

# Case Studies on Water Resource Planning

Lessons learned and keys to  
success

Dr N Walmsley  
N J Hasnip

Report OD 138  
August 1997



HR Wallingford

**DFID**

Department For  
International  
Development



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## **Lessons learned and keys to success**

(TDR Project R6061)

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## Summary

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In recent years, an international agenda for sustainable water resource development and management has emerged based on the Dublin Statement and the principles of Agenda 21. The need for new approaches to planning and management of water resources is reflected in the call for an integrated, multi-sectoral approach which takes account of economic, social and environmental concerns.

The Department for International Development (DFID) is fully committed to improving water resource development and management. Water projects are a central element of the Department's strategy to improve the quality of life by contributing to sustainable development and reducing poverty and suffering. DFID's aid programme is supported by a Technology Development and Research (TDR) programme which is developing new approaches in the water sector to assist in improving integrated water resource management.

As part of the TDR programme, the Overseas Development Unit (ODU) of HR Wallingford has undertaken a series of collaborative case studies to review current planning practices, to highlight their strengths and weaknesses, and to investigate potential constraints to an integrated approach. The case studies were undertaken in Zimbabwe, China (Henan Province), Ethiopia, India (Tamil Nadu), and Australia (Murray-Darling Basin) - thereby representing a broad spectrum of developing country contexts as well as an internationally recognised, successfully managed river basin.

This report draws from the case study investigations and presents some of the essential elements which need to be set in place to support the move towards integrated water resources management. These elements relate to:

- institutional change;
- integrated basin-wide approach;
- the knowledge-base;
- education, communication and participation.

The move towards an integrated approach is a long-term vision for many developing countries which will need sufficient momentum to meet the major challenges set before them. Significant changes in attitudes, practices and procedures will take time to develop and it is important that the process of change is consolidated step-by-step in order to carry with it the support of politicians, professionals and communities alike.

This report aims to provide a comprehensive overview to increase the awareness of concerned professionals in developing countries who do not have access to international literature or conferences covering this subject.





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## **1 Introduction**

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### **1.1 Background**

At the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, a strategy for improving natural resource development and management was developed. Known as Agenda 21, Chapter 18 dealt specifically with freshwater resource management issues and the need to combat widespread scarcity, gradual destruction and aggravated pollution of freshwater resources in many regions of the world.

Chapter 18 presented a pioneering plan of action needed for moving toward development that is economically, socially and environmentally sustainable. It highlighted the importance of an integrated approach to water resource management based on the perception of water as an integral part of the eco-system, a natural resource, and a social and economic good, whose quantity and quality determine the nature of its utilisation. One of the principle objectives to be pursued was that of promoting a dynamic, interactive, iterative and multi-sectoral approach to water resource development and management that integrates technological, socio-economic, environmental and human health considerations. However, whilst the benefits of an integrated approach are internationally accepted, the implementation of such an approach presents many challenges.

### **1.2 Scope**

The Overseas Development Unit (ODU) of HR Wallingford has undertaken a series of collaborative case studies to review current planning practices, to highlight their strengths and weaknesses, and to investigate potential constraints to an integrated approach. The findings of the individual case studies are reported elsewhere, see Bibliography.

This report is the principal output of the work. The report draws conclusions from the earlier case studies and presents some of the key elements for success in an integrated approach. The report is primarily intended for water resource professionals and decision-makers in developing countries who are responsible for reforms in national/regional water sectors and for planning and management of water resources.

### **1.3 The case study countries/regions**

Four developing countries/regions were selected for study, namely:

- Zimbabwe
- China (Henan Province)
- Ethiopia
- India (Tamil Nadu)

These countries represent a broad spectrum of developing country contexts. Each is characterised by a semi-arid climate, or significant semi-arid regions, but their aspirations in terms of economic and social development, water availability and demand, and present levels of water development vary considerably. However, it was notable that in all the developing country situations, significant changes in the water sector were being instigated with the aim of addressing key water resource development and management issues and to facilitate a move toward a more integrated approach. The driving forces behind the changes varied from country to country but were closely linked to addressing urgent needs or to pre-empting future conflicts.

A fifth case study was undertaken in the Murray-Darling Basin, Australia. The Murray-Darling basin has had a well established river basin focus for planning and management of inter-state water resources for over a decade. Internationally recognised as achieving significant success in integrated water resource management, the Murray-Darling Basin provided valuable knowledge on workable frameworks for comparison with the four developing country contexts.



In all contexts, the case studies were undertaken in collaboration with the primary water resource development and management agencies of national and/or regional level. During the case studies discussions and interviews were undertaken with a broad range of stakeholders to ensure a balanced viewpoint was attained. Typically this included stakeholders representing agriculture, forestry, industry, municipal water supply, rural water supply, and environmental concerns at national and local levels. The aim was to reflect the multi-sectoral/multi-stakeholder nature of water resource development and management and to establish roles, responsibilities and input to the planning process.

Driven by the international agenda for a move toward a basin-wide approach to water resource development and management, the case studies were strongly focused on planning and management within a river basin context, the co-ordination with macro planning at the national/regional level, and the links to community-based approaches at the grassroots level. The lessons drawn and keys to success presented in this report therefore reflect this emphasis but also focus on the multi-dimensional nature of an integrated approach.

## **1.4 Workshop**

A 3-day international workshop was also held in Chennai, India, in March 1997, in collaboration with the Institute for Water Studies (IWS), as part of the overall analysis and dissemination of the research findings. The aim of the workshop was to provide a forum for water professionals from a number of countries to share their experiences of integrated water resource development and management and to discuss means of improving current practice.

In total, around 40 participants attended the workshop; representing a wide range of disciplines and sector-based interests. Participants were drawn from the Institute for Water Studies (IWS); India; participants from government agencies involved in HR Wallingford's collaborative research programme - including Ethiopia, China (Henan Province), India (Tamil Nadu), and Zimbabwe; and, participants from other selected water sector organisations. Further details of the workshop is given in Annex I and in a separate report (see Bibliography).

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## **2 *Recognising the challenge***

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### **2.1 Growing awareness and commitment**

A transformation has been taking place in recent years to reform national water sectors and evidence of change is particularly noticeable in the selected case study countries. The driving forces behind these changes not only relate to rising demand, competition for available resources and deteriorating water quality, but also to an increased awareness of the need to manage water in an environmentally-sound, sustainable manner.

In many countries the development and management of water resources is undergoing a process of change in response to the need for this new approach. For example, in Zimbabwe a National Water Authority is being introduced to help promote an integrated approach and in China the issuing of a Water Law has provided clear guidance on agency mandates, responsibilities and regulatory authority. Such changes reflect an awareness that water is a key natural resources on which overall social and economic development depends. However, such institutional changes do not guarantee sustainable resource development and this remains heavily dependent on commitment to change, adequacy of enforcement mechanisms, human resource capabilities and coherent policies.

Awareness of water resource issues has grown considerably but concerted efforts must be continued to ensure that the momentum is maintained to support the aims and objectives of the changes achieved to-date. In particular, planning is based on either distinct economic sectors (agriculture, industry etc) or social enhancement (health education). Water cuts across this sector-based planning making a holistic approach indispensable.



### Recent institutional reforms in Tamil Nadu

There have been a number of key institutional reforms in Tamil Nadu, many under the auspices of the World Bank funded Water Resources Consolidation Project (WRCP). The principal changes being:

- the creation of the specialist Water Resources Organisation (WRO).
- the creation of a Water Resources Control and Review Council (WRCRC) to oversee multi-sectoral water planning and allocation;
- the reorganisation of the Chief Engineers of the WRO on a river basin basis;
- the institution of river basin allocation and planning committees headed by basin Chief Engineers;
- the strengthening of WRO's environmental management capabilities;

In addition, a major component of the WRCP has also been directed at planning and institutional strengthening in the water sector.

The changes and rationalisation of the water sector in Tamil Nadu are consistent with the new international agenda and its focus on integrated water resource management. In particular, the water sector has been given a higher profile via this desegregation of water sector functions, under the newly formed WRO, from the Public Works Department.

## 2.2 Elements of an integrated approach

Integrated water resource management is a dynamic and interactive multi-sectoral, inter-disciplinary process to reconcile conflicts between competing interests for water uses and sub-sectors supported by decision-making at the appropriate level.

As a long-term goal, there are essential elements which need to be set in place as pre-requisites to form a sound base for further enhancements. These elements include:

- Institutional change

to integrate policy frameworks and sectoral plans/programmes at the national level within the remit of broad social, economic and economic goals; to provide co-ordination mechanisms at all levels (vertical and horizontal) to improve co-operation and conflict resolution; to provide an enabling environment supported by strong and enforceable legislation and regulation.

- Integrated basin-wide approach

to adopt a strategic basin-wide approach which reconciles basin/administrative planning and management; to improve water utilisation, protection conservation and management; to enhance environmental planning and management; to account for social, economic and environmental criteria in the decision-making process.

- Knowledge base

to establish inter-disciplinary knowledge and water-related information systems; to facilitate information access and exchange; to improve assessment methods and decision support tools; to build inter-disciplinary teams geared toward planning and management; to provide research support to new initiatives.

- Education, communication and participation

to facilitate community involvement in planning and management; to develop community awareness; to enhance and empower community groups; to foster ownership and support; to provide upward feedback for policy formulation; to improve the skill base in the water sector.



These elements are expanded in the following chapters. Illustrations are drawn from across the case studies to highlight country-specific achievements, demonstrate lessons learned, and to pinpoint some of the underlying factors behind successful approaches.

It must be recognised that standard *solutions* and *models* cannot be advocated for the diverse set of political situations, economic climates, physical settings and cultural diversities found in many developing countries. The keys to success are therefore aimed at illustrating underlying factors behind success and to provide guidance in the way forward.

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## **3 Keys to success**

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### **3.1 An integrated framework**

#### *Integrating policy with other sectors*

Water is a key component of all sector activities and policy development in one sector will have direct or indirect implications on water availability, demand and use. Development of water policy must therefore be integrated and reconciled with sectoral policies to provide a coherent policy framework.

The development of a national water sector profile has been advocated by the Asian Development Bank as a tool to analyse country-specific water sector situations. The profile is designed to gather information from a wide range of sources relating to the national policy environment, capacity for water resource management, water resource status and financial resources. Building on this base, it provides a framework for appraisal and agenda for action specific to the country situation.

Social and environmental objectives must be incorporated into allocation mechanisms through water policy guidance and supported by the development of a strategy for water resource development and management. Allocation through sector driven policies, coupled with subsidies for low value water use inevitably leads to inefficient water allocation and use.

#### **Potential for conflict - China**

The basis of China's policy on water is to control water related disasters, to develop water resources to meet social and economic development goals and to provide these services with due consideration and protection of the natural environment. However, it is recognised that balancing this with other economic, social or sectoral objectives can lead to conflict.

China is striving to raise GDP by a factor of four by the year 2000. The principle means of achieving this goal is through increasing its industrial base and by improving outputs and products from agriculture. Due to land constraints, agricultural production cannot be significantly increased by large scale changes in land use so efforts must concentrate on increasing yields per hectare through provision of reliable irrigation supplies, drainage improvements and improved agricultural practices. As a result, there has been a large increase in the use of fertilisers/pesticides and over-use of irrigation water. These have subsequently led to higher levels of agro-chemical pollution and over-exploitation of groundwater resources. It is therefore recognised that present government policies in the agriculture sector can counteract desired water related objectives and lead to increased environmental degradation.

#### *Water sector co-ordination*

Traditionally, high level committees are often formed to tackle particular problems and then disbanded. The emphasis has now shifted toward the need for a permanent high-level apex body to facilitate multi-sectoral integration at the macro-level. The apex body needs to provide strong co-ordination and clear control over water allocation and use whilst retaining a neutral viewpoint which is not biased toward single sectoral interests.



#### **Water Resource Control and Review Council (WRCRC) - Tamil Nadu**

In 1993, in recognition of the fact that traditionally water resource developments were taking place across the state in a piecemeal manner on a scheme by scheme basis, the government of Tamil Nadu established a high level co-ordinating body called the Water Resources Control and Review Council (WRCRC). This council is chaired by the Chief Minister and includes ministers representing all government departments concerned with the development and use of water resources.

The WRCRC was essentially created to handle multi-sectoral water planning and allocation and acts as the state's principle water policy implementation body. It receives support and advice from a technical secretariat on issues such as water policy, strategy, legislation, regulation and allocation within the State.

A potential drawback or limitation of high level apex bodies is that they are unlikely to meet regularly. The bodies must therefore be supported by a technical secretariat with an inter-disciplinary resource base that is able to advise and work closely with the national apex body to maintain momentum and support the decision-making process.

A key element of water sector co-ordination at the macro-level is strong and well informed economic planning. Economic planning commissions, or similar, need to understand the complex issues of water resource development and management and how it cuts across traditional sector-based boundaries. Weaknesses in this area will lead to continuing fragmentation within the water sector. This can be further exacerbated by sector based financing with short-term commitments detracting from long-term goals and strategies.

#### **National Economic Planning Commission - Zimbabwe**

Integrated development is hampered by the sector-focused financing structure based on the preparation of an annual Public Sector Investment Programme which, despite its name, is centred on individual projects rather than a more strategic framework. Holistic planning at a regional level is thwarted as all proposals for development must be passed upwards for approval. The result is often only partial funding of integrated programmes which leads to a number of disjointed elements which lose their integrated nature.

The Ministry of Finance (MoF) has overall responsibility for the allocation of funds for all development which, at present, is done at a national level. Submissions for funding, which are prepared by each sector, are referred to the National Economic Planning Commission (NEPC) whose role is to appraise proposals and to ensure co-ordination of sectoral activities in economic development. Projects may be either centrally proposed, eg by the Department of Water Development, or locally initiated.

#### *Clearly defined roles and responsibilities*

Co-ordination mechanisms between government departments and sector-based agencies must be retained at all levels from national to regional and regional to local levels. In addition, clearly defined roles and responsibilities including definition of lead and co-operative agencies will prevent over-lapping responsibilities and duplication of effort. Roles and responsibilities need to be specified in water-related policy or legislation.



### **Clearly defined roles and responsibilities - China**

Co-ordination between sectors and government at all levels remains central to the planning process in China. Following the issuing of the Water Law (1988), the responsibilities and mandates of ministerial and government departments, including definition of lead and co-operative agencies, were clearly defined. This aims to prevent over-lapping responsibilities and duplication of effort.

The primary function of the Ministry of Water Resources is to organise and enforce implementation of the Water Law, Soil Conservation Law, and other water-related laws and regulations on behalf of the State Council. The ministry has a wide range of responsibilities ranging from policy formation, strategic planning, economic regulation measures, implementation of the water permit system, as well as arbitrating in water-related disputes and conflicts.

River Basin Conservancy Commissions are responsible for planning and management along the main river courses but Provincial Water Resource Bureaux take responsibility for development along the tributaries. Co-ordination between the Conservancy Commissions and Provincial Water Resource Bureaux is therefore critical. Planning for water pollution prevention and wastewater discharge sites is undertaken in close collaboration between the Environmental Protection Bureau and the Provincial Water Resource Bureaux and, if necessary, the River Basin Conservancy Commission.

Co-ordination of the large number of authorities involved at the national, river basin, provincial and local levels remains a critical factor. In addition, lack of financial support can also hamper the effective implementation of key responsibilities within the various authorities.

### *Institutional stability and continuity*

Stability and continuity are required to ensure the knowledge base within key organisations is retained. Water professionals can be highly trained but there are often too few who are action oriented. Repeated changes in job specification, continuous organisational changes and low salaries create staff demoralisation. Senior staff often hold office for short periods of time or are appointed in uncertain "acting" positions. A lack of clear mandates and responsibilities can lead to insecurity and a lack of openness. It is essential that there is a cultural change in the administration leading to more openness and information exchange.

Organisational structures need to be maintained unchanged for some time to allow confidence to be gained and policies to be developed and implemented. Continual reorganisation of institutions brings instability and mitigates against effective water resource planning.

### *Building on existing structures*

Flexibility and adaptation of existing institutions through a process of gradual change may be as beneficial as radical change. It also retains a more stable institutional environment in which to build capacity and expertise. Capacity building should thus take precedence over constant reorganisation.

Radical institutional change can be avoided if the mandates of key organisations are redirected. In association with this, clarification of roles and responsibilities through the auspices of water administration policy and/or legislation will prevent over-lap and potential conflicts. Realigned organisations will require significant support during the period of transition through a combination of measures such as capacity building and human resource development.

### *Avoiding superimposed administrative structures*

Introducing institutional change is not straightforward. Institutional inertia and rigidity can lead to resistance, multi-layers of authority and increased bureaucracy. Shifting from administrative planning units to a river basin approach is a typical situation in which these difficulties need to be overcome. Effective communication and involvement of all key stakeholders can assist in smoothing transition periods and to build confidence.



### **Changing roles and responsibilities in Tamil Nadu**

One of the changes introduced in Tamil Nadu has been the reorganisation of operation decisions onto a basin, rather than district basis. Tamil Nadu therefore finds itself with at least three families of institutional structures. District Collectors from the colonial period, sectoral departments of the 1960's, and the new river basin institutions headed by Basin Managers.

Water allocation decisions at a basin level will be made by committees comprising of the basin managers, local representatives of other sectors such as agriculture, industry, domestic water supply, and the Collectors of the relevant districts. Basin managers will head these committees, but the changing roles and responsibilities may lead to conflict or resistance from the District Collectors.

Despite the potential for conflict, the reorganisation has generally met with wide approval. Although the incongruent boundaries of water management and local government potentially increases the amount of co-ordination necessary in decisions, it is broadly perceived by commentators that the committees would improve inter-district allocation, provide a better forum for inter-sectoral disputes, and, once fully functioning and endorsed by all parties, should streamline the institutional structure.

### *Shifting from master plans to management strategies*

A national water resource management strategy provides a means of translating policy into action. It provides a set of action programmes to support the achievement of development goals and to implement water-related policies. Implementation of the strategy therefore bridges the gap between policy frameworks and subsequent planning, investigation and implementation of programmes and projects.

The aim in formulating a national water resources management strategy is to provide measures to manage the resource in accordance with adopted goals and policies. Developing such a strategy will also test whether these goals and policies are realistic. Key areas to be considered in the formulation of a strategy include:

- institutional and human resources arrangements;
- stakeholder participation;
- information systems;
- economic aspects;
- environment and health; and
- international arrangements.

This differs from traditional master planning approaches which usually result in a set of investments to be made or site-specific projects to be implemented without a broader recognition of associated issues such as institutional strengthening, human resource development and capacity building.



### **Water Resource Management Strategy - Zimbabwe**

The climate of change in Zimbabwe is very positive. This is largely a consequence of the relative youth of the nation though the capacity and willingness to enact constructive change in water resource planning is due to a number of other reasons, which include:

- the structural adjustment programme which places emphasis on financial accountability and government reorganisation, including the decentralisation of power
- the existence of a relatively well-educated professional class
- a diverse economy which includes a strong private sector
- a culture which encourages the effective formation of lobby groups which contribute to the democratic system
- a series of very dry years which has raised awareness of water issues throughout the country

As a consequence, a number of major, on-going water planning initiatives are taking place including: a review of the Water Act; the development of a Water Resources Management Strategy; and, the creation of a National Water Authority. Discussions through SADC to agree a protocol for the management of international waters are also well advanced.

In 1993, the Department of Water Resources initiated a study to provide guidelines on the development of a water resource strategy in Zimbabwe. The need for a strategy, as distinct from a Master Plan, is widely recognised in Zimbabwe with the emphasis being on methods for management of the water resource base in a manner consistent with national policy. The proposed strategy will be drawn up by the responsible government agencies with comprehensive stakeholder participation.

Key activities to develop and implement the water resource management strategy were: to assess key issues and explore policy options; to devise and implement national guidelines; to provide a resource assessment methodology; and, to develop a framework for water resources allocation and management. These activities would be supported through specific studies, institutional strengthening and legislation.

The development of Zimbabwe's water resource management strategy will consider all elements of the water sector including: available water resources; water allocation and use; water demand and forecasting; pricing strategy; demand management; institutional reform; legislation and regulation; and capacity building.

#### *Economics and finance*

A sense of the economic value of water is necessary if the aims of balancing supply/demand, reducing wastage, conserving the resource, and utilising water for higher valued purposes is to be achieved. Care needs to be taken, however, to ensure water supply for basic needs are not compromised.

Charging for water services is essential for generating funds for operation and maintenance, ensuring efficient allocation, and to signal to users the real value of the resource. In reality, water pricing rarely reflects the true costs of providing water services to the users but steps need to be taken to introduce charging systems which aim, in the short term, to recover at least operation and maintenance costs and work towards full cost recovery in the longer term. Subsidies for the water sector should aim to promote greater efficiency in water use – rather than encouraging wastage or over-use. Linked with other initiatives such as effective implementation of pollution charges, water pricing can serve as an effective demand management tool to complement other non-economic measures.

#### *Legislation and regulation*

An effective and workable legal and regulatory framework is essential. It is important that legislation is seen to be fair and equitable if the system is to remain sustainable. Implementation of water-related legislation requires commitment from central authorities in terms of appropriate levels of manpower, institutional strengthening and technical facilities (eg water quality monitoring equipment) for improved monitoring and evaluation. The legislative framework also needs to be integrated and consolidated with other legislation relating to natural resource management, land-use, soil conservation, pollution control, etc., to avoid conflict and confusion. Areas which need special attention include the protection and use of groundwater resources and water quality. Legislation must take account of local conditions and characteristics as much as possible.



Penalties for non-compliance with legislation and regulatory standards should serve as a deterrent. Penalties therefore need to reflect the financial gains which can be made by non-compliance (eg over-abstraction).

Regulating and monitoring access to water resources through clearly defined water rights can facilitate equity among users and improve water use efficiency. Systems of water rights vary from country to country. Control of surface water use is common but regulation for groundwater use is often inadequate or unenforced resulting in over-abstraction and degradation of the resource.

#### **Water Law (1988) - China**

In 1988 the Water Law of the People's Republic of China came into force. The Water Law (1988) sets out the basic principles for the future administration of the water sector and articles in the legislation relate to:

- development and utilisation of water resources
- protection of water resources
- water environment and water-related projects
- management of water uses
- flood control and preparedness
- management of water projects

The Water Law (1988) aimed to address many of the conflicts and shortfalls of the inadequate and fragmented system which had arisen during the 1970's and early 1980's. The Water Law and its body of associated legislation and regulation stipulates that a unified system of administration is adopted and that all surface and groundwater sources are owned by the State with a water drawing permit system implemented for water allocation and use.

### **3.2 Adopting a basin-wide approach**

#### *The basin as a planning unit*

It is widely accepted that the river basin is the most appropriate unit for planning water resource development and management. The rationale stems from the concept of the river basin as a specifically limited area that acts as a unique hydrological system. Resource development and management in one part of the basin will therefore have an impact elsewhere in the basin. River basin boundaries do not, in general, correspond with political or administrative units, nor with aquifers. River basin planning must therefore resolve and unify planning processes at different levels and planning spheres. One of the clearest shifts in recent years, evident in all the case studies, has been that toward a river basin focus for water resource planning and management.

#### **The Institute for Water Studies (Tamil Nadu)**

The Institute for Water Studies (IWS) is the technical secretariat to the Water Resources Control and Review Council (WRCRC). Previously a research-based organisation of the PWD(WRO), the IWS has become the State's *nodal water planning agency*. Key responsibilities include:

- to prepare basin assessments in co-ordination with other government agencies;
- to prepare macro-level basin framework plans to collectively constitute a State Water plan to serve as a general water resources plan for the State;
- to assist the WRCRC in allocating water between different sectors and provide policy and advice to WRO on environmental matters;
- to establish state-wide planning standards.

Large river basins may be at national or international scales. Transboundary water resource development and management is linked strongly with political issues but there is much in common with national river basins, especially when there are several jurisdictions involved, such as inter-provincial or inter-state river basins. The primary objective is to develop the resources of a basin for mutual benefit of all riparian countries or basin states through



collaboration. Successful collaboration is enhanced if there is a strong focus on well-defined objectives, joint benefits for all basin states, and integration within an overall basin plan and strategy.

#### **Nile Water Sharing - Ethiopia**

Most of Ethiopia's rivers are shared with neighbouring countries. The rivers Abbay (Blue Nile), Tekeze and Baro-Akobo provide 65% of the water resources of Ethiopia. These rivers also contribute almost 85% of the flow in the Nile river at the Aswan dam. Clearly the development and management of water resources within these basins is important to Ethiopia and its neighbours.

The Nile riparian states are all developing countries with agricultural based economies. In the two downstream riparian states, Egypt and Sudan, there is limited rainfall and both have well developed irrigation systems on which they are socially and economically dependent. The upper riparian states are generally less developed and presently depend on unreliable rainfed agriculture. They are prone to droughts and famine, particularly Ethiopia. Most upper riparian states have plans for irrigation and hydropower development.

There have been many initiatives to enhance co-operation between the riparian states for use of the Nile waters but so far with little success. None of the initiatives include all riparian States and the UN and others are working to bring them all together.

There is a clear need for a new legal framework that would bring a more equitable balance of water rights and this can only be achieved through more integrated basin-wide planning. However, there is a lack of information on which to formulate plans. Ethiopia is presently undertaking comprehensive studies for the three tributaries of the Nile which will help to rectify this situation.

#### *Reconciling basin/administrative planning and management*

River basins inevitably cut across traditional administrative boundaries. Balancing a basin-wide approach with administrative and sectoral planning and management requires the adoption of appropriate organisational structures to facilitate an integrated approach.

A permanent apex body at the basin level provides a corner stone for dealing with the inter-relationship between basin/administrative planning and management. One of the key functions of basin organisations needs to be to lead, or assist, in the development of strategic approaches. Implementation and execution of associated projects and programmes can lay with other agencies but co-ordination and leadership should rest firmly with the basin-level apex body.

#### **The Murray-Darling Basin Commission - Australia**

The Murray-Darling Basin Commission is an inter-governmental organisation whose main role is to co-ordinate the management of natural resources across state borders within the Murray-Darling Basin. The main aim of the Commission is to achieve sustainable use of water, land and other environmental resources of the Basin, advise the Murray-Darling Basin Ministerial Council on environmental management issues throughout the Murray-Darling Basin, and administer Natural Resources Management Strategy in the basin.

The Commission office employs about 40 technical and support staff in the areas of river management, natural resources, finance, administration, and communications. The office undertakes close consultation with both State and Commonwealth agencies and is also responsible for the financial management of all activities shared between the four Governments under the Murray-Darling Basin Agreement. All member Governments refer to the Commission for comment on any development proposal or change in water management policy that could have adverse affects on water quality or quantity. Under the Commission, there are more than 20 working groups with experts drawn from government departments, universities, private organisations and community organisations.



### **The role of Basin Managers - Tamil Nadu**

As part of the institutional changes under the Tamil Nadu WRCP, Basin Managers have been established to facilitate planning and management at the basin scale in collaboration with other key departments in the Water Resource Organisation.

At the basin level, water allocation decisions will be made by Basin Committees comprising of the Basin Manager, local representatives of other sectors such as agriculture, industry, domestic water supply, and the chief district administrators, or district collectors. The Basin Managers will head these committees.

### *Improving environmental planning*

Environmentally-sound development is a key principle behind sustainable water resource utilisation. Environmental concerns and action plans need to be firmly routed in planning and management processes to ensure adverse impacts are minimised and mitigation plans established. Environmental plans need to be developed and integrated in to basin planning activities.

The complex inter-relationships between surface and groundwater, water quality and quantity, and land-use and water need to be established through the application of Environmental Assessment methodologies supported by expert advice.

Effective integration relies on strengthening the human resource-base for environmental planning and management. This can be achieved most effectively by the creation of environmental units within basin planning organisations who work closely within an inter-disciplinary team. Such measures need to be supported by technology transfer, training and human resource development.

### **Environmental Units - Tamil Nadu, India**

Tamil Nadu's water resources are scarce and the State's future development will depend on improved planning and allocation of water between sectors and efficient use by the main users, especially agriculture. To achieve these aims the Government of Tamil Nadu (GOTN) has embarked on a vigorous programme to create a specialist water and irrigation agency for the State (the Water Resources Organisation, WRO) and to adjust policies associated with water planning and allocation.

An environmental action plan has been drawn up for implementation by WRO with the aim of fully integrating environmental management in planning, investment and management of the State's water resources. A key element of the environmental action plan was to strengthening WRO's environmental monitoring and analysis capabilities via the creation of specialist Environmental Units/Cells. Two such units have been established in the *Institute for Water Studies and Plan Formulation* of the WRO, the main resource planning departments in Tamil Nadu's Water Resources Organisation. Key responsibilities of the Environmental Units/Cells are to:

- prepare environmental plans for all river basins in Tamil Nadu;
- provide policy advice to WRO on environmental matters;
- establish state-wide planning standards;
- perform environmental review of projects to comply with Environmental. Protection Acts and Regulations;
- provide expert advice on environmental matters to WRO management units;
- plan for environmental mitigation and enhancement;
- provide environmental clearance from Government of Tamil Nadu
- undertake periodic (environmental) reviews during operation and maintenance.

### *Basin-wide water audit*

The purpose of a basin-wide water audit is to establish the facts relating to water use in a basin-wide context. It should investigate the rate at which water use is increasing, review the effects of this increased use, describe the current levels of development, document trends, project trends into the future, and assess the impacts of these changes. The emphasis needs to shift away from a purely water resource assessment focus to include greater consideration of water



allocation, use and demand to support short and long-term planning needs and overall policy and strategy formulation. A water audit provides a basis for determining future courses of action such as inter alia changes to water allocations, restrictions on the construction of future storages and abstractions, and reductions of entitlement.

#### *Water allocation and management plans*

Inter-sectoral and inter-regional water allocation within a basin is a potential source of conflict - particularly in water scarce regions. Allocation priorities should be clearly specified in national and regional policy directives. Policy should also include provisions under emergency situations such as extreme or prolonged drought conditions.

A process for establishing water allocation should include consultation and review with key stakeholders at each major step in the process. Representation of environmental and in-stream interest as well as consumptive users is necessary to balance environmental objectives with economic development objectives. The impacts of river flows on the coastal zone must also be taken into account.

Water allocation agreements should take account of the seasonality of water demands, inter-annual variations in river flows, and the risk to users of failure to meet given demand limits. Attention should also be given to safe-guarding allocations for the environment.

#### **Process of implementing the Water Allocation and Management Plans - Australia**

A clear process for establishing water allocation and management plans in Queensland has been established. The process will help to ensure all stakeholder issues are considered and that full agreement is achieved thereby avoiding conflict. Periodic review ensure the plans are modified and updated in line with changing conditions.

##### ***Step 1 : Project Initiation and Issue Identification***

Data collection and hydrologic modelling on existing entitlements and future plans  
Identification of allocation and flow-related issues through consultation  
Nomination of Reference Panel to represent community and stakeholder interests

##### ***Step 2 : Analysis of Environmental Requirements***

Estimation of environmental requirements by Technical Advisory Panel  
Modelling & reporting of environmental provision options & impacts

##### ***Step 3 : Review of Operations and Preparation of Draft Plan***

Consideration by stakeholders of acceptable balance between competing water uses, translation of existing entitlements, and allowances for future demands  
Preparation of draft plan in consultation with the Reference Panel and advertised for community review input

##### ***Step 4 : Statutory Review and Approval of Draft Plan***

Review and approval process

##### ***Step 5 : Implementation of approved plan***

Periodic review and/or amendment of plan

#### *Status of basin plans*

Planning is only effective if it is a dynamic process with continual update and review. In addition, it is only in the implementation stages that planning realises tangible benefits. As an exercise alone, it has little meaning. It is therefore critical that planning activities and the development of basin plans receive ratification from the appropriate bodies and are imposed as a framework, with obligation, for all water-related planning activities.



#### **Allegiance with administrative units - Zimbabwe**

The need for water resources planning on a catchment basis was identified in Zimbabwe's 1976 Water Act and initiated by the Department of Water Development (now the Department of Water Resources) during the 1980's. However catchment plans have never been ratified and remain in a draft status. A lack of resources and manpower halted the impetus of the planning exercise and only recently has updating of the plans begun, initially only for selected river basins.

The concept of a catchment or river basin as a planning unit has a firm grounding at the central level but this is not necessarily reflected at provincial or regional level. Provincial Water Engineers are fully aware of the catchment plans but planning based on administrative boundaries continues to dominate as perceptions and allegiances remain focused on the local administrative units.

#### *Assessment methods*

Knowledge-based solutions depend on the use of appropriate assessment methods supported by good quality data/information, and expert advice. The shift toward a basin-wide approach to planning and management of water resources must be accompanied by new assessment methods and analysis tools.

Traditional approaches to planning and managing the resource, which often over-simplify the complex nature of water resource development and management, tend to dominate. New methodologies which take account of diverse and non-commensurate objectives need to be developed and applied. Typically, these should include multi-criteria analysis methods to address social, economic and environmental issues.

Standardised approaches and methodologies enable data and information requirements to be rationalised. In turn, this can assist in focusing additional data/information collection at the appropriate level of detail and frequency. This can also have additional benefits such as the adoption of common information management and retrieval systems which can be linked at the national, regional and local level.

The use of standardised approaches also has benefits for long-term capacity building within institutions as in-house capabilities and expertise can be established and consolidated over a period of time. The use of external consultants may be necessary because of human resource constraints but care is needed to avoid conflicting methodologies and a dissipation of core data and information once the consultants have completed their task.

#### **Adopting a multi-objective approach to planning - China**

The complexities of shifting to integrated water resource planning and management is placing great demands on decision-makers. Recognising these difficulties new methodologies to assist in making informed decisions based on economic, social and environmental criteria and concerns have been developed recently under UNDP funding.

The methodologies integrate the more traditional water resource assessment techniques with macro-economic models and multi-objective analysis. Trial applications have been undertaken in a number of regions including North China and Xinjiang province. The developers of these methods hope these earlier successful trials will lead to a common approach amongst all provinces. This would provide a unified framework for analysis and lead to a more integrated approach to water resource planning at national, provincial and river basin levels.

#### *Selection and performance criteria*

Integrated river basin planning forms a framework for more detailed project planning and management. The new approach requires social and environmental objectives to be considered along with economic criteria. In addition, means of assessing beneficiary demand as well as the degree of stakeholder participation throughout the development process will contribute to the assessment of project sustainability.



There is a need to establish clear multi-disciplinary criteria and monitoring indicators to summarise decision-making variables and provide feedback on performance of planned and implemented projects and programmes.

Existing EIA processes provide a useful framework for inter-disciplinary assessments and multi-criteria decision-making. Similar approaches which focus on basin-wide issues are necessary.

### **3.3 Knowledge driven solutions**

#### *Changing attitudes*

Traditionally, water sector activities have centred on the development of the water resource base through engineering-based, project-oriented planning approaches. Whilst this remains valid at the project level, an increased emphasis is needed at a higher level on a more strategic, inter-disciplinary approach which cuts across many disciplines. A significant shift in attitude and professional skills is required to facilitate the change. This relies on continued support and training to enhance the capacities of water sector professionals.

Human resource development is vital to the successful implementation of an integrated approach. The majority of water sector staff are from traditional engineering-based backgrounds. Future needs increasingly require a stronger multi-sectoral capacity within the water sector agencies. The public sector needs to strengthen and maintain its strategic planning functions and separate these from other executive, design and build functions.

#### *Extending the knowledge base*

Major inroads in to what constitutes the knowledge base are necessary if social, economic and environmental concerns are to be adequately addressed in water resource development and management.

Meteorological and hydrological data remain the mainstay of national/regional data collection programmes. Whilst the importance and relevance of such data cannot be denied, the focus can be too narrow and neglect other key areas for information and data collection. Water availability is only one side of the equation and greater attention must be focused on developing and applying multi-disciplinary information systems covering knowledge of natural resources systems, land-use, demographic changes, water use and demand, cultural attitudes, environmental assessments, etc., to support multi-criteria decision-making.

Integration of water quantity and quality objectives is a principal goal in sustainable water resource development and management. Water quality deterioration has a major impact on water use and the support of ecosystems. Despite major water quality problems, the data collection and monitoring of water quality remains a peripheral activity, often under-funded and under-resourced. Water quality monitoring needs to be given higher priority with the adoption of appropriate techniques to support the effective enforcement of legislation and regulation.

Groundwater and surface water systems are inextricably linked, yet data collection and monitoring remains separated and is generally managed by different institutions. Moves to increase water use efficiency and introduce drought proofing measures will increasingly lay in the conjunctive use of surface and groundwater resources. This will necessitate bringing together combined knowledge on the two sub-systems and the integration of planning, management and operational functions.



### **Extending the knowledge base - Ethiopia**

The main thrust in water resources planning in Ethiopia has been the preparation of master plans for each river basin in the country. The master plan approach has weaknesses, principally the top-down emphasis, the focus on identifying possible infrastructure development projects rather than a more integrated management plan, and the neglect of small-scale community based actions. Nevertheless, the plans do extend the knowledge base on water resources in the country. The earlier phases of the master plan studies concentrate on reconnaissance, establishing field measurement facilities and data collection. This provides an excellent basis for planning which is too often neglected by governments and donors. However, more attention is needed on the storage and retrieval system, to improve accessibility of the data.

#### *Information systems*

Integrated water resource management requires combining the data often spread out between various organisations with their own needs and information management procedures. It is necessary to define, organise and manage a network of partners consisting of data producers, managers and users in order to combine their contributions.

The setting up of a rational and reliable information system also requires planners to:

- define the optimum information in relation to the attainment of the objectives;
- design, set-up and maintain an appropriate information system, data base and GIS system;
- optimise additional data collection, by defining additional data to be collected, definition and setting up of additional monitoring networks, and organisation of data collection and validation
- define and produce the most significant summary indicators depending on the potential user's expectations (politicians, decision-makers, technicians, media, etc.)

In carrying out the above, it is required to consider an assessment of the needs in relation to regulations and agreements, an inventory of existing networks, specification of networks (types, spatial/geographic density, measurement frequency, etc.), as well as the human and financial resources needed to operate and maintain them. Good quality field data collection should not be compromised or neglected by the introduction of costly and sophisticated systems.

#### *Information access and exchange*

Information exchange and networking are critical factors in building an integrated approach to water resource development and management.

Access to good quality basic data is essential for water resources planning. The collection, storage and retrieval of data is inevitably the responsibility of several authorities and information exchange is therefore a critical issues to be addressed. New technologies and networking facilities negate the need for large centralised database systems and efforts need to be directed toward efficient access to information rather than the establishment of all-encompassing databases. The mutual exchange of data and information should be encouraged through water policy directives and guidance.

Obstacles to mutual exchange of information can be technical and/or institutional. However, with an increasing trend toward decentralisation, new obstacles are emerging. The need for institutions to become increasingly self-financing may result in reduced data exchange. Information is at a premium and is regarded as a valuable commodity which can be traded with other users. This may lead to a decrease in data and information flows within the vertical structure of ministerial lineage, duplication of effort, and the use of poor quality and/or inaccurate data sets as a substitute for more reliable yet expensive data. Information access and exchange need to be reflected in water policy directives or clearly defined in administrative guidelines.



### 3.4 Enhancing education, communication and participation

#### *Effective communication*

Effective communication is a critical factor in building an integrated approach to water resource development and management. Communication is a two-way process. Understanding community needs and values should result in better policy formulation and hence the implementation of sustainable projects and programmes. Community-based, demand-led projects and programmes will foster greater commitment and ownership from beneficiaries and lead to more sustainable investments.

Communities cannot be expected to make a valued contribution without having comprehensive knowledge of the problems in a river basin and how their local actions may effect these. Establishing community based groups with representation on catchment groups and committees provides the vital link between grassroots and national strategic approaches. The formulation of catchment and sub-catchment groups is likely to be a crucial factor in communicating important local issues and relating these to a wider context. Community consultation can lead to a reduction in conflicts and disputes and ultimately lead to reduced time, and costs, of implementing projects and programmes.

Communication is a specialist subject which requires expert knowledge and know-how. Special units in river basin organisations would benefit communication and transfer of information. Participation at local and basin level can be reinforced by the active use of media (TV, radio, newspapers, newsletters) to promote and educate all sections of the community on water-related issues and concerns.

#### *Involving stakeholders*

Stakeholder interests lay at all levels from individuals to central government. A two pronged approach based on *demand-side* initiatives at the community level and *supply-side* initiatives from government are required to build strong communication and participation. Success relies on the strength of community commitment and the willingness of government to embrace participatory processes. Mechanisms to encourage active community roles can be strengthened through the promotion of appropriate organisational structures, recognition in policy and legislative frameworks, and measures to provide financial autonomy.

#### **Community action in Tigray Region - Ethiopia**

The Tigray Regional Government policy emphasis is on rural development and food self-sufficiency. The strategy to achieve this is through self-help, bottom-up identified projects which concentrate on soil and water conservation of arable rather than non-arable land (ie not concentrating on steeper land). Small scale irrigation (100 to 200 ha), micro-dams and a range of physical and biological conservation measures are included in the programme. Lowest rainfall areas are given priority under the SAERT Commission (Sustainable Agriculture and Environmental Rehabilitation of Tigray).

Although the details of projects are determined locally, the type of project and organisation for implementation are largely determined by the Regional Council. Indeed, villagers are obliged to contribute 20 days of labour towards community projects at a slack time of the year. Bye-laws define beneficiaries of community built dams and responsibilities for operation and maintenance.

It is too early to assess the overall impact of the Tigray rural development policy on water resources. Some concerns which need to be addressed include permits for water utilisation, the effect on downstream users and the combined impact of numerous small projects on the overall river basin. Basin plans which are being developed need to take into account such community based initiatives.

Under a river basin focus, organisational structures need to build on existing societal structures whilst also merging these together to correspond with sub-catchment and catchment units. Building on this concept, allows community-based representation to be made at all levels including the basin and national level.



### **Encouraging community participation - Murray-Darling Basin, Australia**

Over recent decades, the level of community participation in formulating plans and strategies and the willingness of the public to develop their own community led programmes have greatly increased in the Murray-Darling Basin. This is due to the public demanding greater participation in decision making processes as well as recognition from the government that community participation is a key factor in developing strong involvement and ownership of key initiatives. Means of achieving and encouraging community participation include:

*Community Advisory Committee (CAC)* - provides community based advice on the management of the Murray-Darling Basin. The committee is made up of 21 community representatives drawn from the four states in the Basin, as well as representatives from the National Farmers Federation, the Australian Conservation Foundation, the Australian Local Government Association and the Australian Council of Trade Unions. The Committee reports directly to the Ministerial Council.

*Community Action for the Rural Environment (CARE)* - a community initiative to address natural resource management in the Southern Australian part of the Murray-Darling Basin. Its aim is to provide a framework for co-ordinated community leadership and participation in all aspects of natural resource management planning and local action. The CARE program is funded by the Murray-Darling Natural Resources Management Strategy with State Government support to assist communities to develop and activate their natural resource management.

*Catchment Co-ordinating Committees (CCC)* - set up to link local planning and action at community levels with catchment-wide planning and strategy development. Elected representatives of community groups sit on CCC and liaise with government agencies/committees on integrated catchment management issues.

*Catchment Management Groups (CMG)* - community based with technical support from specialists working in the state agencies or federal and university science research communities.

*Salinity Action Groups (SAG)* - substitute for the CMGs in areas with high salinity problems. Mainly farmer representation but also includes local business, government agencies, teachers and environmentalists.

Because integrated water resource management cuts across traditional sectoral and administrative boundaries stakeholder interests rest in many camps such as urban and rural water supply, agriculture, industry, forestry, environment, etc., as well as local, regional and national government levels. Stakeholder involvement therefore requires bringing a diverse range of interests together and facilitating effective communication and co-ordination.

### **Mazowe Valley Catchment Development (MVCD) - Zimbabwe**

Zimbabwe is presently attempting change within the water sector which include embracing the principle of stakeholder involvement along catchment boundaries. During the 1980's user-managed Water Boards were formed, but with no mandate for planning.

The need for improved water resource planning had been long recognised, and an influential group of businessmen, lawyers, public relations experts, politicians, etc. in the Mazowe Valley formed a non-profit making company which subsequently evolved into a government supported pilot project for the development of Catchment Boards - under the on-going changes in Zimbabwe, catchment agencies are to be set-up that will be financially autonomous and stakeholder driven.

The MVCD community driven initiative is aimed at promoting and co-ordinating local initiatives through a series of Sub-Catchment and Water Boards to facilitate short-term and long-term planning, policy formulation and dispute resolution. Care has been taken to ensure all sectors and sub-sectors (urban, industrial, mining, agriculture, etc.) and administrative systems (local government, central government, traditional chiefs, etc.) have representation under the MVCD.

### *Supporting education, training and research*

Education and training is vital to support changing roles and responsibilities. It is important to recognise the need for training at all levels - from central government to individuals - in order to carry the pace of change forward through co-operation and mutual understanding.



A sound technical basis is required for all strategy formulation and project implementation. Technical skills also need to be linked to a broader understanding of economic, environmental and social issues. As such, training is necessary to broaden perceptions - but should not aim to replace expert knowledge and resources in these fields. Training should be linked to functions and responsibilities of target organisations and are likely to include: basin water planning and management; project and programme planning; environmental and social assessment techniques; GIS and remote sensing techniques; economics of water; information systems and management; and performance assessment.

Research is often a marginal activity but with the demands placed on moving toward a holistic approach to water resource management it is necessary to support the development of new approaches and methodologies. The policy, institutional and technological reforms needed for meeting new challenges are complex and need careful analysis, adaptive and applied research and experimentation. Inter-disciplinary approaches in the water sector are relatively new and much can be gained through targeted research. There is potential to link research activities to the remit of river basin administration organisations by providing some core funding for research programmes. Research activities can then be directed at key issues within the river basin context, as identified by the basin administration. Similarly, pooling funding for research from administrative units which are wholly or partially located in a river basin can help to foster administrative links whilst at the same time providing a better understanding of basin-wide issues and solutions.

Maximum use needs to be made of skills available in the private and public sector alike. The promotion of inter-disciplinary research networks across government and research institutions will help to bridge the gap between academics and practitioners whilst also drawing maximum benefits.

#### **Water Resource Research Fund - Tamil Nadu, India**

Under the Tamil Nadu WRCP, a Water Resource Research Fund (WRRF) has been established to fulfil an essential need to modernise planning and management of its land resources. The WRRF is intended to fund high quality applied research with the following objectives:

- to promote the culture of applied research among water and irrigation professionals in the field
- to identify and support applied and problem solving research, specifically addressed to land and water production and sustainability in the water and irrigation sector, especially at the river basin level
- to promote research on social issues, such as farmer's and women's and disadvantaged groups participation in field level activities and decision-making for better management
- to promote co-operation between WRO and research institutions from Tamil Nadu, India, and overseas.

Greater use of pilot projects and application of research findings can demonstrate the benefits of shifting toward an integrated approach and act as a vehicle for generating greater awareness within government departments and local communities. New methodologies and techniques are unlikely to be adopted unless users and beneficiaries have full confidence in their applicability, usability and appropriateness. Validation through pilot implementations can demonstrate reliability and suitability and therefore help to build support for and confidence of new approaches whilst also providing a means of dissemination.

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## **4 Long-term vision and the pace of change**

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In many countries, the move toward a fully integrated approach to water resource development and management is likely to be a long and tortuous path. Significant changes in attitudes, practices and procedures will take time to develop before becoming entrenched. It is therefore important that the process of change is consolidated step-by-step in order to carry with it the support of politicians, professionals and communities alike.



Change for change sake is unlikely to be beneficial. Careful consideration needs to be given to ensure that political, social, and economic settings are compatible with the direction of change. Integrated water resource management has taken many years to become established in western countries. For example, in the UK the period of change has taken some 20-30 years to be finalised and firmly established - and this is despite a highly skilled professional workforce, well educated population, strong tradition in research and relative prosperity. The UK context contrasts sharply with that in a developing country yet expectations for change in the developing world remain high. Over-estimation of immediate benefits and over-simplification of the complexities of meeting the new challenges will only lead to opposition and/or demoralisation.

Despite water being high on the international agenda, the time scale for change must be realistic and result in real changes - not superficial changes which merely mask a system which continues to plan and manage water in the old single sectoral, project-by-project supply oriented manner.

Change must be embraced from within the country. Assistance from external support agencies will inevitably be crucial in promoting and supporting change. Prescriptive answers will undoubtedly meet with resistance so realistic solutions must be worked through mutual co-operation and consultation.

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## **Annex 1**

International Workshop



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## **Annex 1 International Workshop**

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### **Water Resource Development and Management Chennai (Madras), India, 12-14 March 1997**

#### **1 Introduction**

At the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, a strategy for improving natural resource development and management was developed. Known as Agenda 21, Chapter 18 dealt specifically with water resource management issues and presented a pioneering plan on action needed for moving toward development that is economically, socially and environmentally sustainable.

Agenda 21 highlighted the importance of an integrated approach to water resource management based on the perception of water as an integral part of the eco-system, a natural resource, and a social and economic good, whose quantity and quality determine the nature of its utilisation. One of the principle objectives to be pursued is that of promoting a dynamic, interactive, iterative and multi-sectoral approach to water resource development and management that integrates technological, socio-economic, environmental and human health considerations.

The Department for International Development (DFID) - the UK aid agency - is fully committed to improving water resource management. Water projects are a central element of DFID's strategy to improve the quality of life by contributing to sustainable development and reducing poverty and suffering. DFID's aid programme is supported by a Technology Development and Research (TDR) programme which is developing new approaches in the water sector to assist in improving integrated water resource management.

The Overseas Development Unit (ODU) of HR Wallingford has undertaken collaborative research to identify the strengths and weaknesses of current planning practices, to identify constraints toward an integrated approach, and to develop improved planning practices. Case studies of water resource planning and management have been undertaken in Zimbabwe, China (Henan Province), Ethiopia, India (Tamil Nadu) and Australia (Murray-Darling Basin). Building on the findings of these case studies, systematic procedures to help ensure water resource development and management is planned in an integrated manner taking into account long-term planning needs and incorporating environmental, economic and social considerations have been developed in collaboration with the Institute for Water Studies (IWS), Water Resources Organisation, Government of Tamil Nadu, India,

An international workshop was undertaken as part of the research programme to provide a forum for exchange of experiences on water resource development and management and to contribute to the development of the planning procedures.

A full report of the Workshop is given HR Report OD/ITM 58 (1997)

#### **2 The Workshop**

##### *2.1 Objectives*

The overall aims of the workshop were:

- to provide a forum for water professionals from a number of countries to share their experiences of integrated water resource development and management;
- to present and discuss procedures for planning sustainable water resource utilisation.

##### *2.2 Organisation*

The workshop was held jointly by HR Wallingford, UK, and the Institute for Water Studies, Water Resources Organisation, Government of Tamil Nadu, India, with financial assistance from the Department for International Development of the UK Government. It was held at the



Centre for Industrial Consultancy and Sponsored Research, Indian Institute of Technology (IIT), Chennai. The workshop was held on 12-14 March 1997.

### 2.3 *Participants*

In total, around 40 participants attended the workshop including:

- representatives from HR Wallingford;
- participants from the Institute for Water Studies (IWS);
- participants from government agencies involved in HR Wallingford's collaborative research programme - including Ethiopia, China (Henan Province), India (Tamil Nadu), and Zimbabwe; and also from Vietnam;
- participants from selected Indian water sector organisations.

The workshop was intended for professionals in the water sector who are responsible for planning water resource development and management. As such a wide range of professional expertise was assembled representing a range of sector-based interests including rainfed agriculture, irrigation, forestry, domestic and industrial water supply, and environment. Areas of specialisation included policy formulation, national water resource planning, river basin planning, project planning, design, evaluation and monitoring, operation and maintenance, hydrology, hydrometeorology, remote sensing, land-use planning, environmental planning, water quality, salinity, soil conservation, mapping, stakeholder participation, economics, and training.

### 2.4 *Opening of the Workshop*

Inauguration of the Workshop was by Thiru N P Gupta, Secretary to the Government of Tamil Nadu, Public Works Department (PWD). The inauguration programme included:

Welcome address	Er D Subramanian, Chief Engineer, PWD and Director, IWS
Special address	Dr Nigel Walmsley, ODU, HR Wallingford
Presidential address	Er K Thirunavukkarasu, Chief Engineer (Plan Formulation), PWD
Inaugural address	Thiru N P Gupta, Secretary to the Govt., PWD
Keynote address	Er G Ganapathi Subramanian, Engineer-in-Chief, WRO, PWD
Vote of thanks	Er R Subramanian, Executive Engineer, IWS

Mr SH Palmer, British Deputy High Commissioner for Southern India, attended on behalf of the UK Government.

## 3 **Workshop Methodology and Approach**

### 3.1 *Workshop activities*

The workshop was organised into a variety of different forums to achieve the overall objectives. Essentially, these took the form of:

- presentations of country situations by workshop participants
- presentations by HR Wallingford
- open forum discussions on selected issues and topics
- small-group work sessions (with facilitators)
- report back sessions

The means of achieving specific objectives were as follows:



<b>Objective</b>	<b>Means</b>
To highlight the need for a new approach to water resource development and management based on a wide range of country experiences	<i>country papers, special topic papers, discussion groups</i>
To identify the key issues which need to be addressed to support sustainable water development and management	<i>country papers, special topic papers, work sessions</i>
To discuss and develop the concept of project quality and its constituent dimensions	<i>presentations, discussion groups, work sessions</i>
To present a framework for a practical planning tool to assist in planning sustainable water resource utilisation	<i>presentations, work sessions</i>
To discuss tools for applying a procedural approach	<i>presentations, work sessions</i>
Recommendations for further work	<i>discussion group</i>

### 3.2 *Workshop programme*

The timetable for the Workshop is given in Figure 3.1. The main Workshop sessions were as follows:

- Opening session
- Session 1 - Background
- Session 2 - Country papers
- Session 3 - Project quality
- Session 4 - Planning tool
- Session 5 - Application and modules of the Planning Tool
  - project conceptualisation
  - issues screening
  - complementary action
  - action plan
- Session 6 - Assessment of Planning Tool
- Closing session

### 3.3 *Presentations*

Presentations by members of HR Wallingford covered the background to the research programme, material supporting the country papers, and the framework and details of a Planning Tool to assist in planning sustainable water resource utilisation. In most cases, the presentations provided the backdrop against which participatory work sessions were conducted. The content of the presentations is highlighted in Chapter 4 and a full set of the material presented during the workshop is reproduced in Appendix 4 to 12.

### 3.4 *Work Sessions*

The success of the workshop relied on active participation. The workshop drew together a wide body of collective experience and knowledge. The emphasis was on utilising this experience to meet the overall workshop objectives and, in particular, to contribute to the development of the research outputs.

Throughout the workshop, work sessions were formulated to address specific issues and topics. In general, participants were divided into smaller groups, 6-10 per group, with each group discussing different aspects, but with specific targets and outputs to be met. At the end of the discussion session, each group produced written reports consisting of the main points raised during the session. Verbal report back to the whole group was used to ensure all participants were aware of the outcomes from each group and to initiate further discussion. Facilitators were used to assist in all work sessions.



## International Workshop Water Resource Development and Management

Wed 12 March	am	<b>Opening Session</b> <ul style="list-style-type: none"> <li>• Introductory Remarks</li> <li>• Opening Address</li> <li>• Workshop Arrangements</li> </ul>	<b>Session 1 – Background</b> <ul style="list-style-type: none"> <li>• The need for new approaches</li> <li>• Background to the research</li> <li>• Workshop aims and objectives</li> </ul>	<b>Work session</b> <ul style="list-style-type: none"> <li>• Issues and constraints</li> </ul>
	pm	<b>Session 2 – Country papers</b> <ul style="list-style-type: none"> <li>• Introduction to country papers</li> <li>• Country Presentation 1</li> <li>• Country Presentation 2</li> </ul>	<b>Session 2 (cont.)</b> <ul style="list-style-type: none"> <li>• Country Pres. 3</li> <li>• Country Pres. 4</li> <li>• Summary</li> </ul>	
Thur 13 March	am	<b>Session 3 – Project Quality</b> <ul style="list-style-type: none"> <li>• Summary of Key Issues</li> <li>• Dimensions of Proj Quality</li> </ul>	<b>Work session</b> <ul style="list-style-type: none"> <li>• Key issues brainstorming</li> <li>• Issues grouping</li> </ul>	<b>Work session</b> <ul style="list-style-type: none"> <li>• Procedural approach</li> <li>• Initial Assessment</li> </ul>
	pm	Field visit programme Vengal Tank (Thiruvallur Taluk)		
Fri 14 March	am	<b>Session 5 – Application</b> <ul style="list-style-type: none"> <li>• Application of Procedure</li> <li>• Procedure Modules</li> <li>• Procedure Tools</li> </ul>	<b>Work session</b> <ul style="list-style-type: none"> <li>• Project conceptualisation</li> <li>• Tools and methodology</li> </ul>	<b>Work session</b> <ul style="list-style-type: none"> <li>• Complementary action</li> <li>• Tools and methodology</li> </ul>
	pm	<b>Work session</b> <ul style="list-style-type: none"> <li>• Action Plan</li> <li>• Tools and Methodology</li> </ul>	<b>Session 6 – Assessment of Tool</b> <ul style="list-style-type: none"> <li>• User based assessment</li> <li>• Applicability</li> <li>• Needs</li> </ul>	<b>Closing session</b> <ul style="list-style-type: none"> <li>• Emerging Action Agenda</li> <li>• Emerging Research Needs</li> <li>• Closing Statement</li> </ul>

Figure 3.1 Workshop Programme



## **4 Country papers and key issues**

### *4.1 Country and Special Topic Papers*

Participants from China, Ethiopia, India, Vietnam and Zimbabwe prepared and presented papers related to water resource development and management. The overall purpose of the papers was to facilitate an exchange of in-country experiences and practices and to promote discussion. Two papers were requested for each country; i) Water Sector Profile, and ii) Special Topic Paper.

The Water Sector Profile enabled an overall picture of the country/region water sector. The purpose of the Water Sector Profile was:

- to provide a review of the status of the water sector;
- to provide an appraisal of the water sector and opportunities for the future; and
- to provide a basis for comparative analysis between countries/regions.

The Special Topic Paper enabled procedures and studies undertaken when planning projects and programmes associated with water resource development and management to be described, with particular reference to the identification and preparation stages of the project cycle. The purpose of the Special Topic Paper was:

- to provide a review of the planning process;
- to provide an appraisal of current practices in relation to sustainable water resource development and management; and

Copies of papers presented during the Workshop are given in HR Report OD/ITM 58 (1997).

### *4.2 Key issues*

Based on the country presentations and associated working group sessions, key issues were identified and classified under broad categories related to:

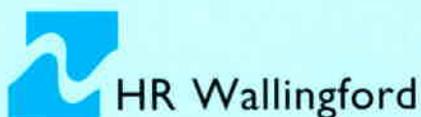
- Policy and co-ordination
- Legislation and regulation
- Management and operation
- Socio-cultural
- Environmental
- Technical
- Financial and economic
- Stakeholder involvement
- Information and communication
- Human resources

Transcripts of key issues and constraints to an integrated approach, based on the working group sessions, are summarised in the table below.

	<b>GROUP A</b>	<b>GROUP B</b>	<b>GROUP C</b>	<b>GROUP D</b>
<b>Policy and Co-ordination</b>	<ul style="list-style-type: none"> <li>Lack of policy</li> <li>Difficulty of co-ordinating between government and private sector</li> <li>Longer planning horizons allowed – complication of shorter terms for political will and interest</li> </ul>	<ul style="list-style-type: none"> <li>Integrated and comprehensive planning</li> <li>Institutional framework</li> <li>Implementation of legislation</li> <li>Single agency responsibility for water</li> <li>Prioritising water allocation</li> <li>Interstate issues</li> </ul>	<ul style="list-style-type: none"> <li>Inter-state distribution of water – needs good and acceptable policy</li> <li>Land and water rights – to be reviewed</li> </ul>	<ul style="list-style-type: none"> <li>Establishing co-ordinating agency</li> <li>Need for well defined water policy, well defined objectives, strategies, and action plans</li> <li>Involving international agencies for developing the capacity for sound training, equipment, facilities</li> <li>Co-ordination of institutions involved in water resources management</li> </ul>
<b>Legislation and regulation</b>	<ul style="list-style-type: none"> <li>Lack of legislation for groundwater abstraction</li> <li>Legislation needed for monitoring irrigation</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of water laws</li> <li>International committee</li> <li>Groundwater legislation</li> <li>Enforcement of law</li> </ul>	<ul style="list-style-type: none"> <li>Requirement of legislation or laws for ground water exploitation</li> <li>Legislation to suit the changing scenario – better management</li> <li>Implementation and monitoring</li> </ul>	
<b>Management and operation</b>	<ul style="list-style-type: none"> <li>Poor institutional arrangement for monitoring water quality and protecting environment</li> <li>Co-ordination of timely supply of inputs (non availability of inputs at the time of need)</li> </ul>	<ul style="list-style-type: none"> <li>Optimal utilisation</li> <li>Watershed management</li> <li>Recycling of waste water</li> <li>Conjunctive use</li> <li>Review of reservoir operation policy</li> </ul>	<ul style="list-style-type: none"> <li>Co-ordination mechanism for operation of interstate rivers</li> <li>Fragmentation of institutions</li> </ul>	<ul style="list-style-type: none"> <li>MIS information</li> <li>Stability of institutions</li> </ul>
<b>Socio-cultural</b>	<ul style="list-style-type: none"> <li>Conflict between castes, race</li> </ul>	<ul style="list-style-type: none"> <li>Encroachment in reservoirs/tanks</li> </ul>	<ul style="list-style-type: none"> <li>Encroachment in waterways, catchment areas</li> </ul>	
<b>Environmental</b>	<ul style="list-style-type: none"> <li>Environmental protection – water quality</li> </ul>	<ul style="list-style-type: none"> <li>Environmental impact assessment</li> <li>Monitoring pollution</li> </ul>	<ul style="list-style-type: none"> <li>Pollution of surface and groundwater</li> <li>Sedimentation of storage systems and diversion works</li> <li>Salt water intrusion</li> </ul>	<ul style="list-style-type: none"> <li>Better management of forests and protection in the reservoir area</li> </ul>
<b>Technical</b>	<ul style="list-style-type: none"> <li>Poor technology and communication about water harvesting – GW/SW interaction</li> <li>poor information about losses</li> <li>Planning against natural calamities</li> <li>High losses in piped supplies – drought and flood</li> </ul>	<ul style="list-style-type: none"> <li>Assessment of potential basin and admin wide</li> <li>Surface and groundwater assessment</li> <li>Micro-level analysis for water management</li> </ul>	<ul style="list-style-type: none"> <li>Very low water use efficiency – steps to increase the water use efficiency</li> <li>Cropping pattern to be linked with availability of water, agro-climatic conditions</li> </ul>	<ul style="list-style-type: none"> <li>Establishing data base, information flow among users</li> </ul>

	<b>GROUP A</b>	<b>GROUP B</b>	<b>GROUP C</b>	<b>GROUP D</b>
<b>Technical (continued)</b>	<ul style="list-style-type: none"> <li>• Identification of GW recharge structures</li> </ul>	<ul style="list-style-type: none"> <li>• Instrumentation for regulation</li> <li>• Water regulation</li> </ul>	<p>Integrated planning for water resources development with inter-sectoral allocation into consideration</p> <ul style="list-style-type: none"> <li>• Management Information systems – needed for all basins including interstate basins</li> <li>• Data collection and monitoring network</li> </ul>	
<b>Information</b>	<ul style="list-style-type: none"> <li>• Poor scientific, technical and social data for planning quantity and quality of data</li> </ul>	<ul style="list-style-type: none"> <li>• Data collection</li> </ul>	<ul style="list-style-type: none"> <li>• Training aspects</li> <li>• Educating the policy makers and decision makers</li> </ul>	<ul style="list-style-type: none"> <li>• Improving the human resource development</li> </ul>
<b>Human Resources</b>	<ul style="list-style-type: none"> <li>• Acknowledge contribution of women and encourage participation in management, education, training, equal pay with men</li> <li>• Encourage awareness among managers and consumers to use water scientifically</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness among public &amp; politicians</li> <li>• Staff capability</li> <li>• Research and development</li> <li>• Training of staff for operation and maintenance</li> </ul>		
<b>Financing and economic</b>	<ul style="list-style-type: none"> <li>• Insufficient finance – development of operation and maintenance</li> <li>• Problem of co-ordinating government and private sectors</li> <li>• Problem on year on year releases of budget systems</li> <li>• Pricing fees – difficulty of collecting money (no leverage) difficulty of fixing rates</li> </ul>	<ul style="list-style-type: none"> <li>• Water service charges – rural and urban</li> </ul>	<ul style="list-style-type: none"> <li>• Pricing of water</li> <li>• User pays principle</li> <li>• Financing for maintenance – need of a strong mechanism</li> </ul>	
<b>Stakeholder Involvement</b>	<ul style="list-style-type: none"> <li>• Top down Vs bottom up</li> <li>• Too little farmer participation – big farmers too dominant</li> </ul>	<ul style="list-style-type: none"> <li>• Stakeholder identification</li> <li>• Stakeholder participation</li> </ul>	<ul style="list-style-type: none"> <li>• Water users associations formation in all sectors and their participation</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness among the users and public</li> <li>• Stakeholder participation</li> </ul>
<b>Special issue – water allocation institutions</b>				<ul style="list-style-type: none"> <li>• Trans-boundary and trans-regional project development and management</li> <li>• Strong political will to solving the trans-boundary and trans-regional problems</li> <li>• Defining organisational structures</li> <li>• Provision of incentives for encouraging the private sector</li> </ul>

HR Wallingford is an independent company that carries out research and consultancy in civil engineering hydraulics and the water environment. Predictive physical and computational model studies, desk studies and field data collection are backed by large scale laboratory facilities and long term programmes of advanced research. Established in 1947 as a Government research centre, the Company now employs more than 200 engineers, scientists, mathematicians and support staff, many of whom are recognised international experts. Based on a 36 hectare site near Oxford, HR Wallingford has extensive national and international experience, with offices and agents around the world.



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