise development, social/human development and environmental conservation and protection.
- Water Management Secretariat (WMS) — This is a unit that collects analyses and uses data on rain fall, availability and use of stored water in reservoirs. This is a quite strong arm of MASL, which helps in its development planning.
- The Water Management Panel of WMS provides a forum for officials of MASL Other Govt. Agencies, such as Irrigation Department, Agriculture Department, Electricity Board etc., and the representatives of farmer organizations who receive Mahaweli water for agriculture in deciding about timing and quantities of Water issues before the cultivation season begins.
- Skilled set of officers with wide experience in different subject areas who are prepared to work as an inter-disciplinary team.
- Highly skilled engineering personnel to maintain huge dams, reservoirs, canals and other infrastructures.

6 Proposed Model for Mahaweli Basin Management

River basin management has been practiced in various countries in a manner specific to such countries. Therefore a model practiced in another country should not be imposed to Sri Lanka. Instead it should develop a model suitable its situation based on, past experience and available resources. It is important to review the lessons learned objectively and improve the efficiency and effectiveness of the MASL when developing a RBM model to replace it.

The World Banks recommendation in respect to formation of a river basin management agency is as follows:

"The sub-component on Natural Resource Management would support the consolidation of environmental management responsibilities through technical support to advise on institutional changes required to perform the proposed functions of the future river basin authority. It would also provide resources for adaptation of proven technologies and approaches to manage and maintain land and water resources. Project support would be for planning and implementing activities for sustainable land and water management through participatory approaches, dissemination of information, provision of training, technical guidance and mobilization of various land user groups in the basin for expansion of sustainable technologies, awareness and extension. Demonstration activities would include programs to find appropriate ways of improving land management, controlling erosion, reducing pollution and controlling deforestation". (MRRP - Project Appraisal Document, 1998)
This proposed model seems to be limited mainly to natural resource management and therefore well developed aspects of MASL such as improved agricultural practices, agro-based enterprise development, farmer participation in decision making etc., are not included in it. If this model is accepted there will occur a serious problem with regard to the Mahaweli contribution to the GNP. Considering all these factors, it is proposed to include the following components in Mahaweli river basin management model.

- Harness the strong areas of MASL and incorporate them appropriately in the new RBM model.
- Geographical area development based on Mahaweli River Basin should be continued with necessary improvements.
- Integrated approach to development with multiple functions should be further strengthened for improved productivity and quality of life of people.
- Natural Resources such as water, land flora, fauna and eco systems should be conserved with proper practices and they should be used optimally for improved productivity. Agricultural activities and other enterprise development activities should be organized in such a way that natural resource base will not be affected adversely. All economic activities should be complementary to social development and environmental management practices and vice versa.
- Hand over irrelevant and unwanted infrastructure including roads, buildings, water supply schemes etc., to other relevant line agencies for management.
- Hand over distributory and field canals to farmer organizations after their capacities have been strengthened to take over and manage.
- Commercialize identified activities of MASL. Already following companies have been formed under MASL as part of Commercialization process.
  • Mahaweli Venture Capital Co. Ltd.
  • Mahaweli Engineering Services Co. Ltd.
  • Mahaweli Nurseries Co. Ltd.,
  • Mahaweli Eco Tourism Co. Ltd.,

This commercialization process will help to reduce the burden of maintaining some physical and human resources by utilizing state funds. In addition it will bring about increased employment and income to the country.

- Develop and promote more enterprise development activities including value added enterprises. Eco-friendly tourism should be promoted in Mahaweli areas, as there is a great potential in this field.
- Operation and Maintenance of headworks (large dams, canals etc.) should be continued by the MASL as is done at present.
- Conservation and protection of environment though proper regulatory and supervisory functions should be carried out by the MASL. eg. Environmental Impact Assessment of identified projects as required by the National Environmental Act.

7 Management approach for Mahaweli RBM

- Develop healthy and effective partnership between MASL officials and community and with private sector.
- MASL officers should be re-oriented to play a facilitator role in achieving its objectives.
- Skills of MASL officers should be enhanced to undertake new challenges.
- Interdisciplinary team approach should be developed among all categories and all levels of MASL officers.
Organization structure should be dynamic and desirable to enable employees to develop a pride in the organization.

Management should try to achieve the goals of sustainable development (economic, social and environmental) to enable long term planning.

Concern should be on natural resources development and human development.

References


THE MAIN OUTPUTS OF THE NORTH CAUCASUS REGION WATER RESOURCES CONSERVATION AND MANAGEMENT; SUB-COMPONENT IMPLEMENTATION

Vladimir V. Khlobystov

After thorough review and study of the materials prepared for the workshop, including River Basin Management and Planning (E. Mostert et al), Statement on Best Management Practices for River Basin Management, Integrated River Basin Management (J. Burton), etc., the Sub-Component implementation team (IT) would like to admit the high level of the prepared documents. We were delighted to find consonance of the river basin management issues mentioned in the workshop documents with objectives, goals, and already achieved results within the North Caucasus Region Water Resources Conservation and Management Sub-Component implementation.

I consider it reasonable to present the Sub-Component outputs as an example of practical implementation of the best management practices for river basin management.

The North Caucasus Region Water Resources Conservation and Management Sub-component is a constituent of the Water Quality and Water Resources Management Federal Component, Environment Management Project for the Russian Federation (EMP). The EMP is funded through the loan granted to the Russian Federation by the International Bank for Reconstruction and Development (IBRD). The Sub-Component is aimed at resolving the mentioned regional problems in accordance with the unified concept of basin management and using the best available international experience, as well as the experience gained in the course of implementing other Sub-Components.

The most important objective of the Sub-Component is developing a modern integrated water management system for the Lower Don basin (from Tsimlyansk reservoir included, down to the Azov Sea within the boundaries of the Rostov Region), which would address the following problems:

- Assessment of hydrological, meteorological, hydrochemical and environmental characteristics of water use, including data concerning reservoirs; principle types of water use, including environmentally sensitive areas and types of water use directly on water bodies; sources of water contamination and deterioration of the environment as well as efficient water use;
- Assessment of environmental impact and trends in water-using industries and managing activities, including the existing and planned investments for water resources use and conservation;
- Developing an integrated system of efficient water use based on a computerised Decision Support System, targeted at Federal managing agencies in the field of water use and protection for current and perspective planning, taking into account the rapidly changing environmental and water management situation; occasional conflicts over water allocation; decrease of damage caused by water contamination and other adverse effects (floods, etc.); maintaining standard water quality; and resolving arguments concerning transboundary water bodies.
- Assessment of current conditions influencing water quality, filling in data gaps and preparing a project on the creation of a modern multipurpose cost-effective monitoring system of the Lower Don water resources, which primary objective is improvement of water quality control in municipal water abstraction sites. This system should comprise data analysis for surface and ground waters (taking account of physical, chemical and biological parameters) as well as data collection to fill in data gaps.

- Development of an action plan illustrating methods of managing a small water catchment in a chosen site. This plan allows to implement activities concerning the condition of the water catchment and river stretches, evaluation of the impact of various sources of pollution, river discharge regulation and water use in the economy, developing a system of activities for managing point pollution sources, including erosion, bottom sedimentation, inflow of pesticides, nutrients, and effluents from animal and poultry farms.

Reaching the strategic goals of the Component and the regional Sub-component presupposes performing six principle tasks. The key results achieved within the Tasks implementation are given below.

Within implementation of Task 1 “Assessment of adequacy, reliability and appropriateness of existing available data and databases for operational management and strategic planning, and development of an Integrated Information Management System (IIMS)”:  

- The Inter-agency Agreement on data exchange regulations under the Integrated Information Management System has been prepared and is now being finally co-ordinated and signed in environmental agencies.

- Software and hardware for the IIMS has been purchased, installed and tested to provide implementation of the results.

- An operating model of the IIMS has been assembled and put into operation, to illustrate information exchange between the central server and terminals of participating agencies with local information networks. IIMS terminals were installed in the Oblast Environmental Committee, Natural Resources Committee, DBWA, Federal Sanitary and Epidemiological Control in the Rostov Oblast, the North Caucasus inter-regional department on hydro-meteorology and environmental monitoring and Rostov Oblast department on hydro-meteorology and environmental monitoring. The testing process of data and information exchange has been initiated.

- Raw data is being entered into the IIMS. Programmes on the initial data input were developed for the Rostov Oblast department on hydro-meteorology and environmental monitoring.

- An HTML page with IIMS databases has been designed, with a technology allowing their constant updating.

- Technical means to provide user-friendly access from the Internet to open information in the IIMS database, as well as mechanisms of editing information by IIMS operators from remote work stations have been developed.

- The web page of the Sub-component and North-Caucasus CPPI branch is placed in the Internet in Russian and English. The page is constantly updated. The address is: http://www.ncbcppi.rnd.runnet.ru/

- A CD version of the State Report on the Rostov Oblast Environment Status in 1998 was prepared, as well as some other education and information materials.
Under implementation of Task 2 "Development of a new prototype of an integrated, cost-effective monitoring system for water resources management":

- The concept and the system of the Lower Don monitoring, including "The Procedure of Monitoring water bodies of the Rostov Oblast", was developed and approved by the local stakeholders.
- Using the selected criteria and parameters and the developed software, temporal and spatial assessment of water quality in the lower stream and main tributaries of the river Don was performed. Quality assessment of analytical data regarding content of nitrites, nitrates, ammonium, phosphates, total phosphorus, BOD5, α- and β-HCCH, 4,4'- DDT, 4,4'-DDD, 4,4'-DDE, oil products, chrome, copper, zinc, manganese and other substances in the Don river water on the stretch from the Tsimlyansk reservoir to the river mouth has been carried out for the period from 1985 to 1995, with account of analytical methods applied, means of conservation and storing conditions of samples.
- A Draft Agreement "On the procedure of monitoring water bodies in the Lower Don basin" has been prepared and is being signed.
- Bidding documents have been prepared for procuring equipment for the Monitoring System. A tender was undertaken, and its winner was declared. Now a contract is being prepared.
- "The Programme of Environmental and Technical Activities in the Rostov region on preventing water contamination by oil products and their soluble components" has been prepared (discussed and approved by the Regional Administration Co-ordination Board on environmental protection; recommended for practical use).

Under implementation of Task 3 "Demonstration of the methods of small water catchment management":

- The Agreement "On joint use, reproduction and protection of water resources of the transboundary water body, the Kundruchya river basin, between the authorities of the Lugansk Oblast, Ukraine and the Rostov Oblast, Russian Federation" has been signed on April 27th, 1999.
- The Decision of the Krasny Sulin municipality and regional authorities № 410 "On water protection zones of water bodies and water management activities", dated April 15th, 1999, was prepared and signed.
- The Agreement "On joint use, reproduction and protection of the Kundruchya river basin" has been prepared and signed by municipalities of the towns Krasny Sulin, Gukovo and Novoshakhhtinsk located within the Kundruchya river basin area.
- Guidelines on the development, co-ordination and implementation of programmes for rehabilitation and protection of small rivers have been developed. They are waiting for discussion and approval on the SMC meeting on May 6, 1999.
- A 20-page brochure containing a concise description of the outputs, environmental problems of the water catchment, ways of ameliorating water use and the environmental situation in the water catchment and pilot activities was prepared to be disseminated among local authorities and managing structures for study and co-ordination.
- A project on soil and water protection activities in a part of the Sokolovskoe reservoir water catchment in the Kundruchya river basin, Terms of Reference included, was prepared and approved. The first and second phases of demonstration activities have been completed in the Sokolovskoe reservoir basin. In the pilot catchment area (173.3 hectares) more than 5,000 trees were planted in order to reduce land erosion and prevent nutrients and solid substances intrusion into the reservoir. The implementation of the proposed
activities will lead to a significant improvement of the quality of drinking water supplied
to the population of the cities Krasny Sulin and Novoschakhtinsk.

- Proposals have been prepared for the investment projects “Construction of the third
  section of the Shakhty-Dond water pipeline and supplying 6,47 million m³ of Don water for
  Krasny Sulin and Novoschakhtinsk”, “Replacement of water pipelines in Novoschakhtinsk”
  and “Reconstruction of the Prokhorovskoe reservoir”.

- The Plan of integrated rehabilitation activities for the pilot site of the Kundruchya river
  has been prepared. It contains a description of the current condition of ponds in the
  Kundruchya river basin; recommendations for liquidation of engineered dams and an
  evaluation of the required expenses; recommendations for managing hydro-technical
  constructions on ponds of the water catchment; a description of a modern system of mine
  waters treatment with recommendations for its improvement by introducing the method of
  biological desalination; and a plan of implementing the system of environmental
  monitoring of mine waters. A concise description of the management plan for the
  Kundruchya river basin has been prepared.

- The model of forming background components of hydrochemical regime in the system of
  the Kundruchya basin water flows was developed (The Kundruchya river Model), as well
  as the Guide on operating the Kundruchya river Model. A web page presenting The
  Kundruchya river Model has been designed and placed on the Internet.

- A project of the monitoring network for the unified monitoring system of the Kundruchya
  river was designed, as well as a monitoring programme, taking into account pollution
  characteristics (the range of identified parameters, frequency and schedule of sampling).
  Activities on the approval of the system have commenced.

- An educating programme complex for managing small water catchments for experts of
different levels and managers (using the example of the Kundruchya river) was prepared
on a CD (both Russian and English versions).

Under implementation of Task 4 “Analysis of water resources conservation and management
policy”:

- In order to improve the legal basis of the Sub-component and water management quality,
a Framework Agreement has been composed on the North Caucasus Region Water
Resources Conservation and Management Sub-component implementation (August 1996).

- The Oblast Governor Decree №269 "On Measures for Implementing the Environmental
  Management Project in the Rostov Oblast", dated August 6, 1997, was put into action.

- The Oblast Governor Decree №307 "On Licences for Water Use in the Rostov Oblast",
dated August 10, 1998, was put into practice.

- The Legislative Board of the Rostov Oblast has approved the Decree №6 "On
  establishing payment rates for different payees for water use in river and sea basins",

- In order to form proposals for improving the legal framework and organisational
  principles of water use and protection:
  • the existing economic mechanism of water abstraction in the Lower Don basin and the
    actual inflow of payments collected for water abstraction in the Rostov Oblast from
    surface and ground sources were analysed;
  • the legislative basis for performing principle functions of Federal bodies concerning
    water resources management is to be analysed;
  • socio-economic impact of introducing payments for water use in the irrigation of the
    Rostov Oblast was evaluated.
The Main Outputs of the North Caucasus Region

- expenses for performing operating and reconstruction works on the Lower Don water bodies were quantitatively estimated in order to assess the possibility of financing the works using payments for water use accumulated in the budget.
- MS Excel worksheets were created to estimate payments for various water using sectors in line with the Federal Law "On payments for using water bodies" which came into action on May 12, 1998. The tables allow to forecast the inflow of payments into the Oblast budget by modifying rates.
- a conceptual model of paid water use for the Don river basin was created, tasks were specified, general and local dictionaries and reference books were prepared for the system of paid water use, a structure of databases and the scheme of information exchange for the system of paid water use was developed.
  - Development of the information reference system “Payment system for water resources and water bodies use” was commenced.
  - Activities on preparation of the Digest of the existing documents on procedures of interaction in the sphere of water resources conservation and use were undertaken. Sections “Licensing”, “Hydrotechnical safety”, “Payment for water use and fines”, “Surface waters use and conservation”, “Monitoring”, “Environmental expertise”, “Water protection zones”, etc.

Under implementation of Task 5 “Efficient use of water resources and development of the decision-making support system for the Lower Don water system management” one of the principle elements and practical outputs of the Sub-component is the creation and practical application of the Decision Support System for the Lower Don basin water management in the work of Federal agencies. Based on the established concept of DSS creation the following items were produced as separate interrelated blocks and are now being tested:
  - A set of tasks related to the information-referential sub-system of the "Assessment model and forecast of water quality dynamics under conditions of emergency effluent discharge" block; "Planning the regime of the Manych reservoirs work"; "Planning the regime of the Sokolovskoe reservoir work on the Kundruchya river";
  - A programme complex "WES modelling: estimation of water balances for the Don basin to assess water provision of water using scenarios", "Operational Management of the Tsimlyansk reservoir management" and Establishing standards of discharging pollutants into water bodies".
  - Software implementation of the simulation model of the Lower Don WES for the analysis of the water economy situation in the river basin in the process of perspective planning.
  - "Agriculture and irrigation" optimisation model;
  - Tasks of estimating the water economy system operational regime using time series, within the "Perspective Planning" sub-system, etc.
  - Water economy estimations of the WES functioning in the Don river basin were carried out for the 2005-2010 level of development, as well as for the current level and for 2020.

A workshop was held in Azov (June, 22nd – 25th, 1999) to disseminate the North Caucasus Sub-Component results and implement them into the practical work of the water management agencies located within the Don river basin and some other RF regions. The demonstrated system was approved by all the workshop participants, namely representatives of the federal and regional environmental and natural resources committees, specialists from Moscow, the Urals and Upper Volga. It was recommended to disseminate the received outputs for further use in the committees of natural resources and basin management associations in the RF regions.
Certain system blocks will be tested in operation in accordance with the Implementation Plan. By now, more than 20 sub-systems and blocks have been conveyed for testing. At present, most of the mentioned blocks are being used in DBWMA work, to estimate the discharge forecast and flooding of the flood lands this season. The estimations are already used by the anti-flood Board at the Oblast Administration.

Under implementation of Task 6 "Perspective planning":

On the first stage specific information on the following issues was collected and analysed:
- indicators of perspective use of water resources in the Don river basin for water supply of municipal and construction sites, hydro- and heat power stations, industries, fish stock reproduction, fishing and commercial fish breeding;
- irrigated areas in the Lower Don basin and water demand for irrigation;
- requirements to the minimum sanitary flow and navigation estimations;
- planned indicators of a decline in water abstraction thanks to technical improvement of water supply systems;
- requirements of the Lower Don WES participants to the volume and regime of using the Lower Don water.

These data were applied in developing scenarios of perspective water use in the Lower Don.
- An Action Plan aimed at improving the management of the Tsimlyansk reservoir and its water catchment.
- The "Set of priority activities for preventing a shift in the Don river bed on the stretch village Razdorskaya - village Bagayevskaya - village Manychskaya in the Rostov Oblast" Terms of reference and estimations of project and research works were prepared.
- A preliminary list of investment projects which can be included into the perspective plan of sustainable development of the Lower Don water economy complex and other financing programmes.
- Proposals and materials for Amendments to Main Statements of the Water Use Rules in the Tsimlyansk reservoir on the Don river were prepared.
- Criteria of evaluation for policy scenarios of using and protecting the Lower Don water.

Under implementation of Task 3 of the Federal Programme on Co-ordination "Standards and Water Quality Objectives for the North-Caucasus Region":
- A group of experts was formed to work on the implementation of the Regional programme on developing and adapting a system of standards and water quality objectives.
- The Regional programme on developing and adapting a system of standards and water quality objectives in the North Caucasus was co-ordinated with stakeholders and approved by the local authorities.
- Task 1 of the Federal Programme has been almost completed. For Task 2, the following sections have been completed: "Preparation of proposals for the project of conceptual document concerning the system of standards and target indicators of water quality". The list of standards and quality objectives water quality in the Kundruchya river basin were identified and their outline description given.
- Using the basin approach standards and water quality objectives in the Kundruchya river basin for sulphates, total salinity, nutrients (nitrites, nitrates, ammonium ions) and easily oxidised matter (identified with the help of BOD5), pesticides and heavy metals. A generalised system of establishing norms for surface water quality is being deeloped
with the help of water quality objectives adapted to the local conditions of the Kundruchya river basin.

- The first stage of the DSS development for the system of standards and water quality objectives have been completed, allowing to receive a model of riverine discharge and water quality formation in the Kundruchya river basin.

- Standards for surface water quality, adapted to the conditions of the Kundruchya river basin were developed.

- Objectives for waste waters entering the Kundruchya river were developed for principle ions, nutrients, organic matter, mineral compounds of nitrogen and phosphorus, organic substances, heavy metals and pesticides.

- Draft Guidelines on establishing of the regional standards and water quality objectives (using the North-Caucasus region as an example) were prepared.

- The developed standards and water quality objectives were tested on of the area Vodocanals.
RIVER BASIN MANAGEMENT OF TSURUMI RIVER, JAPAN

Toshio Okazumi ¹, Yutaka Hosomi ²

1 Outline of Tsurumi River Basin

The headwaters of the Tsurumi River are in Kami-Oyamada in Machida-city in the Tokyo Metropolis. This area, in which nature is still abundant, has 1,300 metric tons of spring water per day, and all of this water finally comes together to become a river. Flowing down the Tama hills to its mouth, where it flows into Tokyo Bay, the river’s entire length is 42.5 km.

Approximately 70% of the Tsurumi River basin consists of hills and tableland. In 1958, most of that was untouched nature. Areas that are low, flat hills and easy to develop are near the cities, and since 1965, urbanisation of those areas has been extremely swift. Now, some 83% of the river basin is urbanised. Therefore, what we have to think about is the continuing urbanisation in this area: the burden on the Tsurumi River is increasing each year. If it continues like this, someday the river may overflow. And it would be sad if the water stagnated, released bad odours and became home to fewer and fewer creatures.

Map 1: Tsurumi River Basin Urban Land Changes

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2 "Comprehensive Flood Control Measures" in Tsurumi River

2.1 The Project of the Comprehensive Flood Control Measures

The comprehensive flood control measure is flood control measures taken to increase the heavy outflow of rainfall away from urban river basins. Following are notifications from the Director-General of the River Bureau of the Ministry of Construction from May 1980:

1. In each river basin a Basin Council for Comprehensive Flood Control Measures should be established.
2. A Basin Improvement Program should be developed, based on ensuring flood control safety for rainfall equivalent to an hourly discharge of 50 mm (return period, 1/5 1/10) for 10 years.

For this, the following measures will be implemented:
- Aggressive progress on river rehabilitation works
- Development of the Basin Improvement Program, which sets the direction and measures for river maintenance and increase of water retention and retarding functions appropriate for the river basins, and carrying out various measures based on this
- Making public the submergence of major floods, with contributions of guidance on proper land use, flood prevention and ease of evacuation during an emergency
- Working to increase understanding of flood control issues by local people and to obtain their co-operation

Map 2: Specified Rivers for Comprehensive Flood Control Measures' Project
2.2 Establishment of the Council for Comprehensive Flood Control Measures

Self-governing departments in each river basin (river, city, residential, construction, land, road, agricultural administration, etc.) in collaboration with the Ministry of Construction established a Council for Comprehensive Flood Control Measures for the areas with rivers designated as Comprehensive Flood Control Measures Specified Rivers (17 rivers nationwide as of 1995). In order to effectively implement comprehensive flood control measures, careful consultation is underway.

The council for Tsurumi River Basin Comprehensive Flood Control Measures, established in 1980, decided on the Basin Improvement Program for the Tsurumi River in April 1981, and has promoted comprehensive flood control measures. The council which is organised by Vice-Governors or Deputy mayors of each local government, Director-General of the Kanto Regional Construction Bureau, Ministry of Construction and other members, also oversees the implementation of the Basin Improvement Program. Additional issues are currently:

- Continued development of the river basin into the future is anticipated.
- Quickly improving the safety degree against floods is difficult, with only conventional flood control facilities improvements of the past.
- Water retention function measures for the Basin Improvement Program are delayed.
- The outflow to the river is increasing, due to pump installations in the lowland area.
- Banking in the retarding area is still progressing.
- The time of flood concentration is being shortened. In order to solve these problems, the Tsurumi River Basin Council for Comprehensive Flood Control Measures is investigating new comprehensive flood control measures for the unified river and river basin with a long-term view. Towards actualising that policy, the New Basin Improvement Program was decided in May 1989. This Program newly established long-term maintenance targets for the beginning of the 21st century that were not in the old Program, and is extolling the development of many policies. According to the development status of the past, 90-95% of the river basin areas are supposed to become urbanised by the beginning of the 21st century, and countermeasures for these circumstances are under investigation.

2.3 Measures in river and sewer

The retention function of the river basin has decreased due to the population increase and housing development. The inflow volume of rainwater, etc. into the Tsurumi River has increased. In order to ensure safe flow capacity, water retention projects and sewer improvement, including the implementation of large-scale dredging and other river channel improvement, are being promoted.

River Channel Improvement

So far, construction of large-scale embankments and dredging work has been done in the Tsurumi River. In the course of the dredging work to expand the cross-section area of the river, the equivalent of three to four Tokyo Domes has been dredged up.

Through such river improvements, the Tsurumi River has doubled its flow capacity compared to 1975, when the Comprehensive Flood Control Measures were started. River improvement still continues today.
International Workshop on River Basin Management

Multipurpose Retention Basin
a). Retention Land Projects
The Tsurumi River multipurpose retention basin is located in Kozukue in Kouhoku Ward in Yokohama, where the Tsurumi River and Toriyama tributary merge. In the future, based on the master plan of flood control, there are some programs to regulate flow volumes of 800 m³/sec of the basic peak discharge volume of 2600 m³/sec at Sueyoshi Bridge through upper- and middle-reach regulation reservoirs, including the Tsurumi River multipurpose retention basin. In order to ensure safety from flooding of the scale of the 1958 Kanogawa Typhoon, the post-World War II maximum rainfall, flood control of 200 m³/sec will be done.
b). The Yokohama International Sports Stadium
The Yokohama International Sports Stadium was built on one comer of the Yokohama General Athletic Park on the retention basin. It is the largest domestic sports stadium, with a capacity of 70,000 people and a total floor area of 166,000 m². The 1998 National Athletic Meeting at Kanagawa and the 2002 World Cup Soccer Games are scheduled to be held here. In order to avoid hindering flood control capacity, the piloti method (elevated-floor style) has been incorporated in the construction of the Yokohama International Sports Stadium.

Sewer Improvement
a). Rainwater Storage Pipes
In order to prevent flooding when heavy rain falls, rainwater will be temporarily stored in storage pipes.
b). Oninawashi Park Regulation Reservoir
It is estimated that a 50 mm hourly rainfall will hit the Tsurumi River every eight years, and therefore the Park Regulation Reservoir will be established. Water exceeding a certain level will be stored in a tunnel and discharged after the river water level decreases.

2.4 Measures in the River Basin
Supplementing the decreased water retention function and retarding function, the outflow control facilities which temporarily hold fallen rain are indispensable for preventing the Tsurumi River to flood. Besides that, measures to preserve existing forests and paddies and to improve underground percolation facilities are being implemented.

Outflow Control Facilities
Facilities which temporarily hold fallen rain so that it does not flow into the river all at once are called outflow control facilities. At present, there are approximately 2000 facility sites (storage capacity approximately 2.5 million m³) established along the Tsurumi River basin.

The Kirigaoka regulating reservoir has a total reservoir area of 29,318 m². The temporary reservoir has a regulating reservoir, the secondary reservoir has tennis courts, and the tertiary reservoir has a Japanese croquet (gate ball) field, a parking lot and a piloti style office. Rainwater that overflows from the regulating reservoir flows onto the tennis courts, then the gate ball field, parking lot and finally under the piloti style office. The total reservoir capacity is 96,000 m³. During Typhoon No. 18 in 1991, 4.80 m high rain water was held in the tennis courts.
Preservation of Green Areas
Woods and forests have a superior natural water retention function for enabling fallen rain to percolate. Protecting the forests is also an important comprehensive flood control measure. Present green areas are strictly preserved by municipality.

3 The co-operative activities with residents
Since the Flood Disaster Defence Planning Committee was established in the Tsurumi River basin, Comprehensive Flood Control Measures have been carried out. Also, a variety of measures such as river improvements through large-scale dredging and the establishment of flood prevention regulation reservoirs have been implemented. However, as the rapid progress of the river basin continues, more than ever, co-operation from the residents, as well as from the local self-governing bodies, is important. Because of that, May 15 of each year is designated Comprehensive Flood Control Day, to raise awareness of the importance of comprehensive flood control among the people in the river basin. This day was chosen because it was the day in 1980 when the Director-General of the River Bureau indicated the intention to promote comprehensive flood control measures. Also, the week of May 15 to 21 is Comprehensive Flood Control Promotion Week. Last May, we had a festival named “Good Rapport with the Tsurumi River” to deepen residents’ understanding of “Comprehensive Flood Control”. Many residents participated in the festival and enjoyed it very much.

There are also “TR Net” activities as one of the residents’ activities. “TR Net” stands for the Tsurumi River Basin Networking. The role of this organisation is to bring together all the groups (there are about 50 groups now) which act independently, and to build up closer co-operation between residents and the administration. It gives information to residents, forms partnerships, and participates in public projects. It aims to develop basin culture and lives which enable us to coexist with nature. Last year, “TR Net” got the Award of the Minister of Construction in the Japan Water Grand Prize, which is awarded to the best activities for improving water environment. It shows their activities are highly regarded.
AN OVERVIEW OF RIVER BASIN MANAGEMENT IN NIGERIA - DEVELOPMENT OPTION

Orji, O.A.C. 1

1 Introduction

Nigeria is located in the West Africa Sub-region. The climate is largely semi-arid in the north and humid in the south. There are two distinct seasons, namely the dry (cool) season and the wet/rainy (hot) season. The rainy season spans July to September in the North and April to November in the South. The annual rainfall varies from about 250 mm in the extreme north-east to over 3,000 mm in the south-east. Peak rainfall occurs in the month of August in the North, while two peaks are recorded in the South, in July and September.

The general geology of Nigeria consists of two major rock formations, the Basement complex or the crystalline rock area and the Sedimentary deposits. The former underlies about 48% of the land mass and occurs mainly in the north-central, south-central and eastern parts of the country, while the remaining 52% of the land mass is underlain by sedimentary deposits in the north-western, north-eastern and central-southern parts as well as, the intervening troughs among the basement complex areas. On the basis of the geology, aquifer type and river basin configuration, the country is naturally divided into ten sedimentary groundwater provinces, while the large Basement complex area is constituted into the eleventh groundwater province.

The potential groundwater resources of Nigeria are estimated at 51.9 x 10^9 cu.m, while the surface water is estimated at 267.3 x 10^9 cu.m.

The country is well-drained with a network of rivers, lagoons, lakes and streams. The drainage pattern is controlled by the River Niger system and its major tributary, the River Benue. The two rivers traverse the country in a north-easterly and north-westerly manner, forming a confluence before emptying into the sea (through a delta) in the Gulf of Guinea. Both rivers Niger and Benue are international rivers. While River Niger rises from the Guinea Highlands (Fouta Djallon), River Benue rises from the Republic of Cameroun. Apart from the River Benue, other principal tributaries of the River Niger are the Sokoto and Kaduna rivers. Other dominant features of the drainage include the Cross River in the south-east, the west littoral rivers and the inland lake (the Lake Chad) in the north-eastern corner of Nigeria at its border with Chad Republic.

Following the natural drainage pattern and the configuration of the river basins, the boundaries of the nation's twelve River Basin Development Authorities were determined.

2 History of River Basin Development Authorities

Organised water resources development for agriculture and other uses in Nigeria started in 1955, when the Report of the International Bank for Reconstruction and Development (IBRD) mentioned the need for an organised approach towards harnessing the water resources of Nigeria. Hitherto, water resources development for agriculture had been in the hands of small-scale subsistence farmers. In 1962, however, the Federal Government decided to include the issue of water resources development for crop irrigation, as well as, urban and rural domestic uses in the First National Development Plan (1962-1968).

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The need to combat the ravaging and devastating Sahelian drought of the early 1970s, and as forestall desert encroachment was a major propelling factor to the establishment of the River Basin Development Authorities (RBDAs) in Nigeria. So, in 1973 the Sokoto-Rima and Chad Basin Authorities were created under Decrees Nos. 32 and 33. However, prior to this time the Niger Delta Development Authority was created and assigned the responsibility of developing the riverine areas of the Niger Delta. The number of River Basin Development Authorities was increased to ensure a nation-wide, systematic and consistent water resources (surface and groundwater) development for multi-purpose use, and to provide irrigation infrastructure, control of flood and erosion, and water resources management. The RBDAs were also envisaged as tools to stem the rapid rural/urban migration that were attendant problems of the oil boom era in Nigeria.

Consequently, after the creation of the Federal Ministry of Water Resources in 1976 with the specific mandate of formulating national water resources development policies and their co-ordination, the Federal Government, through Decree No. 25 of 1976, set up eleven (11) RBDAs (including Sokoto-Rima and Chad Basin Development Authorities) with the following functions:

1. To undertake comprehensive development of both surface and groundwater resources for multi-purpose use, with particular emphasis on the provision of irrigation infrastructure, control of flood and erosion, and watershed management.
2. To construct, operate and maintain dams, dykes, polders, wells, irrigation and drainage systems and other works necessary for achievement of the Authority's functions, and to hand over all lands to be cultivated under the irrigation schemes to farmers.
3. To supply water from completed storage schemes to all users for a fee to be determined by the Authority with approval of the Federal Ministry of Water Resources.
4. To construct, operate and maintain infra-structural services, such as roads and bridges linking project sites, provided that such services are included and form an integral part of the list of approved projects.
5. To develop and keep up-to-date a comprehensive water resources master plan, identifying all water resources requirements in the Authority's area of operation, through adequate collection and collation of water resources, water use, socio-economic and environmental data of the River Basin.

The amended Decree No. 87 of 1979 widened the functions of the RBDAs to include afforestation; fisheries; mechanised land clearing and cultivation; large scale multiplication of improved seeds; livestock; tree seedlings; processing of crops, livestock products and fish produced by farmers; and to assist the State and Local Governments in the implementation of a wide range of rural development work such as construction of dams, wells, boreholes, feeder roads, agro-service centres, staff training etc.

In 1984, the River Basin Development Authorities were split into eighteen (18) River Basin Development Authorities to cover each state of the Federation, apart from Lagos (the former capital of Nigeria), which was combined with another State (Ogun State). However, this structure did not last as in 1986 the RBDAs were reorganised and returned to 11. Their functions were redefined and substantially modified by the enactment of Decree No. 35 of 1987, which divested the RBDAs of direct agricultural production and engagement in extension services while focusing on the development of water resources for irrigation, domestic and industrial purposes.

In 1994, the RBDAs were re-designated River Basin and Rural Development Authorities (RBRDAs). Today, we have on ground twelve (12) such Authorities covering the entire country.

Before this time, the inability of some government outfits including the River Basin Development Authorities to satisfactorily meet their set objectives led to the introduction of
some macro-economic measures, including the partial commercialisation of the RBDAs in 1992. By this, the RBRDAs were to operate as commercial enterprises.

3 Impact of the River Basin Development Authorities

The impact of the River Basin Development Authorities can broadly be assessed in terms of achievement of the set objectives.

a) The RBDAs have in the last two decades constructed many dams. However, the use to which the impounded water is put remains an unsolved issue. Of the more than 200 large/medium (>15m) and 98 small (<15m) dams in Nigeria, not less than 70% is under the control of the RBDAs. The RBDA dams store about 12 billion cubic metres of water. Out of these, about 5.78 billion cubic metres are dormant (and not put to any useful purpose) due to the fact that the downstream activities are either uncompleted or not in place at all.

b) The total area irrigated by the RBDAs is estimated at 100,000 ha., while about 151,000 ha. is expected to be fully equipped with irrigation infrastructure. This is a far cry from the proposal to irrigate about one million hectares of land under the 4th National Development Plan (1980-1985).

c) Under watershed management and rural development, the RBDAs have engaged in water supply through drilling of boreholes, construction of roads in their project areas, small earth dams, and flood detention structures.

In their more than 20 years of existence the RBDAs ought to have greater impact on the nation's socio-economy beyond what obtains at the moment. Some of the factors responsible for the present low level of performance by the RBDAs will be highlighted in the next section.

4 Constraints to Performance of the RBDDAs

- The approach to river basin development.
  The general definition of the same functions for all RBDAs without regard to the prevailing ecology and ecosystem of the different river basins is an issue that needs to be re-examined. Also, the RBDAs had to contend with conflicts arising from the initial approach of acquisition of land from the owner communities and development of land without involving the farmers from the onset, leading to problems of payment of compensation for inundated land, economic trees and property, as well as disputes over acquired lands.

- Inconsistencies in government policy and inadequate planning, preparation and logistical back-up for their implementation.

- General lack and paucity of data for planning, development and management purposes, leading to over-designing and failure of projects.

- The policy on partial commercialisation of the RBDAs worsened the situation of data collection, which is now accorded little or no priority because of its low revenue yielding capacity.

- Poor instrumentation and poor maintenance culture.

- Politicisation/ political interference in operations and resource allocation, including the location of projects. Irrigation projects have had to be cited in unviable areas without farmers. This results in completed but under-utilised, and uncompleted or abandoned projects.
Inadequate funding, which is a direct reflection of the general state of the nation's economy. The RBRDAs have completed studies that are awaiting actual implementation, as well as dams that are completed without operational downstream facilities.

- Low revenue generation capacity, particularly with the sale of some assets of the RBRDAs by the Technical Committee on Privatisation and Commercialisation.

5 Recommendations/conclusion

- It is very feasible to achieve rational and optimum development of the river basin under integrated river basin management. That implies evolving management programme(s) and processes that would ensure the actualisation of development projects while at the same time not compromising sound and environmentally balance management and equitable sharing of the resources of the river basin among the competing demands.

- The best watershed management cannot be achieved without relevant qualitative and quantitative data on the basin resource.

- The policy thrust on food security through increased food production; poverty alleviation; and rural development can still be achieved through integrated watershed management.

- The RBRDAs are located in various ecological zones of the country and should be encouraged to project and carry on with development programmes and management practices that are best suited to their very environment. This will involve re-definition of policy objectives of the RBRDAs with individual specialisation.

- Participation of the Organised Private Sector (OPS) and Non-Governmental Organisations (NGOs) in water resources and river basin management is long over due in the sector. In addition, involvement of the Community Based Agencies (CBA) from the planning stage to programme execution has become an imperative and should be further explored.

- River Basin Development in Nigeria in the last two decades has had a chequered history that involved policy, operational and structural changes to enhance its relevance and efficiency. If concerted efforts are not made to give proper focus and sustainable policy direction to integrated river basin management, the situation of the River Basin Development Authorities will remain largely the same, at least in the foreseeable future.

References

MEKONG RIVER COMMISSION
MRC Secretariat, Phnom Penh, Cambodia

1 Introduction

Purpose of the Paper
This paper is prepared for all the Mekong friends and general readers who are interested in the Mekong River Commission (MRC), the unique and the only international river basin organization in Southeast Asia. It presents a brief account of the MRC which was established on 5 April 1995, its mandate and especially, its current Strategic Plan and Work Programme 2000. A brief introduction to the Mekong Committee (MC), its forerunner organization, is also made in this paper and in view of this, it is expected to be useful also for researchers and others who have specific interest in the historical aspects of this organization and the related development issues in the Mekong River Basin (MRB) as a whole.

The Mekong River and its Basin
The Mekong River (as shown in map 1) is one of the great international rivers of the world. It has a total length of over 4,800 kms, ranking as the 12th longest river in the world and the longest in Southeast Asia. It originates in the Himalayas and flows through the mountainous tracts of China's Yunnan province until it reaches the border of Myanmar and Laos. The River forms the Lao-Thai frontier for some 900 kms before crossing into and passing through Cambodia. The Mekong Delta begins further downstream and finally empties into the South China Sea. The River's drainage basin covers some 795,000 sq.kms. The River renews years after years fertility of the soils it floods, provides water for irrigation and particularly, for rice cultivation. It is rich in fisheries, a wealth of bio-diversity and a large hydropower potential. It is a main highway for inland navigation and trade. Indeed, life and welfare of over 60 million people who live in this large Basin are much dependent on the immense richness of the River and its system. After decades of developments which have taken place in different parts of the riparian countries, environmental concerns have become more pronounced in the region in the recent years.

The Mekong Committee (MC)
Prior to the establishment of the MRC in 1995, the MC has been established (in 1957) and in operation for nearly 40 years, with its Headquarters (Mekong Secretariat) located in Bangkok. The MC was under the umbrella of the United Nations Economic Commission for Asia and the Far East (ECAFE, the predecessor of ESCAP). In accordance with its 1957 Statute, the MC was to "promote, coordinate, supervise and control planning and investigation of water resources development projects in the lower Mekong basin". The MC had four member countries, namely, Cambodia, Laos, Thailand and South VietNam. With support and assistance from a good number of donor countries, international organizations and agencies, it has managed to complete a large number of projects and activities. However, much of the potential from the Mekong's water and related resources is still untapped and needs to be managed for the well-being and sustainable benefit of the basin's inhabitants.

During these years the MC had to struggle through many difficult periods of social and political turmoil. But, thanks to the continued support from the donor community, it has never ceased its operation. During 1975 and 1978, for example, its work was severely...
The Mekong River Basin

Characteristics:

Area: 795,000 km\(^2\) (21)
Length of mainstream: 4,800 km (12)
Average discharge: 15,000 m\(^3\)/s (8)

Map 1: The Mekong River Basin
hampered by the political changes in three of its member countries, namely, Cambodia, Laos and Vietnam and as a result, its activities during this period had to be scaled down to a minimum level. In 1978, as Cambodia failed to continue its participation, Laos, Thailand and Vietnam jointly decided to establish the Interim Mekong Committee (IMC) to continue to carry out basic studies and investigations. The IMC was in operation until 1995 when the four member countries agreed to establish a new organization.

2 Mekong River Commission

Evolution of the Mekong River Commission

With the improving situation in the region and following the October 1991 Paris Peace Agreement, Cambodia submitted its request to re-join the MC/IMC. The recent and rapid economic and environmental changes in all of the four member countries have also called for a new organization with a new set of mandates to cope with the countries' new needs.

In response to these situations, a Mekong Working Group (MWG), comprising of representatives from the four MC/IMC member countries, was initiated in December 1992. This Group undertook a review of the existing Statute and mandate of the Committee and carried out the necessary preparations for the establishment of the Mekong River Commission under a new cooperation framework. It was a logical consequence of the new political and economical situation in the region, e.g. the peaceful climate and the increased economic growth due to the changing mechanism from centralised to market-oriented economy of the countries in Indochina. Under the Chairmanship of UNDP, the MWG met five times. The last meeting was held in Hanoi in November 1994. During this meeting the draft Agreement on the Co-operation for the Sustainable Development of the Mekong River Basin (Agreement) was initiated.

The Agreement was signed by the plenipotentiaries from Cambodia, Lao PDR, Thailand and Vietnam on 5 April 1995, at Chiang Rai, Thailand. It has 42 important articles, forming a legal framework and new mandate of the Commission. In addition it provides principles for sustainable utilisation of the water resources of the Mekong River system, institutional, financial and management issues relating to the mechanism of co-ordination between the member countries. As a whole, the Agreement aims principally at promoting environmental conservation and sustainable development on a regional co-operative and equitable basis, and consideration of economic and social factors affecting the people, leading to the enhancement of overall quality of life of people in the basin.

Structure of the MRC

As a newly established inter-governmental organisation in the region, the Mekong River Commission has a three-tiered organisational structure, namely, the Council at ministerial or cabinet level, the Joint Committee at Director-General level and the Secretariat at the technical level. The Council has one member from each participating State, who is empowered to make policy decisions on behalf of his/her government. Chairmanship of the Council will rotate annually and it will convene at least one regular session each year. Similarly, the Joint Committee consists of one member from each participating State; its chairmanship also rotates annually. It will convene at least two regular sessions each year. Major functions of the Joint Committee include implementing the policies and decisions of the Council, formulating the basin development plan, collecting and exchanging data, conducting studies and assessment to protect the environment and maintain the initial effort toward resolving any differences that may arise, and making recommendations to the Council on the structure of the Secretariat. The Secretariat (generally called MRC Secretariat), however, was created to provide technical and administrative services to the Council and the
Joint Committee. Its headquarters was located in Bangkok until August 1998, before it was moved to Phnom Penh, Cambodia. The Secretariat is headed by the Chief Executive Agent and has nearly 120 people in its staff from the four member States as well as other countries.

It is expected that with the new mandate, the MRC will be able to carry out important roles of the Mekong Committee, its predecessor, in helping to co-ordinate water resources development, management and environmental protection in the region. In addition, it will be able to participate effectively in such other regional development initiatives as the Quadrangle Economic Zone, the Greater Mekong Sub-regional Co-operation sponsored by the Asian Development Bank (ADB-GMS), the Mekong Basin Development Framework initiated by ASEAN, etc. These development initiatives have one common goal, i.e. to further promote regional co-operation and economic development among the riparian countries within the entire Mekong River Basin. After the signing of the Agreement and at least for the first 2-3 years, the MRC had to carry out a number of projects and activities initiated by the IMC. Many of these projects/activities have duly been completed.

MRC Strategic Plan

It was in early 1998 that a Task Force established by the MRC Secretariat started working out on a draft Strategic Plan of the MRC for 1999-2003. With the technical assistance provided by UNDP and with an intensive participation of the member countries, the draft Plan has finally been approved by the MRC Council at its Fifth Meeting in October of the same year. The approved Plan defined clear vision and mission statements of both the MRB and the MRC which will be introduced hereunder.

- Vision for the MRB
  "An Economically Prosperous, Socially Just and environmentally Sound Mekong River Basin”.

- Vision of the MRC
  "A World Class, Financially Secure, International River Basin Organisation Serving the Mekong Countries to Achieve the Basin Vision”.

- Mission Statement
  “To promote and co-ordinate sustainable management and the development of water and related resources for the countries’ mutual benefit and the people’s well-being by implementing strategic programmes and activities and providing scientific information and policy advice”.

The Strategic Plan provides also a clear set of strategies for the MRC in implementing effectively its 1995 Agreement and especially, in achieving its five specific short- and medium-terms goals as following:

a) Establish and implement the Rules for Water Utilisation and Inter-Basin Diversions;
b) Formulate the Basin Development Plan to provide an effective general planning tool and process for sustainable management and development;
c) Establish and implement MRC environmental management policies and guidelines for the use and conservation of water and related resources, and integrate socio-economic considerations into all MRC development activities;
d) Complete and evaluate the currently funded on-going programmes and projects, and progressively initiate new development activities in accordance with the Strategic Plan;
e) Improve the capacity of the MRC to implement its Mission, to play the leading role in co-ordinating the Basin’s water related activities, and to meet stakeholder expectations.
To be successful, the Plan identified four (4) specific Key Result Areas (KRAs) in which the MRC has to place its efforts in order to achieve the goals. They are:-

KRA#1: Natural Resources Planning and Development;
KRA#2: Environmental Management and Social Considerations;
KRA#3: Databases and Information System; and

3 MRC WORK PROGRAMME AND EXTERNAL SUPPORT

Work Programme 2000

In accordance with the Strategic Plan, the MRC prepares annually its work plan (called Work Programme) which explains not only its on-going activities but also its programmes and projects of priority that need technically and financially assistance, from the donor countries and co-operating agencies. In this connection, the MRC Council has just approved the Work Programme 2000 at its Sixth Meeting held in Phnom Penh on 18 October 1999. This Work Programme contains 84 projects/activities, all of which fall within the above-mentioned four KRAs. Of the total, 39 are on-going projects (18 fully funded and 21 partially funded ones), with the combined project costs (external funding) of some US$44 million. Together with the 21 partially funded projects, the number of the projects/activities which are seeking funding is 66, with a total project value of US$75 million. However, of the total 66 projects, 20 are considered top priority for which a total of about US$11 million is being sought for immediate implementation in 2000 (for more information on the MRC Work Programme 2000, see figure 1).

It may be added that the so-called Programme Approach is being emphasised and strengthened by the MRC. In the current Work Programme, there are five important programmes to be noted. They are:

- Environment Programme;
- Fisheries Programme;
- Hydropower Programme;
- Hydrology Programme; and

In 2000, the following programmes are expected to be developed and completed further, e.g., Agriculture and Irrigation Programme (AIP), Basin Development Plan (BDP), Water Utilisation Programme (WUP), etc. For the BDP which will serve as the basis for carrying out future development work of the Mekong River Commission, although still subject to a final appraisal by donors, it is expected to commence fully in mid-2000. For the AIP and WUP, however, their initial implementation already started in view of the funds which have duly been made available by donors.
Figure 1: MRC Priority programmes/projects (From Key Results Areas through Goals to MRC Mission)
Donor community and co-operating agencies
For the benefits of the readers, it may be noted further that the MRC is a non-profit international organisation which has to rely most of its resources, both technical and financial ones, from international donor community, including donor countries, international funding institutions (e.g., the World Bank, the Asian Development Bank, etc.) and various co-operating agencies (e.g., UN specialised agencies, ESCAP, Asian Institute of Technology, etc.). The MRC financial resource also come partly from its member countries, in terms of annual membership fees. The major part is, however, from the donor community, in terms of the programme as well as institutional supports.

Donors have always been very important to this organisation, since the MC/IMC periods. Their assistance and supports had made the implementation of numerous number of the projects and activities during the last 40 years possible, meeting needs of the member countries and in particularly, the Basin’s peoples. Furthermore, they often generated goodwill atmosphere and contributed to building of peace in the region. They helped to highlight the importance of the Mekong and the Committee’s work. These functions of the donor community and its assistance remain fully valid and meaningful to the Mekong River Commission. As discussed earlier, the MRC vision is to become a world class and financially secure organisation in the future. Currently, the MRC is only at its initial stage of preparations for achieving this challenging goal. It still has a long way to go and that is why a lot of assistance is still required from the donor community.
1 Introduction

The River Nile is one of the largest, longest, and most remarkable rivers of the world. Along its banks ancient civilisations came into existence. As it flows on its long voyage northwards from the sources in the South, near lake Tanganyika at latitude 4° South, up to its mouth at the Mediterranean Sea at latitude 31° North, it crosses 35° latitudes. The Nile Basin area is estimated to be about 2.9 million km², the equivalent of one-tenth of the African Continent. Its course traverses ten countries: Burundi, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, the Sudan, Tanzania, Uganda and Zaire. In addition, it contains Lake Victoria, the largest freshwater lake in the Eastern hemisphere, Ruwenzori Mountain (5120 m), the third highest mountain in Africa, and Cairo, the largest City in Africa.

Over this great spatial extension, climates, flora and fauna vary just as the races, civilisations, languages, customs and religions. Agriculture plays a crucial role in the life of Egypt. With its situation as a semi-arid zone, Egypt's dependence on the Nile and on the development of an appropriate irrigation system based on the river is very crucial. The total cultivated area within the country is about eight and a half million Feddans. The Nile Water is used predominantly for irrigation which accounts for 84% of all water demand, while industry uses 8%, municipalities 5%, and navigation 3%.

2 The River Nile

The River Nile collects its water from three basins, (map 1, next page):

a. The Equatorial Lake Plateau Basin.


c. The Ethiopian Mountain Basin.

a) Equatorial Lake Plateau Basin

The source of the Nile is at the head of the River Kagera, more than 6,800 km from the Mediterranean Sea. This river enters Lake Victoria, the second largest lake in the world (69,000 km²) on its western shore. The Victoria Nile flows out of the Lake at the northern end over the Ripon Falls which have been submerged since the construction of the Owen Falls Dam in 1954. The annual outflow of the lake amounted to 31.5 km³/year for the 1946-1980 period.

After a series of rapids, the Victoria Nile enters the shallow Lake Kioga and passes through its swamp vegetation, over the Murchison Falls, and then enters lake Albert (5,200 km²) at its northern end. At its southern end, the lake receives the Semliki River. The Semliki also drains Lakes Edward and George, in the Western Rift between Uganda and Zaire. The discharge at Lake Albert exit is 35.6 km³. The Albert Nile issues from this lake and flows in a swampy channel to Nimble, the Sudanese border, where the river is known as Bahr El Gabble. It plunges over the Fila Cataract and numerous other rapids to Rejaf (57 km upstream Mongalla). The annual volume of water reaching Mongalla is 39 km³. Below Rejaf, the river flows in a valley that becomes more and more swampy until, beyond Bor, it enters the real

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Map 1: The Nile River Basin
swamps of the Upper Nile, known as the Sudd Region. The losses are more than 50% of the water passing Mongalla due to seepage, evaporation and transpiration. The average annual discharge of the Gebel and the Zeraf at their outfalls into the White Nile is about 165 km\(^3\). The White Nile, about 957 km in length, begins at lake No and joins the Blue Nile at Khartoum. It receives water on its course, the Sobat, Bahr El Zeraf, Bahr El Jebel and Bahr El Ghazal. The discharge of the White Nile at Malakal (23 km D.S. Sobat confluence) is 28 km\(^3\), which is about two-seventh of the total water supply of the Main Nile. Throughout its stretch, it is a wide-placed stream with a very small slope. The valley is wide and shallow, thus causing a considerable loss of water by evaporation and seepage.

b) Bahr El Ghazal Basin

The Bahr El Ghazal basin is located in the southern part of the Sudan. It lies between latitudes 4\(^0\) and 14\(^0\) North and between longitudes 23\(^0\) and 31\(^0\) East. It drains a large area of about 526,000 km\(^2\), with heavy rain, but the country is mostly flat and swamps are extensive, estimated at 40,000 km\(^2\). The Bahr El Ghazal flows to the southwestern Sudan, joining the Bahr El Jebel at Lake No, a large lagoon where the main stream takes an easterly direction. The average rate of rainfall on the basin is assumed to be 900 mm, while the evaporation is 2.0 meters per day. Most of the important rivers in this basin are torrents originating in the south-west where the rainfall is heaviest. The main tributaries of the Bahr El Ghazal include the Loll, Jur, Tonj, Gel, Naam, Yei and Bahr El Arab. The Rivers Loll and Jur contribute about 70% of the total discharge of the basin, while the Bahr El Arab contributes less than 0.5%. The average annual yield of the tributaries is about 14 km\(^3\). Despite large yearly variations in precipitation and hence in the stream flow of each sub-catchment, the output from the Bahr El Ghazal basin measured at Lake No is insignificant and is not more than 0.5 km\(^3\).

c) The Ethiopian Mountain Basin

The Sobat River and Machar Marshes

The Sobat River is formed by the Baro and Pibor. Its basin covers an area of 186,400 km\(^2\), the Baro basin being 41, 400 km\(^2\), the Pibor basin being 109,000 km\(^2\) and the main Sobat basin being 36,000 km\(^2\). The Baro draws its supplies entirely from the eastern hills of Ethiopia. The greater part of the Pibor comes from the flat marshy plains of the south-eastern Sudan. The Baro is considered to be the main feeder to the Sobat as it contributes 9.5 km\(^3\) at its mouth, while the Pibor contributes 3.4 km\(^3\).

The average annual discharge of the Sobat at its outfall into the White River is 13.3 km\(^3\), equivalent to one-seventh of the total supply of the Main Nile. The Sobat, like the Blue Nile and the Atbara, in flood time, brings down mud from Ethiopia, though only a relatively small amount gets into the White Nile.

The basin of the Machar Marshes is bounded on the south by the basins of the Sobat and Baro, on the west by the White Nile, on the north by Melut road and on the east by the western slopes of the Ethiopian Hills neighbouring the eastern boundaries of the Sudan. Many torrents spring from these western slopes and pour down forming Khors Ahmer, Tombac, Yabus, Daga and Lau, which flow in the Machar Marshes, in addition to the rain water and the outflow on the right bank of the River Baro and Khor Machar. The catchment area of these Khors is estimated at 10,300 km\(^2\). The average rate of rainfall is 0.800 meters. The area of Marshes is about 20,000 km\(^2\). The quantity of waters drained to the White Nile from these Marshes is insignificant, and varies between zero and 0.5 km\(^3\).
The Blue Nile
The Blue Nile rises in the Ethiopian Plateau at heights of 2,000 to 3,000 meters above sea level. Its basin covers an area of 324,100 km$^2$. The river issues from Lake Tana (3,035 km$^2$) in a series of rapids, and about 30 km downstream it plunges over the Tis Lessat Falls, dropping some 45 meters into a deep narrow gorge with vertical walls. The river remains entrenched in this deep canyon until it finally emerges near the Ethiopian-Sudanese border. The river then flows west and north-west through the Sudan to join the White Nile at Khartoum, forming the Main Nile.

Numerous tributaries are fed by rains in the Ethiopian Highlands including the Dinder (34,700 km$^2$) and the Rahad (35,600 km$^2$). Both are strong streams in the flood and are reduced to pools later. The average yield of the Blue Nile is 50 km$^3$, about four-seventh of the total supply of the Main Nile.

The Atbara River
The Atbara, the last tributary of the Nile, flows into the main stream nearly 320 km north of Khartoum. It rises in Ethiopia at heights of 1,830 to 3,000 meters above sea level. Its basin covers an area of 143,800 km$^2$. The two principal tributaries that feed the Atbara are the Bahr Esalam and the Satit.

The Atbara rises and falls rapidly, like the Blue Nile. Although it carries a large volume of water in August and September, it is reduced to a series of pools from December to June. The average annual discharge of the Atbara River is about 12 km$^3$, which is equivalent to one-seventh of the total supply of the Main Nile.

Once the Blue Nile joins the White Nile at Khartoum, the Nile is known as the Main Nile. It does not receive any tributary except the Atbara River. It flows onto Egypt through Rosetta and Damietta branches to the sea. The length of the River is about 3,065 km. Between Khartoum and Aswan the river is 1,885 km long, and crosses six cataracts where the river is not completely navigable, although sections between the cataracts are navigable by sailing vessels and by river steamers. The average annual discharge at Aswan is 84 km$^3$, (Fig 1).

3 Control Structures on the Nile
There are seven dams and reservoirs on the Nile and its tributaries. Two of them are for year-round storage. These are the Owen Dam on the outlet of Lake Victoria in Uganda and the High Aswan Dam on the Main Nile in Egypt. The annual reservoirs in the Sudan are Sennar and Roseires on the Blue Nile, Khashm El Girba on the Atbara river and Jebel Awlia on the White Nile. In Egypt, the Old Aswan Dam on the main Nile is no longer used to store water but as a regulator to better utilise the Nile water.

The construction of these dams shows how co-operation between different countries on the Nile, in this case Uganda, the Sudan and Egypt, leads to better utilisation of the Nile water, and is in fact a good example for the use of shared rivers. It is hoped that this type of co-operation will continue in the future and further develop among the ten nations of the Nile Basin.

In Egypt, the following hydraulic control structures are in existence on the Nile river: the Old Aswan Dam, Esna Barrage, Assiut Barrage, Nagah Hammadi Barrage, Delta Barrage, Edfina and Zifta Barrages, (Fig 2).
Figure 1: Schematic for Nile River Yield
Figure 2: Schematic Diagram of Nile River Control Works
4 Upper Nile Conservation Projects

At present, considerable quantities of the Nile waters are being lost in the swamps of the Bahr El Jebel, Bahr El Zeraf, Bahr El Ghazal and the River Sobat. The total amount lost annually without being made use of is estimated at 42 km$^2$. It was considered essential that these losses be prevented or reduced as much as possible and the yield of the river increased for use in agricultural expansion. The following is a brief outline of the main projects for the utilisation of lost water in the Upper Nile.

5 Co-operation in the Nile Basin

Water resources can be developed by maximising the Nile yield, which represents only 7% of the total rainfall on the Nile Basin, by bilateral and regional co-operation among the Nilotic countries.

5.1 Joint Projects between Egypt and the Sudan

Considerable amounts of Nile water are lost in the swamps of the Bahr el Jebel, Bahr el Zeraf, Bahr el Ghazal and Sobat rivers. It is essential that efforts be made aimed at minimising these losses and increasing the yield of the river for use in agricultural development in the two countries without causing any negative effect on the environment. The two countries agreed that the Sudan, with the agreement of Egypt, will construct projects in the above-mentioned regions in order to ensure the technical co-operation between the two governments and to continue the hydrological survey of its upper reaches. The two governments agreed to form a Permanent Joint Technical Commission known as P.J.T.C for Nile Water.

5.2 Joint Projects between Egypt and Uganda

The co-operation between Egypt and Uganda was greatly strengthened since the construction of the Owen Falls Dam in Uganda. Meanwhile, many projects would be executed between the two countries in the field of weed control, and hydropower generation, where private investment could be encouraged.

5.3 Regional Co-operation

The co-operation between the riparian countries started in 1967 with the assistance of UNDP by the establishment of HYDROMET, and is continued in TECCO NILE with the assistance of CIDA. This co-operation should be strengthened to carry on the activities of the Nile Basin River Action Plan (NBRAP) for the purpose of ensuring a sustainable development of the Nile Basin for the benefit of all riparian states.

In spite of the efforts made to date to conserve the water resources of the Nile, and to control them in the lower Nile Basin in Egypt and the Sudan, the demand for water from such water resources for various uses, in particular for irrigation, is on the increase. Under the present circumstances, a water resources' deficit can be forecasted for the next two decades. The amount of water needed by the riparian upstream countries to meet the food requirements of their growing populations will also be increasing. So, additional water resources must be created to meet the comprehensive water resources' requirements of the Nilotic countries in the two decades to come. This is possible by reducing evaporation and evapotranspiration losses in the swampy areas. Such water resources management can be achieved by means of
development schemes of yearly and year-round storage in the lakes, taking into account the environmental constraints within the scope of regional co-operation among the Nilotic countries.

The River Nile in its upper reaches is one of the least developed rivers in the world. The distinctly differing meteorological, hydrological, and physical characteristics of the White Nile Basin and its swamps and lakes and the variable seasonal flows of the Ethiopian plateau make for great development options.

There is also the fact that the specific yield of the River Nile is very low compared with that of other large rivers in the world, because it is passing through vast arid and semi-arid areas in Egypt and the Sudan. The potential of hydropower in some countries, such as Ethiopia and Uganda, is significant. So, the approach to developing the river is different from one area to another, and the socio-economic benefits can be gained from the River by different approaches.

5.4 The Win-Win Solution

The River Nile provides a very low specific yield, but it is one of least developed rivers in the upper reaches. The win-win solution is favourable and will offer a lot of socio-economic benefits. The river must be looked upon as one hydrologic unit and a sustainable, environmentally sound development plan should be our goal.

Co-operation among some of the Nile Basin countries started in the form of Bilateral agreements at the beginning of this century, but regional co-operation started in 1967 by the formation of the Hydrometeorological survey of the catchments of Lakes Victoria, Kyoga, and Albert (the Hydromet Project). The project lasted 25 years, until 1992, in which considerable amounts of hydrometeorological data were collected, and photography, ground and hydrographic surveys took place. The training of staff of participating governments was also a major activity of the project.

Ministers responsible for water affairs in the Nile Basin countries met in Kampala, Uganda, in December 1992, and agreed that future co-operation on water resource matters should be pursued. They agreed that these matters should be pursued for a transitional period, under the name of 'Technical Co-operation for the Promotion of the Development and Environmental Protection of the Nile Basin' (TECCO NILE). An agreement to this effect was signed by Ministers from the six countries of Egypt, Rwanda, the Sudan, Tanzania, Uganda, and Zaire. The other four countries, i.e. Burundi, Kenya, Eritrea and Ethiopia, participated as observers.

A Council of Ministers of water affairs, COM, was formed with a technical committee acting as a steering committee for this framework. The long-term objectives are as follows:
- To assist participating countries in the development, conservation and use of the Nile Basin water resources in an integrated and sustainable manner, through basin-wide co-operation for the benefit of all.
- To assist participating countries in determining the equitable limits to be set for each riparian country to the use of Nile waters.

5.5 The Nile Technical Advisory Committee (TAC)

It was proposed to the COM to form a new transitional institutional mechanism with all riparian states as equal members to succeed TECCO NILE until the final institutional and legal framework for co-operation is formed, which is one of the activities of the Nile River Basin Action Plan, under a regional co-operation category. The NRBAP comprises the following five main Categories: Integrated Water Resources Planning and Management,
The River Nile Basin: A Vision for Development

Capacity Building, Training, Regional Co-operation, and Environmental Protection and Enhancement. It was agreed that a shared vision could be legitimised by action on the ground, action that benefits the peoples of the subbasins of the Nile.

5.6 The Main Activities Proposed in the Basin as a Strategic Action Program:

A Shared Vision Program
This program would articulate a shared vision and comprise a limited range of effective activities to create a co-ordination mechanism. It is composed of different main activities as follows:
- Stakeholder involvement and awareness
- Economic and sectorial analysis
- Win-Win planning and scenario development
- Applied Training
- Institutional and legal co-operative framework
- Capacity building and human resources development.

5.7 The Subsidiary Action Programs

International experience confirms that it is often visible development that provides the incentives for transboundary co-operation and sustains political commitment. In the Nile Basin, there are strong indications that there exists a substantial Win-Win solution across the basin. This action program would plan and implement action on the ground at the lowest appropriate level, taking into account benefits and externalities of activities planned for other countries.

The main activities are as follows:
- River regulation
- Water harvesting and conservation
- Hydropower generation
- Irrigated food production
- Watershed management and soil erosion control
- Reduction of evaporation losses from swamps
- Development of fisheries
- Transport and navigation development
- Eco-tourism development
- Weed control
- Waste water treatment, pollution control and water quality management
- Water use efficiency improvement.

It should be noted that the shared vision program and the subsidiary action programs are supporting each other. The proposal on these activities is still subject to COM approval.

6 Measures towards Effective Technical Co-operation

Lessons derived from the past thirty years of technical co-operation in the Nile Basin have shown that several elements have to be secured in any co-operative framework for effective technical co-operation and hence sustainable development in the Basin. These are:
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a) Political Commitment
The Nile Basin is one of the least developed basins in the world. This is mainly due to lack of political commitment. Therefore, to this effect, in its meeting held in March 1998, the Council of Ministers (COM) proposed to hold Heads of States' summits, in which their commitment will enhance and foster co-operation among the Nile Basin countries. However, this momentum must be maintained.

b) Awareness Program
There is a need to establish an awareness program in the Nile Basin countries, which should not be limited to just the public but also be extended to the decision-makers and professionals. This is because enhancing the awareness of decision-makers is essential to political support, while enhancing the awareness of professionals is essential to technical support. On the other hand, enhancing the awareness of the people and their representatives is crucial to supporting any programs or projects in the Nile Basin.

c) Donors' Support
Most of the Nile Basin countries are very poor and some of them rank among the poorest countries in the world. This financial situation has hampered the economic development in the Basin. Therefore, donors play a crucial role in contributing substantial funds in order to enable the shared vision and subsidiary programs to be implemented. However, the Nile Basin's contribution should be that of providing an environment conducive to co-operation.

d) Human Resources Development
A cadre of highly trained professionals is the core of the technical co-operation in the Nile Basin. Therefore, training programs in various fields, such as: International Water Law, GIS, Mathematical Modeling, and other aspects, are extremely important to enhance the capabilities of professionals and to create a common understanding of the Nile Basin problems.

e) Institutional Capacity Building
It is common in the Nile Basin countries to find duplication and overlap among the many institutions involved in water-related activities. Also, the capabilities needed to play their roles and achieve their goals are limited. Therefore, institutional capacity building is required to enhance technical co-operation and avoid duplication of work. Some of the ongoing projects in the Nile Basin, such as the Nile Basin Water Resources Project, are also aimed at enhancing institutional capacity building. However, more efforts are required in this regard.

7 Conclusions and Recommendations
- Mutual trust and goodwill of member states are necessary for technical co-operation among the Nile Basin countries.
- Objectives of technical co-operation among the Nile Basin countries should be well focused and sound.
- Strong commitment by member states, both technically and financially, will enhance technical co-operation among the Nile Basin countries.
- Emphasis on socio-economic needs is recommended.
- Emphasis on construction rather than planning is more effective with respect to the development process.
Active support from External Support Agencies (ESAS) is indispensable for the development of the Nile Basin.

References

SOME ASPECTS OF RIVER BASIN MANAGEMENT IN VIETNAM

Prof. Ngo Dinh Tuan ¹, Dr. Le Dinh Thanh ¹

Vietnam is a tropical monsoon country with more than 20 river systems. The natural conditions make it difficult to develop and manage the natural resources, especially water resources. Typhoons, floods and droughts are the typical natural disasters in Vietnam. In the field of river basin management, Vietnam has not a great deal of experience. In this paper some aspects of the river basin management are presented briefly.

1 Brief background information on water resources in Vietnam

In Vietnam, there are about 2,360 rivers with a length of more than 10 km and about 300 lakes and lagoons. Up to now, more than 750 large and medium-sized reservoirs and several thousand small reservoirs have been constructed. These reservoirs are intended to be used mainly for agricultural irrigation, power generation and flood control.

Water resources of Vietnam

The estimated average yearly volume of surface water of Vietnam is about 830 billion m³, of which:
- generated inside the country: 310 billion m³/year
- flowing into Vietnam from neighboring countries: 520 billion m³/year (mainly on the Red river system in the North and the Me Kong river system in the South of Vietnam).

The potential groundwater supply is about 50 billion m³/year. The groundwater is distributed mainly in the plain regions of river valleys.

In general, more than 90% of the total sediment load of the rivers is concentrated in the flood season. The average and maximum sediment densities of some typical rivers are as follows:
- Thao river, at Lao Kai site: average 2,844 g/m³, maximum 21,000 g/m³
- Da river, at Ta Bu site: average 1,258 g/m³, maximum 13,600 g/m³
- Total sediment volume of the Red river at Son Tay site: 118.3 million tons/year
- Total sediment volume of the Me Kong river at Tan Chau + Chau Doc: 104 million tons/year.

Some unsustainable factors of water resources in Vietnam

1. Water resources vary a great deal in space and time during the year:
   a) The annual rainfall in Vietnam is about 1,800 – 2,000 mm but in some places it reaches 3,500 mm (Ha Giang province, and upper Dong Nai river) or even 5,000 mm (Thua Thien Hue province). In other places it is only about 400 – 700 mm (Binh Thuan and Ninh Thuan provinces). In coastal areas the daily maximum rainfall reaches up to 700-800 mm or even 1138 mm (Ta Luong, Thua Thien Hue province), but in the inland areas it is only about 150 – 200 mm.
   b) The water volume during three months of flood season constitutes 75-80% of the total water volume of the year. Where there are high rainfall and thick forest cover, a basin of 1 km² already ensures continuous runoff throughout the year; but where there are less rainfall and no dense forest cover, even a river with a basin of more than 500 km² can run dry in the

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dry season. Floods are very high, especially in the rivers along the coast of Central Vietnam because the slopes of the basin and the rivers are very steep. The observed maximum flood reaches up to 25 m³/km² for a basin area of 100 km².

2. Unbalance of water resources in utilization and exploitation
a) The annual water volume flowing into Vietnam constitutes about 62.3%, the water generated inside Vietnam only 37.7% of the total yearly water volume. The water of the Me Kong river flowing into the delta is about 57% of the total water of the country, but only 4.18% of this is generated in Vietnam itself. It is very difficult to make and decide on the strategy for exploiting and using the water sensibly (especially with respect to fresh water supply, flood control and salt water intrusion control) when the use of water in upstream areas is increasing in the dry season.

b) The water volume with a frequency of 75% is about 733 billion m³/year, of which in the dry season only 170 billion m³. The total water demand in the year 2010 will be about 126 billion m³. Consequently, in many rivers in the South of Vietnam the fresh water demands will be more than 35% or even 70% of the water resources of the river. In 2010, the water demand in the dry season will be 91 billion m³, about 20-40% of water sources in the dry season in the rivers of the North, and even up to 140% for some rivers in the South of Vietnam.

3. The shortage of water resources is increasing
Due to the global climate change, the annual rainfall and runoff of rivers in Vietnam have a reducing, and evaporation an increasing trend, while all water demands are rising quickly, such as water for domestic uses, irrigation, but especially for industrial uses, tourism and other services. These will constitute many sources of water pollution if no measures for treating and controlling the water resources of rivers are taken.

4. Increase in water disasters
a) Typhoons are increasing in intensity and frequency. On average, the increase is about 0.6 typhoon per decade. The strong typhoons (levels 10-12) have occurred more frequently in recent decades; they make the water surge by more than 2.0 m along coastal areas where they land. According to recent estimations, the sea water level has an increasing trend of, on average, 0.2 cm/year. The phenomenon of erosion and deposition in river mouths and estuaries is increasing dangerously.

b) The maximum daily rainfall is increasing. The upstream forest areas are reducing continuously (for example, in 1941, 43.8% of the total natural area in Vietnam was forest area, in 1975 29.3%, and in 1990 25.5%). This leads to increasing annual maximum floods, and flush floods occur in almost all regions of the country, especially in small basins in mountainous areas with less cover.

c) The runoff in the dry season is reducing due to:

- reduced rainfall in the dry season
- reduced regulation effects of upstream forests
- water exploitation and use by weir systems upstream.

These make the dry season start earlier by about 1-2 months, and salt-water intrusion into the rivers occurs for longer periods. In the 1990s, droughts occurred in many parts of Vietnam, and now drought has become a big problem for agriculture.

5. Water pollution is more serious
a) In general, the water quality of rivers, lakes, and reservoirs is presently good enough for use purposes. But in industrial and urban zones and near tourism activities, the water is being
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polluted. In the near future, the pollution situation will become more serious if urbanization and industrialization develop rapidly without control and management.

b) Agricultural activities using fertilizers, pesticides and chemicals are also starting to reduce the water quality in canals, rivers and also in soil. In Vietnam, wastes from the food industry are also polluting water and soils.

2 Some aspects of integrated river basin management in Vietnam

For any river basin, the natural resources water, forest and soil should be managed. The resource water plays a very important role in the economic and social development of any country, and also in the development and balance of ecological systems. Therefore, river basin management is water resources management on the basis of the concept of sustainable development.

Status of integrated basin management in Vietnam

There are many 'owners' in the water management of the river basin, so that many overlaps occur in this management, for example:

- supply water for industry (Industry Ministry)
- supply water for domestic use (Construction Ministry)
- supply water for agriculture (Agriculture and Rural Development Ministry)
- water quality and water environment (Science, Technology and Environment Ministry)

This situation is very difficult for integrated river basin management, because each 'owner' has its own plan and investments for water uses.

1. There is a lack of cooperation between the companies and institutions in the field of water supply, drainage and environmental protection (rainfall water, waste water from domestic activity and industry).

2. In terms of water use and management, the relationship between upstream and downstream parts is not yet so good due to the fact that there are many basin 'owners'; this leads to some conflicts in planning and managing the water resources.

3. In Vietnam, there are still no country-wide strategies or policies for the exploitation and integrated utilization of water resources or for water resources protection.

4. There are some projects in river basin planning but they have not yet been approved officially.

5. In water resources research and management, there are still no official documents or books with statistics and monitoring results of water resources, not even for large rivers such as the Red river and the Me Kong river.

6. The traditional concept in water use of the Vietnamese people is that "water comes from nature." This is one of the reasons why incorporating water management issues into policy and law is a difficult and slow process.

7. The Water Resources Law of Vietnam has been approved and issued by the Vietnam Assembly in May 1998, but up to now it has been difficult to apply, because:
   - the guide documents based on the law are lacking
   - the frameworks for water resources management at the state, local and river basin levels have not yet been created.
International Workshop on River Basin Management

The content of management in river basin planning defined in the Water Resources Law of Vietnam:

1. The Activities of Management:
   a) Set up, report on, approve and supervise the implementation of the river basin planning, ensuring consistent management between river basin and administration territory.
   b) Carry out the co-ordination between related institutions of different Ministries, Sectors and Provinces concerning basic investigations, statistics, and the assessment of the water resources of the basin, and also concerning the setup, reporting on, approval and supervision of the implementation of the planning of river branches.
   c) Propose the solution to conflicts on the water resources in the river basin.

2. The Institution for managing the river basin plan belongs to the Ministry of Agriculture and Rural Development. The Government has defined the organization and activities of this institution.

Some typical measures used in river basin management in Vietnam

1. Improve the knowledge of people on water saving, environmental protection, reforestation and forest protection, strictly enforcing the laws, especially the Water Resources Law and Environmental Protection Law and other related regulations.
2. Implement the water saving measures, improve the efficiency of water works and irrigation systems.
3. Establish the limitations for the exploitation of surface and groundwater for the sake of environmental protection.
4. Develop the strategy to redistribute the water resources over the country and in each region.
5. Plan the exploitation and sustainable utilization of water resources of whole river basins (upstream and downstream areas).
6. Carry out reforestation and protection in upstream areas of the basin, and also in hill, plain and sand areas in coastal regions.
7. Construct upstream reservoirs for water regulation, flood control, water supply and also for microclimate, water table and soil improvement.
8. Plan the sea dike system, reduce salt-water intrusion and improve coastal protection.
9. Strengthen the river dike systems, carry out river training, control the erosion after dams and weirs and sedimentation in the river mouths.
10. Water should be considered as a good and must be managed in a consistent manner from the central government to local provinces, with the river basin as intermediary.

3 Typical examples of the activities and measures for integrated river basin management in Vietnam

Red River Basin

1. Propose the re-establishment of the Committee for Red river basin management.
2. Report on and approve the official river basin development planning.
3. The activities and measures for river basin management are as follows:
   a) Typhoon and flood control, including:
      – Constructing reservoirs on Da and Lo rivers (two largest branches of the Red river system in the North of Vietnam) combining with energy generation, water supply and shipping.
      – Planting and protecting about 1.3 million ha of forest in upstream areas of the Red river basin.
River Basin Management in Vietnam

- Strengthening the forecast and warning system for the purpose of flood control.
- Preparing and constructing the region for storing or diverting the flood water when extreme floods occur.
- Carrying out the river training and strengthening the river dike and sea dike systems along the coastal line of the Red river delta.

b) Water supply and Drainage:
- Improve the efficiency in management of large existing reservoirs (Thac Ba, Hoa Binh in the North and Tri An, Dau Tieng in the South).
- Optimize the operation of the Hoa Binh reservoir on the Da river (Red river system) for flood control and irrigation in downstream areas.
- Improve the efficiency in the management of irrigation systems in the whole basin and delta.
- Enhance the water supply and drainage systems of the cities, industrial zones, and low land areas, and also plan the systems for pollution control and waste water treatment.

Me Kong river Delta
At present, we have the International Me Kong River Commission which includes four countries (Thailand, Laos, Cambodia and Vietnam). Vietnam is the lowest country in the basin, and the Me Kong delta is the most sensitive area with respect to environment and ecology because any changes in water quantity or quality in upstream areas will have an effect in the delta. That is why Vietnam pays much attention to the management of this delta. Now we are trying to:
1. Propose setting up a suitable institution for the management of the Me Kong delta (Me Kong Delta Committee). This must maintain close relations with the International Me Kong River Commission.
2. Develop integrated planning for the Me Kong river delta and a report for official approval.
3. The activities and measures for integrated management:
   a) Improve the efficiency of flood control to ensure:
      - Cultivating 2-3 rice crops
      - Improving the salt and alum soils
      - Using the suitable crop pattern with a higher value of products, especially using the new rice crop with less water demand.
   b) Improve the system for controlling and monitoring the flood by:
      - Heightening the dike system of the cultivated areas.
      - Carrying out the river training enabling the flood to flow effectively to nine river estuaries of the Me Kong river.
      - Diverting a part of water volume at the beginning of the flood season to the western sea by improving old canals and constructing some new canal with flood control works.
   c) Supply the fresh water for rural areas, limit the salt-water intrusion, plant and reforest the mangrove forests along coastal areas of the delta.
   d) Develop the environmental planning and control the environmental pollution in the whole delta.
   e) Develop close relationships between the Me Kong Delta Committee, the Me Kong river Committee of Vietnam and the International Me Kong River Commission in order to regulate the rights in water utilization for the purpose of sustainable development in the delta and the whole basin.
References


Summary

The National Water Commission (NWC) is responsible for administering the national waters and their inherent public goods as well as recognizing the rights and ensuring users' compliance with obligations, thus contributing to the realization of the objectives of the National Development Plan, since it provides legal security to users, promotes the social and economic development of the country and protects the environment.

Our country is still faced with scarcity, waste and water-pollution problems, giving rise to less water being available that has the correct quality for the most important uses, a conflicting situation for users, states and regions. This document outlines the strategies established by the National Water Commission for granting legal security to users with respect to water-use rights, as well as the corresponding advancements, invariably considering user participation to be a fundamental aspect in deciding what uses have priority and what water quality they want for their rivers, lakes, underground waters, etc.

1 Introduction

The Mexican Government National Development Plan 1995-2000 establishes as a main premise that economic development must be attained in harmony with the environment, where water plays a fundamental role.

The main international forums related to water agree that the natural scarcity of water is worsened by squandering and water pollution, which menaces four fundamental aspects of human safety and security:

- Food production
- Human health
- The ecosystems balance
- Social, economic and political stability

Mexico has 93 million inhabitants, a surface of almost two million square kilometers and an annual average rainfall of 777 millimeters, which equals an average per capita availability of 5,000 cubic meters yearly, enough quantity according to international standards, but its uneven distribution in space and time and the scarcities of water with the correct quality for different uses result in frequent conflicts among users and regions. As for water use, approximately 210 million cubic meters are extracted annually, of which 58% is allotted to generating electric energy, 32% to agricultural activities and 10% to public, urban and industrial use.

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2 Legal Framework

The Mexican Constitution provides in Article 27 that water, including underground water, belongs to the nation and can only be used by concession of the government. In 1926, the Law on federal water irrigation was promulgated, which focused on water use for agricultural purposes, giving rise to large irrigation districts being created in the northern part of the country.

The growing demand for water for different uses required a new law aimed at and regulating the use of water, so the Federal Waters Law was published in 1972, and the first regulation on prevention matters and pollution control was issued.

After twenty years, the Federal Waters Law could not fully deal with problems which emerged when resource usage and pollution intensified. As a result, the President sent the Congress the National Waters Law initiative; once approved it was put into effect on December 2, 1992.

The National Waters Law reaffirms the principle that water use will be carried out through a concession granted by the Government through the National Water Commission (NWC). Among the most important objectives are the following:

- To regulate the use of the national waters, the distribution and control thereof as well as the preservation of the quality thereof in order to attain a sustainable development of the resource.
- To entirely administrate surface and underground water, in quantity and quality.
- To take the hydrographic basin as a frame of reference for planning and handling water use harnessing.
- To sponsor greater participation of users in harnessing and administering resources through basin councils.
- To establish a water market through concession transfer regulated by the Water Rights Public Registry (WRPR).

In the concessions granted, rights and obligations of the users pertaining to the use of national waters are established; in addition, in order to discharge waste waters into riverbeds, rivers, lakes or the sea, a permission is required which indicates the maximum allowable values for polluting substances contained in the discharge.

The National Waters Law integrates three different basic instruments enabling adequate water resource management.

Regulatory:
- Defines the user rights and obligations for water use and discharges and sets terms and dates for complying with the Law, as well as sanctions and defense mechanisms for the user.
- It recognizes the need for maintaining "ecological flows".
- The Federal Government can reserve water volumes required for the public interest.
Economic:
- Establishes the obligation to pay for the rights to use national waters, for services provided by the National Water Commission and it also provides that water rights can be commercialized through the regulated market.

Participation:
- It considers the participation of society through its basin councils which coordinate between the users and Federal, State and Municipal authorities, whose purpose it is to take advantage of the resource in whatever terms society defines.

In relation to economic instruments, there is another legal provision fundamental to attaining an efficient use of water and preserving its quality: The Federal Law of Rights. This fiscal law is based on the user pays principle, which relates to the availability of the resources, and the polluter pays principle.

With regard to the polluter pays principle, the Federal Law of Rights establishes the charges to be levied on wastewater discharges into recipient bodies. The charge depends on pollution concentrations, the water volume discharged, the use of the recipient water, and its capacity to assimilate pollution. In this connection it should be pointed out that the objective of such charges is, apart from revenue raising, to stimulate the cleansing of water recipient bodies, so that users who present projects for improving their production processes and/or build wastewater treatment plants do not pay, nor do those who comply with quality regulations.

Since 1989, the Federal Law of Rights has promoted changes, since the Congress can carry out annual revisions, among which the following stand out:
- Adjustments in the charges to be levied so that they reflect the opportunity costs of the resources.
- Inclusion of contributions that help waste-water treatment.
- Reduction of administrative processing charges in order to benefit low-income users.
- Adopt charges to be levied on non-consumptive uses such as the electric sector.

3 Strategies of the National Water Commission for Improving Water Use Management

The water management process begins with the applications filed by users for the use of national waters and their inherent goods. NWC makes the evaluation and, if positive, will approve the application if a concession is available; it is subsequently registered in the WRPR and the document that lawfully guarantees their rights is finally issued.

Before 1992, 1,200 concessions were granted mainly because high officials operating at regional levels did so while not being authorized to do so, since concessions could only be approved by three persons (the President of the Republic, the Agriculture and Hydraulic Resources Secretary and the Assistant Secretary for Hydraulic Infrastructure). Besides, provisional permits had also been issued with which users considered their right to use water to be protected. Since 1993, based on the new National Waters Law, an intensive title holding program was started, taking into consideration the following aspects:
- Delegation of powers to regional and state areas with respect to title approval.
- The priority to be given to actions to regulate users that made use of large volumes was established.
- Simplification of procedures requiring just one request for hydraulic services.

In this context, 22,013 concession titles were issued in the 1993-July 1995 period.
Subsequently, in October 1995, three presidential decrees were published, which granted administrative facilities and forgave taxes due by national water users, which solved the main legal and economic problems that prevented facilitating the user regulatory process. Among the facilities provided by the Decrees are:

- Not paying for the administrative processing services relating to obtaining their concession titles.
- Forgiving the payment of the fine for not having the documentation authorizing the extraction and/or discharge of water.
- Forgiving all or part of the amount of certain charges due for water use.

To disseminate the decrees, intensive promotion campaigns were engaged in by radio and the press, as well as through meetings with chambers and entrepreneurs' associations and rural organizations, including agreements with the Indigenous National Institute, so that through its broadcasting systems in different tongues the benefits of the above-mentioned decrees were conveyed to rural communities.

During the period in which the decrees were in force, i.e. between October 12, 1995, and October 11, 1996, some 176,000 users applied, of which 56% relates to the farming sector. Nonetheless, since this number only represented 50% of the total estimated universe, it was necessary to extend the terms so that other users could also enjoy the benefits by setting for the farming sector and rural communities a deadline until December 31, 1998, for applications to be filed. Also, the criteria for granting concessions under a scheme based on the principle of trusting the users were changed. Thus, the concessions were granted for a ten-year period and the volumes requested by the users were authorized. After this period, the volumes will be adjusted, with the users' joint participation, according to water availability, through basin councils which are the coordination agencies between authorities and users.

Due to these actions, by December 31, 1998, the total number of applications filed by users had reached 374,185, of which 132,280 belong to the farming sector, 65,177 are for the use of federal zone areas, 10,434 are for industrial, commercial and service enterprises, and 166,294 are local. As a result, by June 30, 1999, there were 265,327 titles on record in the Water Rights Public Registry (WRPR).

On the other hand, as regards the simplification of procedures to be followed by users before the National Water Commission, amendments were made to the National Waters By-Law in the following aspects:

- Expiration of concessions for water volumes: The National Waters Law provides that concessions for water volumes granted to users but not used in three consecutive years will expire. Nonetheless, for the purpose of motivating users that have improved their industrial and service processes to make more efficient use of water and to encourage the treatment and re-use of waste waters, some changes were made to the by-laws regulation, signaling the cases in which the expiration on account of non-use will not become operative:
  
  • If an infrastructure was built making the use of water more efficient.
  
  • In case there is enough installation capacity, but the total water volume is not being used because it is being reserved for future growth or expansion.
  
  • When more than three years are required to build the necessary infrastructure and installations in order to benefit from the total volume of water granted.
Transfer of rights to the use of water: To stimulate the water market and remove obstacles limiting it, the National Waters by-law was amended so that now users are able to transfer their rights separately from the land property right, including the possibility for use to be changed. This will also facilitate the expansion of production plant capacity, stimulating the creation of new job opportunities. Similarly, it will sponsor reducing transaction costs (having to buy land that will not be used).

In relation to fiscal matters, the annual reforms to the Federal Law of Rights were put forward simultaneously, and have made it possible to update the charges to be levied for the use of national waters and waste-water discharge, also facilitating regulation of the low-income resource users, exempting them from paying administrative processing cost.

And with the intention of reaching the goals set in tax-collecting water matters, Federal actions aimed at broadening the taxpayers' base were intensified as were awareness campaigns through mass media, reminding users of their duties as taxpayers. Also, in order to facilitate payments, banks were engaged to receive taxpayer payments throughout the country.

User control actions were intensified in order to guarantee the proper implementation of the existing legislation, assuring that users comply with the provisions in their concession titles or discharge permits.

In compliance with the Public Administration Modernization Program, a specialist group has been formed in the National Water Commission, competent in water use management matters, simultaneously incorporating advanced technology in computer science and telecommunications matters, making it possible to improve the scarcely available human resources in the National Water Commission.

The NWC institutional answering capacity was increased, installing more offices throughout the country, while mobile offices were improved to attend to the localities of the users, thus moving the service nearer to the user. Additionally, the staff tending on customers was given additional training, giving the user greater comfort and personal attention.

4 Other Actions

Throughout the present administration, the National Water Commission has focused its efforts on modernizing the institution's role. Its main function is to promote and coordinate the financing of the necessary infrastructure to cover the needs of the population, and promote the decentralization of services to the state and municipal governments, supporting through adequate water resource management sustained and sustainable economic growth benefiting all Mexicans, in order to so create in the medium term an environment of equality, certainty and trust concerning water profit and use. Similarly, the foundations are laid enabling attaining a promotion investment process, the creation of transfer markets and financing with the participation of the whole society.

In the context of decentralization, it is being contemplated to separate administrative functions from operational functions, and transfer some operational functions to the users, carrying out in an integral manner the planning and management of water harnessing at basin levels, while keeping at the federal level such functions as sustain regional interests in the Nation's interest and such decisions as affect more than one federal entity, while ensuring that the power and right to intervene in support of low-income users is always reserved to the Federal Government. This is leading to a new relationship between government and society, in which society will have greater participation in financing, building and operating new infrastructure projects, and the government will turn into a finance promoter and coordinator, as well as a decentralizing and service-evaluation agent, keeping the function it performs intact.
At this time, a modern water handling scheme has been introduced which takes into consideration the integration of basin councils conceived as coordination and entity agencies in order to contribute to the planning and creation of integral management actions and sustainable development of hydraulic resources. Choosing 13 hydrologic regions throughout the country, identifying 14 priority basins in which 80% of the water extracted by different socio-productive sectors is harnessed, and where the main pollution problems and extreme meteorological phenomena exist, such as floods and droughts.

When the user regulatory process and the respective title registration at the Water Rights Public Registry (REPDA) have been completed, mechanisms to carry out the transfer of water rights should be adequate, which may result in a potentially important Water Rights market. With this in mind, the existing regulation will have to be updated and new norms issued that regulate the market, including specific mechanisms that inhibit possessing more volume than that really required by the users.

In view of possible conflicts arising from the development of a water rights market, whether from the transfer of rights, monopolizing intentions or interbasin or interstate problems, it is proposed to create a federal entity with broad legal support to solve these problems.

As for tax-collecting matters and with the intention of introducing and promoting water-use efficiency, it is contemplated to include a charge equivalent to the cost that it represents for the NWC to administer the resources (similar to the property tax payment).

A new campaign has started that promotes water culture, based on permanent educational work at all levels and in all sectors of the population, creating awareness of the magnitude and relationship that exist among diverse problems caused by giving away the resource.

5 Conclusions

A main aspect of the adequate management of water uses is user participation as well as the taking of special follow-up measures outlined below:

- Improve knowledge about the availability of water by modernizing the measurement of flow and water quality of the network.
- Intensify the creation of basin councils so that they will operate in the year 2000.
- Together with the users, undertake actions aimed at reducing the overexploitation of water supply sources within the framework of the basin councils.
- Engage in the reconstruction and development of the institutional capacity of the National Water Commission within the framework of the Public Administration Modernization Program.
- Improve the quality of attention given customers in the course of the concession and permission granting process, as well as in water-rights transfer control.

On the other hand, it is to be expected that by abiding by the law the users will be able to present inconformities. The courts should also be trained to issue resolutions conforming to the law. In addition, the Commission should be prepared to efficiently assume the role of arbiter when users are seeking relevant arbitration.

Another main aspect is the improvement of information systems for the registry and control of applications filed by users and the fulfillment of their administrative and fiscal obligations, for the purpose of supporting decision-making at managerial levels based on trustworthy and opportune information.

Finally, it should be noted that one of the key aspects in attaining sustainable development for water use is education. Therefore, it is necessary for primary-level teachers to create awareness of the importance of using water efficiently and preserving its quality. In this sense, the National Water Commission is promoting an initiative called the National Water
Movement, with the object of creating broader awareness of the importance of an adequate handling and preservation of water, in which the active participation of users will have a fundamental role.
FLOOD / DISCHARGE MANAGEMENT; RHINE ACTION PLAN ON FLOOD DEFENCE

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1 Introduction

Floods are recurrent natural phenomena that play an important role in the management of most European rivers. It is well known that man has increased the risk of river floodings due to hydraulic interventions, intensive building activities and the use of all areas in the vicinity of rivers. To aggravate the situation, today's knowledge about the effects of climatic changes indicate that a general increase of floodings is to be expected in the next century. Improved flood prevention and protection remain indispensable, in the future even more so than ever before.

Since every river and its catchment area have their own typical physical (hydrology, morphology, climate, ecology, etc.) and socio-economic characteristics, it is very important to take them into account when working out river basin flood prevention and protection plans. Important experiences on this issue have been gained recently in the basin of the Rhine, where a flood prevention plan has been developed within the framework of the International Commission for the Protection of the Rhine, which was adopted last year by a Conference of Rhine Ministers.

Since in flood management so much depends on the characteristics of the river basin, it does not make sense to develop one single concept for dealing with this issue. However, as the concepts of risk and risk management are generally valid, the experience in the Rhine basin could be applied even in arid or semi-arid areas covering over 55% of the world's surface. Basically, risks of damage by flooding are the combined result of flooding risks and vulnerability.

Some basic ideas and actions for the Rhine basin which were laid down in the Rhine action plan on flood defence, are discussed below. These ideas and actions can be drawn upon by other joint bodies when developing plans for flood management.

2 General

On January 22, 1998, the 12th Conference of Rhine Ministers adopted the "Action Plan on Flood Defence" in Rotterdam, involving costs of up to 12 billion ECUs. This Action Plan aimed at the improvement of precautionary flood protection (= flood prevention) will be implemented over the next twenty years.

This Rhine Action Plan marks a change in thinking about floods: from purely defensive action to the management of risk. This new approach opens perspectives on a wide variety of possible technical measures that can contribute to reducing the risk of flooding.

For the first time, there is an international commitment to giving considerably more expanse to the Rhine in the event floodings should occur. Over the last two centuries, the Rhine has lost more than 85% of its natural alluvial areas, as man used them for settlements or agriculture. Present countermeasures, such as the allocation of alluvial areas, their preservation and expansion, and improved water storage in the entire catchment area must be

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simultaneously directed towards an ecological improvement of the Rhine, its valley and its catchment area.

But man must learn again to live with floodings. According to current estimates, the total assets possibly affected in areas at flood risk may amount to about 1500 billion ECU. In the future, if flood plains cannot be kept free, flood risks must be taken into account when fixing land use and physical planning projects. Risk awareness must be improved and private precaution by people, trade and industry must be strengthened. Thus, damages can be avoided or reduced by adapted constructions in areas which are normally protected but nevertheless at risk of extreme floodings. The new Atlas of the Rhine presents the flood-prone areas and thus the problems related to floodings.

3 Targets

The most important targets of the Action Plan on Flood Defence are to reduce damages up to 10% by the year 2005 and up to 25% by 2020. Extreme flood levels downstream of the regulated Upper Rhine are to be reduced up to 30 cm by 2005 and up to 70 cm by 2020. These ambitious targets can only be reached if all flood-protection protagonists will closely and constructively co-operate. The hitherto practised sector-based way of thinking must be replaced by integrated reflection and action on a local, regional, national and international scale. First of all, the policy areas related to water management, physical planning, nature conservation, agriculture and forestry are concerned.

On January 22, 1998, the Rhine Ministers explicitly asked all those responsible to implement the necessary flood preventing measures with priority, even in times of financial bottlenecks. Time will tell whether we are capable of preventive and concerted reflection and action.

4 Principles of the Action Plan

Floodings are natural phenomena. The natural variation of water levels is part of the feature of rivers. It is the basis for river flow dynamics and the development of a typical flood-plain profile. Extreme floodings occur when intensive precipitation falls on soils which are already saturated due to previous precipitation or which are frozen and so cannot absorb any water. Extreme floodings can be influenced to a limited extent only. Various human interferences have clearly altered the river regime. Thus, the starting point is to remove these human interferences from the river regime, as far as possible. This means above all increasing water storage on the surfaces and in the flood plains, but also reducing the damage risks in flood-prone areas.

Flood damages are created by the interplay of two independent mechanisms. Nature - supported by man - dictates high-water levels. At the same time, man increases the values along the river and the damage risks. At a given time, the combination of floodings and the accumulation of values in areas at risk create more or less great damage.

The measures of the Action Plan are scheduled to go hand in hand with ongoing or planned measures for the protection and restoration of aquatic and terrestrial habitats in general, particularly in the Rhine valley. The improvement of the ecological situation must be integrated equally into all interdisciplinary plans in order to compensate for the ecological deficiencies of the past.

The demands of the Arles and Strasbourg Ministerial Declarations, issued following the floodings in the rivers Rhine and Meuse in 1995, take integrated reflection and action on a local, regional, national and supranational scale for granted. In this connection, contributions
of water management, physical planning, nature conservation, agriculture and forestry are required.

The contribution of water management:
- Reduction of discharge peaks by improving the soil seepage capacity, by storing water and by reactivating flood zones
- Ensuring runoff capacities and - where required - increasing them by river development
- Reduction of flow velocity by renaturation measures in streams in the catchment area
- Ensuring flood defence by dikes and walls
- Prolonging early warning times by improved forecasting

The contribution of physical planning and urban development:
- Preventive consideration of flood aspects when fixing land development and physical planning
- Protection of existing and potential runoff and storage areas
- Limitation of damage risks by keeping areas at flood risk free of unsuited uses and by increasing risk awareness
- Integration of streams into urban development; storage and seepage of precipitation in urban settlements
- Reduction of discharge peaks by protecting and developing free areas and equivalent land development

The contribution of nature conservation
- Reduction of discharge peaks by reactivating flood plains and renaturing water bodies
- Reduction of discharge peaks by preserving and restoring wetlands enabling water to be stored in the entire catchment area

The contribution of agriculture and forestry
- Reduction of discharge peaks by improving the seepage capacity of agricultural areas
- Reduction of discharge peaks by opening areas for flooding
- Reduction of erosion by suitable forms of agriculture
- Reduction of discharge peaks by natural forest development and afforestation

Close co-operation in these policy areas will allow the planning of measures which serve several aims at the same time. Not all measures may be justified by the aims of flood prevention. But they are justified in view of their positive effects in several fields of policy.

If flood damages are to be sustainably limited, it is important to influence the uses along water bodies. This will lead to success far more rapidly than the sole effort to sustainably influence floodings. Often, drainages may be reduced easier than flood stages.

Apart from the action in different policy areas it is important to strengthen precautionary measures. This issue directly addresses all those possibly affected by floodings: citizens, industry and trade.
5 The contribution of private precaution

Reduce damages by making adapted constructions, even in those areas which are normally protected but which may be at risk of rare extreme floodings.
Avoid or reduce damages by taking appropriate measures in industry or trade.
Avoid water pollution in cases of flooding by appropriate in-house measures (e.g. emergency plans).
As in other areas of life, insurance may constitute an instrument supporting private precaution.

The guiding principles in matters of preventive flood protection
1. Water is part of the whole - Water is part of the natural ecological cycle of all surfaces and of land use and must be taken into account by all fields of policy.
2. Store water - Water must be stored in the catchment area and along the Rhine as long as possible.
3. Let the river expand - We must let the river expand so that the runoff may be slowed down without any danger.
4. Be aware of the danger - In spite of all efforts a certain risk remains. We must learn again to live with this risk.
5. Integrated and concerted action - Integrated and concerted action in the entire catchment area is a prerequisite for the success of the Action Plan.

6 Action targets

Precisely defined action targets with closely related contents to be simultaneously pursued have been defined for the Action Plan. The measures connected with these targets are listed in the following chapter and must be carried out in successive stages. The Action Plan aims at preventing all flood situations, not only extreme events. The targets are ambitious but realistic. They demand considerable efforts, financial efforts as well as efforts of political implementation in order to change present ways of thinking and of use.

The Action Plan sets the following targets (reference year 1995)
1. Reduce damage risks - No increase of damage risks until the year 2000, reduction of up to 10 % by 2005 and up to 25 % by 2020.
2. Reduce flood stages - Reduce extreme flood stages downstream of the impounded part of the river up to 30 cm until the year 2005 and up to 70 cm until the year 2020.
3. Increase awareness of floodings - Increase the awareness of floodings by drafting risk maps for 50 % of the flood plains and the areas at flood risk by the year 2000 and for 100 % of these areas by the year 2005.
4. Improve the system of flood forecasting - Short-term improvement of flood forecasting systems by international co-operation. Prolong the forecasting period by 50% by the year 2000 and by 100 % by the year 2005.

These political targets are based on an estimation of the effects of a package of measures. The measures have been listed according to categories, costs and effects. (See ICPR report "Wirkungsabschätzung von Wasserrückhalt im Einzugsgebiet des Rheins", publication 2nd semester 1998)
7 Categories of measures

The effects and costs expected for five categories of measures are being compared below. There are separate comparisons for the years 2000, 2005 and 2020. In order to have a clear overview, effects and costs are presented for the entire period, starting in 1998.

The measures do not have the same effects in all cases of flooding along the entire Rhine. Therefore, the effects of the different measures cannot simply be added up, but the range of local and physical effects must be accumulated in order to obtain the precise sum of effects for a specific flooding at a particular place.

Today's knowledge of the effects of climatic changes indicates that in the next century a generally greater risk of floodings - also along the Rhine - is to be expected. Due to the existing uncertainties, all measures on flood protection to be taken from now on should simultaneously serve as many targets as possible. Some measures are not only justified in view of their effects in flood protection, but they also serve important targets in other fields of policy, as is the case of the renaturation of streams. This policy of "no regrets" opens up possibilities for great flexibility in choosing measures.

The effects of flood protection have been quantified as far as possible. For some categories of measures, it is, however, necessary to limit oneself to a qualitative description of the effects of flood protection and of other effects. The costs of the Action Plan are presented in pie charts for the three periods in order to show the part the states and the policy areas play in the Action Plan.
1 Introduction

The enormous effort that is currently being put into finding institutional arrangements that will support Integrated Water Resources Management and lead to sustainability, is both entirely appropriate and very difficult. There is no doubt that natural resource management is about managing people and institutions, hopefully in an adaptive way where change is possible as knowledge grows. This development comes after a long period of technocratic management and policy formulation which has created command and control systems, alienating people, and leading to decisions that are not responsive to different “world views”. One of the outcomes is water resource allocation that has starved non-human organisms of vital water of appropriate quality.

Some of the reaction to this technocratic past is to reduce understanding of the biophysical world to a bit player in policy formulation and management. This massive swing of the pendulum is as unhealthy as the technocratic past.

The challenge, however, is not to simply relocate biophysical understanding closer to centre stage, but rather to find linkages between institutional and biophysical analytical systems which have meaning for both groups of phenomena. Despite the evidence that many decisions in catchment management are not knowledge-based, those of us who believe that knowledge is important to natural resource management must continue to find ways of helping policy makers and managers to use knowledge. In the case discussed here, the knowledge largely comes from the natural sciences, but the same argument applies to all forms of knowledge relevant to catchments. Finding analytical frameworks that link knowledge to policy and management is therefore a continuing challenge.

It is worth reminding ourselves why knowledge is important. Without knowledge, there is ignorance of the biophysical workings of a system, of the economic, cultural and social bases for people’s decisions, of the economic imperative of the people affected by policy, and of the likelihood that institutions can adapt to new policy and still be useful. Without knowledge, there is no chance for adaptive management and for feedback from monitoring to policy. Without knowledge, sectional interests can capture the policy agenda, especially if such interests have powerful political positions, such as irrigators.

The central arguments of this paper are:
- Natural science is essential but is only part of the necessary knowledge base and array of activities involved in IWRM; and
- Natural science (like all other forms of knowledge) must be explicitly connected to policy and management.

To make the explicit connection between natural science and policy and management, policy should concentrate on the levers that are connected to the responsive parts of the biophysical system. Levers connected to unresponsive parts of the system are obviously of no value, and their creation wastes resources. Of course, the connection of levers to the wrong parts of biophysical systems is partly an outcome of poor conceptualization.

In the following brief exposition, attention will be given to spatial scale dependence of phenomena responsive to management; trajectories through time and therefore the efficiency

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of remediation and monitoring; and material budgets as a reality check on policy and management. Water quality, sedimentation, and nutrient pollution will receive most attention, but the principles apply widely.

2 Spatial scale dependence

An observer walking from the head of a catchment would note that hillslopes are steep and get gentler downstream, that stream channel segments between tributary junctions get gentler downstream, that hillslopes are connected directly into channels in the headwaters, but that further downstream hillslopes are separated from channels by floodplains and river terraces, and that some small channels debouch onto fans and therefore do not connect to the rest of the channel network.

A keen analyst would detect that transport rates of sediment and particulate nutrients, expressed per unit area of catchment, decline downstream along with water discharge per unit area. The analyst might also note, if sufficient data were available, that the rate of transport in the main rivers in the lowlands is highly correlated with both the rate of transport in the smallest headwater streams and the rate of hillslope and channel erosion in the headwaters.

Both sets of observations provide very clear messages: everything is not connected to everything else; headwater regions provide most of the sediment and, in rural catchments, most of the particulate nutrients.

The first message is not what most ecologists teach, and gives some hope of isolating parts of catchments for intensive management. The second message provides a target for management. Unless streams are enormously unstable, streambank stabilization in lower reaches will have little effect on sediment loads and turbidity.

There are a great many of these kinds of lessons and linkages to policy and management. Another that is worth telling is to do with spatial variability of drainage density (length of channels per unit area of catchment), a fundamental property of catchments. Hillslope length and gradient are clearly correlated with drainage density; in fact length of hillslope is the reciprocal of drainage density. Hillslope length and gradient are in turn, key factors in controlling the rate of soil delivery from hillslopes to streams. In parts of catchments where drainage density is high, we might expect hillslopes to be short and steep, yielding large amounts of sediment to streams, at least in headwater regions where floodplains do not intervene between channels and hillslopes. In these same locations, the channels are efficient conduits of sediment, storing very little and moving it quickly. A little further downstream, floodplains appear and channel erosion can contribute to the total load of sediment. This area is also one where stream gradients are still high, discharge is increasing, and so sediment transport capacity is high. Channel erosion is the result. But in many temperate catchments, hillslope erosion still dominates the sediment load despite channel erosion. In sub-humid to semi-arid catchments, channel erosion usually dominates.

Here is a further example of strong spatial scale dependence of processes and phenomena, providing clear evidence of the need to spatially target management and therefore policy. The policy levers in these examples need to be connected to a relatively simple measure of catchment connectivity and hierarchy. The stream network is the obvious candidate. Management guidelines could provide different advice for landowners, for example, who have low order (ie. headwater) channels on their properties, versus those further downstream on higher order channels.

To many professionals, these ideas and prescriptions are both obvious and perhaps even insultingly simple. Yet most of these relationships are either not well known or are not used in policy and management. One of the conjectured reasons for this situation is that most policy is of the “one size fits all” type, and strong spatial variability is very difficult to cope with. Also,
if cause and effect are not close in space, and in time, for areas of most management significance, then management targets are hard to define.

3 Trajectories through time

In many of the “frontier” catchments of the world, the conversion of vegetation cover for agriculture and/or pastoralism has set off channel incision and gullying. These are highly unstable and nonlinear systems, in which a small force produces a very large change. But gully erosion is also a self-damping phenomenon, in which the rate of spread of the gully network must slow as the fingertips of the network get close to the catchment boundary and run out of contributing catchment area.

The trajectories of such systems are predictable, at least in overall shape. A gully network will extend approximately logistically; that is, it will expand slowly, then rapidly, then slow down as it approaches an asymptote. Sediment yield from an expanding network will increase rapidly, steady, and then decline. The decline occurs after the network is at its maximum planimetric extent, and is the result of gully walls flattening and stabilising.

Knowing where a particular catchment is placed on such trajectories would be valuable to managers. There is little point in attempting to stabilize a gully network that is already at its maximum extent. Equally, there is every point in aiding the stabilization of gully walls even after the network has reached its maximum extent but before the walls have self-stabilized.

This example shows that management interventions should differ depending where a system lies on a temporal trajectory.

One more example in this section will suffice. Waves of sediment, or particulate nutrients, move down through catchments after initial disturbance in headwaters. Spatial analysis shows that headwaters should receive most attention as a source, but the time lag between disturbance and arrival of sediment downstream means that there will also be a lag between management intervention and improvement. Because of the loss of material onto floodplains, producing declining transport rate per unit area of catchment (see above), the impact of headwater disturbance will be more and more muted further downstream. The same is true of restoration measures, implying that monitoring the effectiveness of headwater restoration must be at a place where an effect could reasonably be expected; but not too far downstream.

Again the distance between cause and effect, both in space and time, poses a serious challenge to policy where accountability and demonstrable effects usually require clear cut results in relatively short periods of time.

4 Material budgets

Eutrophication of lakes is driven, in part, by nutrient enrichment. Catchment management in many parts of the world has concentrated on switching off sources of nitrogen and phosphorus. This has been relatively straightforward in the case of point sources, such as factories or sewage plants. Expensive, but straightforward! Much more difficult has been switching off rural diffuse sources.

What are the diffuse sources? Because of the dominance of experience in this field from North America and Western Europe, the automatic answer to this question is: feedlots and animal excreta, fertilizer in solution and/or in particulate forms washed off hillslopes.

In many parts of the world, phosphatic fertilizers produce little soluble phosphorus, feedlots are few, and hillslope erosion by sheet and rilling processes is not the dominant source of particulate phosphorus. In drier areas, gullying and channel erosion produces enough native phosphorus, derived from weathering of minerals such as apatite, to drive eutrophication once bottom waters of a lake have gone anoxic and the phosphorus has become
chemically available to cyanobacteria. In such systems, targeting feedlots, sewage outfalls, detergent usage, and sheet and rill erosion would achieve little. Yet the “one size fits all” mantra, which in this case is global, means that different management models have not been developed for different regions of the world, until recently.

Material budgets, for water, sediment, nutrients, carbon, pollutants, and pathogens are readily connected to the levers of policy. Choosing the appropriate conceptualization is crucial, so that sheet and rill erosion of hillslopes, channel erosion, landsliding and glacial processes are all included in a sediment budget if they all occur in a catchment of interest. The magnitude of their contribution to the transport of sediment, the storage of sediment, and to catchment yields is estimated. These calculations should take account of the spatial dependence of the components of the budget and, if appropriate, the temporal trajectory of these components.

The available management options can be considered in the light of a budget. The costs of pulling the appropriate levers can be calculated in a way that leads to a benefit/cost ratio of value to the actual system rather than the assumed system.

Of course this approach is based in natural science knowledge and is not preferred by many in the policy community. It is common place to apply generic (one size fits all) solutions to all systems, under the heading of “best practice”. It is not at all clear how this approach can apply to budgets, which are dominated by entirely different source types.

5 Concluding remarks

If a team trying to design a rocket did not use appropriate knowledge, they would almost certainly fail. This is also the case in catchment management and IWRM. But this does not mean, however, that the only knowledge of value is scientific; a conclusion that could be reached from the comment about rocket design.

Partly as a response to years of technocratic planning and policy, and domination by natural science, there has been a backlash against natural sciences in natural resource management. While this is in some ways unfortunate, it has created an opportunity to realign different kinds of knowledge and to connect policy, management and knowledge in new and healthier ways.

The particular examples given here demonstrate how knowledge of spatial dependence, time trajectories, and material budgets can be connected to policy and management. But it has also demonstrated that the favoured “one size fits all” approach to policy is not appropriate. Our institutions must be capable of sophisticated differentiation, developing policy and management systems that are suitable to particular types and parts of catchments.
Thinking about the contribution which could be made to this already well-supplied workshop I realise I should be very brief indeed. So I just summarise some points which I think should receive a bit more focus during the discussion sessions. They have been thought over by me during the past years and have lead to some publications, which are given as references. They relate to 7 subjects:

1. River ethics
2. Education and training
3. Data collection
4. Water transfer
5. River basin related legal measures.
6. River basin management and river management
7. Navigation as part of river basin management

1 Integrity of rivers and river ethics

There is a big difference between facing the global water problems, where water is just seen as part of the hydrological cycle which could be regarded as all being H₂O, and the management of rivers. Rivers have some specific qualities, among them that they constitute precious ecosystems. Their waters are living waters. Rivers as such have integrity and should be handled respectfully. This handling of rivers and their basins by man can be called river ethics. River basin management should not only be guided by principles of human ethics (among them concern about the social well-being and health of the riverine population), but also by principles of river ethics.


2 Education and training

River basin management should have the aim of educating the basin stakeholders towards treating the river and the basin with respect. This tasks starts with school-education: here the main aspects of the value of biological systems and their integrity should be taught. Also education and training of basin authority’s staff should include topics related to ethics., dealing with the importance of mutual respect and trust.

Ref.: Sector vision on Water education and training (WET)

3 Data collection

One of the urgent problems facing scientific studying of river basins is the lack of dependable data. One source of this lack is that collection of data usually is performed on a national scale using other than basin boundaries. Governments should be requested to collect data (also ) on

1 Emer. professor of water law Faculty Civil Engineering T.U. Delft.
4 Water transfer

Of late many questions have been raised about the interbasin transfer of water. These kinds of transfer should be minimised as much as possible. Their necessity should be underpinned by well grounded suprabasin water use management plans. These should consider water savings in the receiving basin as well as other means of water supply (desalination?).


5 Legal measures

As legal aspects of basin management remain important (even in a networking society), water law should be developing along with new management practices. Most water laws are based on a national scope. But there seems to be a need for the development of legal frameworks which are directly related to the basin, id est river basin laws, which take the basin as their territory of governance. The need for these has been detected on the international river scene. Some conventions have come into being. But as there are many types of river basin authorities, so is the need for different kind of legal models. Here lies a task for several national and international legal committees, among them a Permanent International Water Convention Committee, which should every 10 years work out model-proposals for the updating of international water conventions.


6 River basin management and river management

When dealing with river basin management (and especially when dealing with the legal aspects of such management) it might be wise to consider as distinct items: river management, river corridor management and river basin management.


7 Navigation as part of river basin management

When dealing with river basin management it is necessary to give ample thoughts on the inclusion of navigation aspects (especially because of effects on the channel from locks and maintenance works) in the institutional and planning set-up of the basin.
Annex A: List of Participants

Prof. dr ir. G.J.F. Alaerts, World Bank, The Netherlands
Prof. J.A. Allan, HR Wallingford/ SOAS, United Kingdom
Mr A. Altinors, Ministry of Foreign Affairs of Turkey, Turkey
Dr A. Atiq Rahman, Bangladesh Centre for Advanced Studies, Bangladesh
Ms A. Baer, Consultant Unesco, France/Israel
Dr M. Banskota, ICIMOD, Nepal
Prof. B. Barraque, LATTES–ENPC, France
Prof. ir E. van Beek, TU Delft – RBA/ WL Delft Hydraulics, The Netherlands
Dr G. Bergkamp, Ecosystem Management Group, Switzerland
Mr mr. I.A. Betlem, FAO – LEGN, Italy
Prof. dr J.J. Bogardi, UNESCO Water Division, France
Ms mr. durs. N.W.M. Bouman, RBA Centre, The Netherlands
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Prof. F.N. Correia, IST - Dep.Engenharia Civil, Portugal
Mr Y. Deda, Ministry of Agriculture and Food, Albania
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Mr B.J. Heij, RIVM, The Netherlands
Prof. A.N.F.G. Henriques, Instituto da Agua (INAG), Portugal
Mr A. Hewage, Mahawel Authority of Sri Lanka, Sri Lanka
Ms D. Hirsch, Stichting Both Ends, The Netherlands
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Ms D. Jassikova, Ministry of Environment, Slovakia
Mr R.W. Johnson, U.S. Bureau of Reclamation, Lower Colorado Region, USA
Ms C. Kafdagli, GAP Regional Development Administration, Turkey
Prof. durs. W.J. Kakebeeke, Ministerie van VROM, The Netherlands
Mr L. Kardoss, Danube PCU of the EPDRB, Austria
Mr Vladimir V. Khlobystov, NCBCPPI, Russia
Mr J. Kristensen, Mekong River Commission, Cambodia
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Dr Le Dinh Thanh, Hanoi Water Resources University, Vietnam
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Mr Thang Nguyen Viet, National Environment Agency, Vietnam
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Mr T. Okazumi, World Water Vision Unit, France
Ms O.A.C. Orji, Federal Ministry of Water Resources, Nigeria
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Ms Y. Rees, Water Research Centre, United Kingdom
Mr J. Rey, Global Water Partnership, Sweden
Mr L. A. Robaux, Office International de l'Eau, France
Ms M. Roodenburg, Secretary RBA Centre, The Netherlands
Mr M.B.A. Saad, National Water Research Center, Egypt
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Ms P. Wouters, University of Dundee, CPMLP, United Kingdom
Mr K. Yasinok, GAP Regional Development Administration, Turkey
Annex B: Organisation of Workshop

Organising Committee

Dr. Erik Mostert, RBA Centre: chairman
Prof. Ir. Eelco van Beck, RBA Centre
Mr. Drs. Nicolette Bouman, RBA Centre
Joost Geijer, MSc, Cicat, TU Delft
Dr. Ellen Hey, vice-director GLODIS, Faculty of Law Erasmus University Rotterdam, Associate Professor
Prof. Dr. Hubert Savenije, IHE Delft
Ms. Marian Roodenburg, secretary RBA Centre

Administrative Support

Berry Blijie, RBA Centre
Jasper Groebe, RBA Centre
Ir. Maarten den Hartog, RBA Centre
Michiel Schram, RBA Centre
Annex C: Programme of Workshop

Wednesday, 27 October 1999

Chair: R. Brouwer

13.30-14.00 Opening addresses
- Mr K. Zoeteman, Deputy Director-General for Environment, Ministry of Housing, Spatial Planning and the Environment, The Netherlands
- Ir L.H. Keijts, Vice Director-General Water Management, Ministry of Transport, Public Works and Water Management, The Netherlands
- Prof. ir H.J. Overbeek, Dean Faculty of Civil Engineering and Geosciences, Delft University of Technology

14.00-14.30 Introduction to the workshop and keynote paper river basin management
E. Mostert

14.30-15.00 Discussion

15.00-15.30 Tea

15.30-16.00 Keynote paper on Incomati basin. A. Carmo Vaz
16.00-16.30 Keynote paper on the Yellow River basin. Wenxue Li
16.30-17.00 Keynote paper on Danube basin. L. Kardoss
17.00-17.30 Discussion
17.30-19.00 Reception

Thursday, 28 October 1999, morning session

Chair: R. Brouwer

9.00-9.30 Keynote paper on Sao Francisco basin. R. Gaal Vadas
9.30-10.00 Keynote paper on Colorado basin. B. Johnson
10.00-10.30 Coffee
10.30-13.00 Parallel sessions, part I:
   A: Operational management (Cf. statements 1-13, 51)
      Moderator: M. Mutale, rapporteur: J. Bogardi
   B: National and international institutional framework and international cooperation (Cf. statements 14-21, 38-47, 51)
      Moderator: D. Jassikova, rapporteur: I. Betlem
   C: Policy and planning (including public participation and analytical tools)
      (Cf. statements 22-37, 48-50, 51)
      Moderator: F.N. Correia, rapporteur: E. van Beek
      - Introduction by moderators
      - Inventory main issues and possible recommendations

13.00-14.15 Lunch
Thursday, 28 October 1999, afternoon session

Chair: A Rahman

14.45-15.15 Keynote paper on role international organizations and donors. G.J. Alaerts
15.15-15.45 Tea break
15.45-18.00 Parallel sessions, part II: formulation of conclusions and recommendations
20.00 Dinner

Friday, 29 October 1999

Chair: P. Wouters

9.00-9.30 Plenary reporting of results parallel sessions
9.30-10.30 Plenary discussion
10.30-11.00 Coffee
11.00-12.30 Plenary discussion, continued
12.30-13.00 Closure
13.00-14.00 Lunch

Saturday, 30 October 1999

Excursion to the Water Works Biesbosch, the Biesbosch nature area, and the windmills at Kinderdijk (UNESCO world heritage site)