Themes for action

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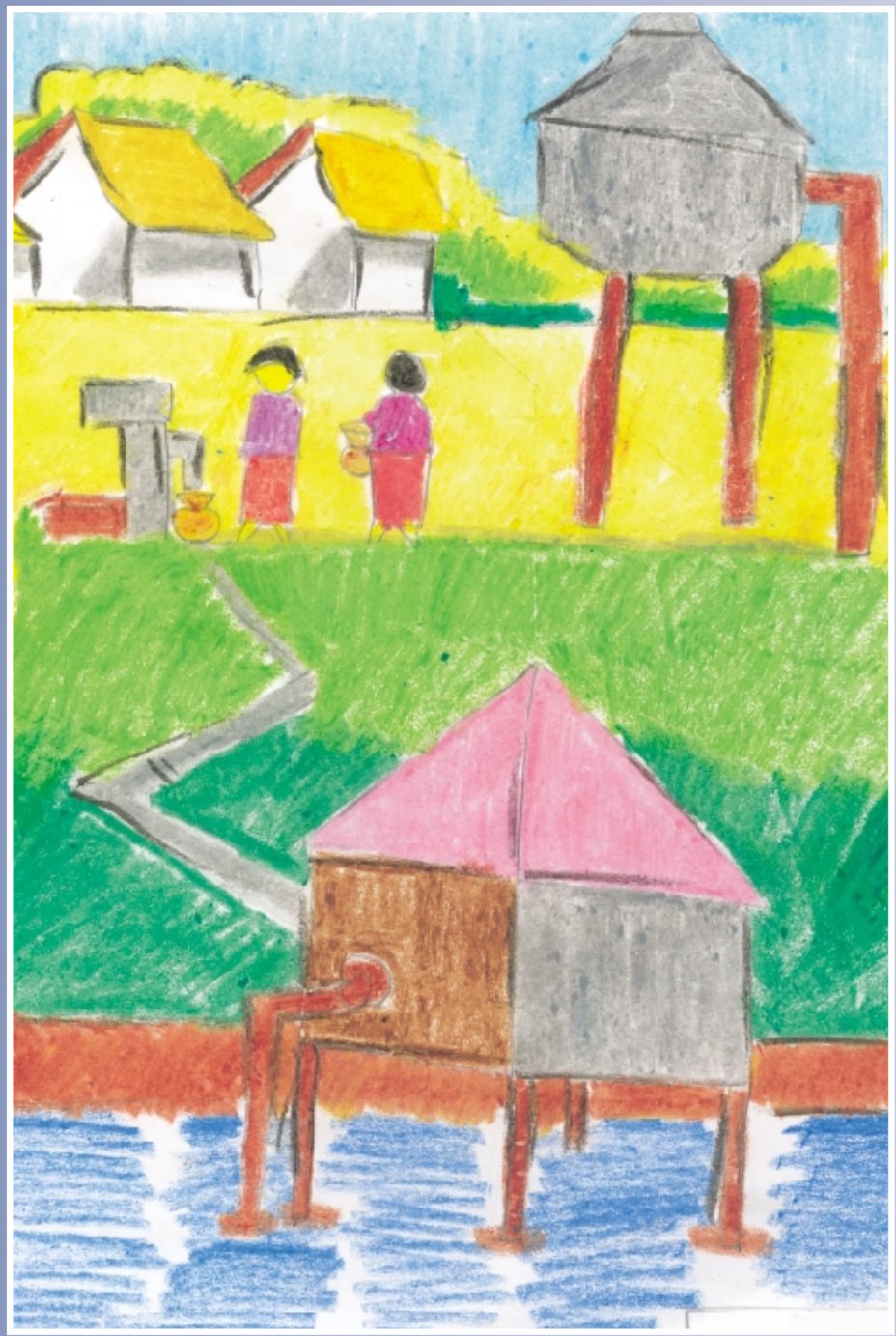
Themes for action

Making water governance effective



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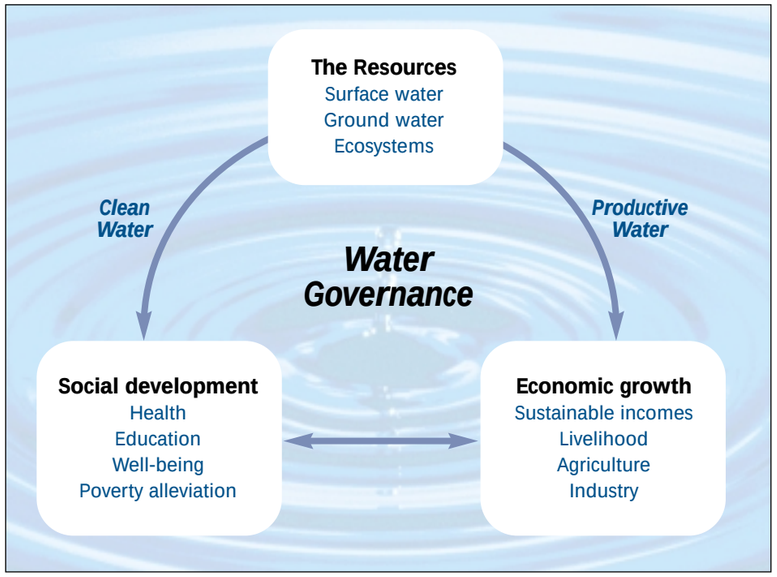
Making water governance effective

The water crisis is mainly a crisis of governance. The present threat to water security lies in the failure of societies to respond to the challenge of reconciling the various needs for and uses of water. The Vision can only be achieved if the institutions that determine the management and use of water resources are effective.

Water needs careful husbandry and management in order to serve humanity and nature renewably and sustainably. Protecting the resource and at the same time reconciling powerful, sometimes conflicting, social and economic demands upon it lie at the heart of water resource management. And *governance* lies at the centre of the tension and delicacy of balance between different water uses and their management.

> ***"Co-ordination of inter-sectoral water allocation is needed, with emphasis on demand management and enhanced stakeholder participation within the framework of comprehensive institutional reforms"***
>
> The Arab Countries Vision for Water



Good governance requires transparency and accountability, participatory mechanisms appropriate to local realities, needs and wishes, and respect for the law and contractual obligations. Good water governance exists where agencies of government allocate and manage water resources based on legitimate policies, laws and an efficient administration. Governance encompasses many interlinked social players and must be responsive to citizens' needs and to the long term sustainability of the natural resource base of the country and region.

To achieve the Vision at least 75% of all countries should put into place a process for enacting comprehensive policies and strategies for IWRM by 2005. The remaining countries need to do this by 2015. These targets should be agreed by governments as an essential means to the goal of global water security.

This chapter discusses governance under three headings:

- **Putting IWRM into practice;**
- **Promoting transparency and participation;**
- **Reform and development of institutional frameworks;**
- **Realigning economic and financial practices.**

Putting integrated water resource management into practice

The challenge is to work towards good water governance. In many regions and countries, the rules of water governance have to be changed and the performance of the players improved.

The key to effective water policy reform is the enactment of enforceable legislation that establishes the rights and obligations of all stakeholders, while retaining sufficient flexibility to adapt to changing circumstances. Such water policy reform must be matched to the capacity of societies to adapt to change. The presence of an effective legal and regulatory framework has been shown to act as an essential spur to private investment and the participation of the non-governmental sector (commercial and civil society) in water services.

The key to effective water policy reform is enforceable legislation which establishes the rights and obligations of stakeholders while retaining sufficient flexibility.

Political leaders and governments, both national and local, will need to:

- Create an enabling environment in which the goal of safe water and secure food and livelihoods for all can be achieved by sustainable means. This will require encouraging, creating and then integrating, large numbers of private initiatives (by individual water users – women and men – corporations, commercial business and civil society) and public sector initiatives (by local governments and public utilities).
- Establish the rules by which the transactions between the stakeholders take place. These should be participatory, transparent, gender-sensitive, clear and create trust.
- Take responsibility for water resources and establish institutional arrangements to manage and resolve water-related problems such as over exploitation of aquifers and many more.

In water policy reform there are no universal models and no universal timetables. Windows of opportunity are often the essential catalysts for water policy reform.

Integrated water resources management (IWRM) is an essential component of good water governance. IWRM has two dimensions. On the one hand, it consists of a common sense holistic approach to water that integrates hydrological, engineering, social and economic best practices – an approach accepted as desirable by most water professionals.

Windows of opportunity

In South Africa, the end of apartheid in 1994 enabled radical ideas and approaches to be embraced. Water policy reform and the introduction of new water laws were politically feasible as part of the realignment of rights and entitlements. The presence of a lawyer at the helm of the Department of Water Affairs and Forestry lent confidence to the process of legislative and regulatory reform. In Eastern Europe, accession to the European Union provides impetus to change. Many countries are drafting new water laws, often with help from the World Bank. The next action is to provide support to such countries so they can develop capacity and reform institutional structures. Only then can the laws be implemented and enforced.

IWRM and the sector users

The second dimension of IWRM is more contentious, and requires integrating the seemingly incompatible goals, beliefs, interests and knowledge of every water user. Social and political capacity is thus as important as physical water availability in good water management. This is the more difficult and largely unfulfilled political challenge; but it must be met if water security is to be achieved. Increasingly, there are conflicts between rural and urban communities, between agriculture and industrial/domestic use, and between environmental use and all other users. There are also an increasing number of conflicts between countries or states over shared water resources. Of all the contentious issues, the conflict over allocation of the increasingly scarce resource is becoming by far the most important and one that IWRM must resolve.

Given the political nature of integration, the first challenge to enabling IWRM is to cultivate the political critical mass in favour of it. This involves raising awareness of local and wider water crises and serious shortfalls in water services, and simultaneously raising the profile of successful initiatives.

The Hague Forum is only one of many opportunities for politicians and policy-makers to meet and learn more about integrated water resources management. Some countries with deeply ingrained traditional approaches have resisted IWRM, at least initially. However, indications are that the trend toward its adoption is growing. More action is needed, involving lobbying, advocacy and roundtable exchange, from committed professional associations, civil society and others to explain the need for, and benefits of, integrated water resources management and raise political commitment wherever possible. This is discussed further in the next chapter.

"Governments should be encouraged to set up Water Resources Task Teams with a clear mandate to address the issues comprehensively. These teams should draw upon the necessary expertise from all walks of life, including civil society and the academic community."

South Asia Vision for Water

Benefits of an integrated approach:

Through harmonisation of water management plans, spatial development plans, and environmental policy plans, several combined land and water development projects were initiated in the Netherlands in recent years: raising of storage capacity in river basins through habitat creation, landscaping and the development of outdoor recreation areas along the Rhine and the Meuse; the combination of water storage, habitat creation and natural water treatment in several newly developed housing areas; clean land use earmarking for dunes and other areas, where groundwater is abstracted for drinking water; nature and landscape development with natural water treatment in several small rivers.

Putting IWRM into practice involves developing three components of governance at the same time. These are the enabling environment, briefly discussed above, an institutional framework, and management instruments and tools. Many countries need help in developing these components and putting them to work.

The intention is that the Toolbox will become a user-friendly compendium of alternatives for policy-makers implementing the Framework for Action.

The IWRM Toolbox

One place they can turn for help is the IWRM Toolbox currently under development by the Global Water Partnership. The Toolbox contains a range of options on a wide range of topics, including social and administrative change, economic, legal and regulatory instruments, capacity building, financial instruments and technologies including examples of best practices. The instruments and ideas in the Toolbox are based on a wide range of experiences and knowledge held by practitioners, policy makers and water managers from all over the world.

The GWP recognises that there are many different ways to implement IWRM, requiring a variety of tools, policies and actions. Annex II illustrates the scope of the Toolbox and gives a sample page of the first draft. It will be developed as an early priority action of the Framework for Action and then disseminated as widely as possible through the Internet, through publications and through training networks. The intention is that the toolbox will become a user-friendly compendium of alternatives that policy-makers can use as they try to implement the Framework for Action.

Promoting transparency and participation

IWRM principles cannot be accepted in a society that does not enjoy transparent water allocation and management at all levels; and without the trust engendered by transparency, the participation of water users cannot be secured.

The critical nature of water for domestic use and agricultural production, and the substantial expenditures involved in the provision of water services, have resulted in corruption in many parts of the world. Corruption has misdirected investments and stifled partnership between water providers and users. It has created indifference and cynicism, and assigned a low priority to the search for a balance among water uses. A lack of transparency has led to opportunistic behaviour; decisions in water resource management are often the outcome of negotiations between central government bureaucracies and financial institutions with no meaningful participation of relevant stakeholders. A number of actions will contribute to greater transparency and participation in the water domain, as discussed below.

Devolving responsibility to water users

This is an on-going trend that closes, if not completely removes, the gap between those that control and those that use water. In irrigation this means that the drive towards management transfer to farmer-controlled organisations – as, for example, in Mexico, Andhra Pradesh (India) and Albania – needs to continue. Wherever practical, in new irrigation schemes, users should manage the investment directly, rather than public entities managing all the funds and then asking for cost recovery from the users.

Similarly, in water supply and sanitation, demand-driven approaches need to become the norm. Water utilities need to operate under greater autonomy in decision-making, have sustainable strategies for cost recovery, clear standards for assessing performance, and be publicly accountable through regulation. Customers' interests need to be represented and consulted. Where formal local organisations are formed, special care is required to ensure that women are properly represented. Community management is a powerful mechanism for developing IWRM.

Although community management started through rural development projects, it is now increasingly seen in urban settings, fostered by NGOs who believe that the urban poor, like the rural poor, can be mobilised to help themselves. Experience in rural communities has shown how effective people can be in installing their own water supplies. This will need to be replicated widely in urban settings, which face the largest future challenges in demand for drinking water and sanitation.

"We must build on people's energy and creativity at all levels – empowering and building the capacity of people in households and communities to take action, and applying technologies that respond to actual needs."

Vision *21: Water Supply, Sanitation and Hygiene*

Documenting urban community management

One research programme by the international NGO Solidarité Eau looks specifically at water and sanitation in small towns, informal neighbourhoods within cities, and peri-urban areas in Africa. It concludes that community-based organisations have as valid a role as the other types of organisation (such as municipal authorities, private concessionaires and ad-hoc project committees) that are moving into the managerial vacuum left by the shrinking of public-sector water distribution companies.

The small local organisations that support community management lack the resources to publish their work or evaluate it scientifically. A few international NGOs do publish examples of successful community actions and recently access to such information has greatly increased. Access to documented success is important so that lessons can be learned and applied elsewhere. Without documented proof of success many governments and others are sceptical that communities really can manage their own supplies, particularly at any scale larger than a village. The IWRM Toolbox mentioned above will provide a useful place for recording and sharing the results of case studies and pilot projects.

Actions for Community Management:

- Government and other agency staff to voluntarily reduce their own power and involve communities in the decision-making process from the beginning.
- Government and external agencies to provide technical support to community organisations.
- Local governments to pass and enforce legislation that favours community management.
- Community organisations to devote the time and energy to managing their own services.
- The advocates of community management to research and document their successes and inform others to develop sustainable application on a larger-scale.

Most examples of successful community management are so far relatively small in scale, although there are exceptions (see examples below). With government support, good initiatives can be scaled up to some extent. This requires institutional and capacity development at the local level, and appointing or electing representatives at the different and successively higher groups to give them power to make important decisions.

The active involvement of the private sector can encourage efficiency and transparency, and introduces the concept of contract between service suppliers and users.

Large scale community management

An example of successful community management is the large-scale gravity-flow water supply system serving over 60,000 people at Bwera in Uganda. It is the third-largest water supply in the whole country. Its construction, operation and maintenance have been managed by the community, with initial support from WaterAid, an international NGO. The supply serves 14 small towns and villages. Each village elects a water committee for the maintenance of its distribution system, while a central committee is responsible for the source and the supply pipeline. Each committee has a written constitution, and the relationship between the central and village committees is also defined in writing. Since the project was completed in 1996, significant numbers of people have moved into the area because of the reliable water supply. The district government has recently decided to site a new hospital there for the same reason and the water committee has negotiated the tariff for a metered supply for the hospital. For most of the past three years, Bwera has been at risk from the civil war in neighbouring Republic of Congo and yet the water supply continues to function well without any external support to the committees.

Broadening the options for operating utilities

For water supply and wastewater there is a gradual shift in many countries from central government as the operator to communities, autonomous public authorities or the private sector. This shift demands a parallel and fundamental shift in behaviour and expectation by both old and new entities. The active involvement of the private sector can encourage efficiency and transparency, introduces the concept of contract between service suppliers and users, and can significantly improve service delivery. Government's role, meanwhile, changes to one of effective regulation, in the context of laws which are both clearly articulated and effectively enforced.

In an increasing number of larger conurbations, water supply systems are operated by private companies under public service standards, often with private capital investment. In many parts of the world, informal water vendors play an important role in providing water services and their role should be formalised and contribution improved. The broadening of options with private service providers – both domestic and international – further brings competition from bodies of a different nature and thus provides an incentive for publicly owned utilities to reform. Various examples of public-private partnerships now exist around the world. These can form the basis for the reorganisation of water utilities. The term 'private sector' is used in this report for a range of entities including small local enterprises as well as large corporations. The table opposite identifies the different modes of public and private involvement.

Summary of Options for public–private partnerships

Option	Ownership	Financing	Management
Concession	Public	Private	Private
Lease (Affermage)	Public	Public	Private
Management Contract	Public	Public	Private
Service (Technical Assistance)	Public	Public	Public & Private
Joint Ownership	Private & Public	Private & Public	Private & Public
Full Privatisation	Private	Private	Private
BOOT	Private then public	Private	Private

From: EC Guidelines for Water Resources Development Co-operation

In many parts of the world, informal water vendors play an important role in providing water services and their role should be formalised.

The maintenance of public service standards needs strong regulation and can be facilitated by benchmarking. An example is the GWP programme in support of the Water Utilities Partnership (WUP) in Africa. Such initiatives need to be more widely replicated. Civil society in general and water consumers associations in particular will have an important role in monitoring these service standards. For any of this to happen, national governments must sincerely want to transfer management of water systems to users; they must encourage both user and commercial investment, and create the legal framework for stakeholders' organisations to function.

Recommended actions include:

- Both governmental and non-governmental organisations should work with finance institutions to further develop the modalities of demand-driven water development and promote domestic investments in small and large water facilities.
- International water research and training centres should provide support by piloting and documenting new approaches, and providing appropriate training.
- In many poorer countries, the international community should help governments to develop the capacity and institutional structures to implement the right legislation, set standards, negotiate contracts and establish well-managed regulatory systems and enforcement mechanisms.

Many countries are beginning to implement reforms that promote private sector investment and reap rewards in terms of efficiency.

Toolkit for public-private partnerships

The World Bank has prepared a useful toolkit for private participation in water and sanitation. It sets out the different options for private sector involvement, the pros and cons, key factors for success and practical guidance on the steps to take and the pitfalls to avoid when considering private sector involvement. It provides detailed help in setting the legal and regulatory framework and advice on drafting contractual agreements.

It should be stressed that an increased role for the private sector does not diminish the role of government; it changes it. Direct operational and financial involvement of government decreases and water resource management, regulation and governance increase. The government also needs to make sure that the rules in which the private sector operates are extended to public service providers (municipal authorities, irrigation agencies etc), providing public entities with incentives to increase their efficiency and transparency. For example, one of the roles of OFWAT, the regulatory body governing the privatised water industry in the UK, is to monitor prices and ensure compliance with environmental regulations (e.g. on the quality of wastewater discharges). Many countries, for example China and Chile, are beginning to implement wide reaching reforms that promote private sector investment and are reaping rewards in terms of efficiency.

Even with increased private involvement, municipal authorities are likely to remain the main water managers in urban areas around the world. These municipal authorities need to be helped to modernise along the lines of efficient private operators.

Where governments are reluctant to change or modernise, a concern for the poorest communities is often given as a reason for restricting private sector involvement. However, the poor already suffer from bad or non-existent services from the public sector or are exploited by local, unregulated operators. A strong regulatory body and a more transparent system would thus benefit the poor.

Recommended actions for Government include:

- Pursue and accelerate the on-going trend towards devolution of responsibilities to water users and building transparent and accountable mechanisms for resource allocation.
- Improve the allocation of water resources through better decision-making and the use of decision making tools which can express the value of water in different uses.
- Establish the right operating framework to attract private sector and civil society involvement in providing water services.
- Force both public and private sector operators to obey the rules.

Reform and development of institutional frameworks

Strengthening national and local institutions

Effective institutions are essential for the planning and implementation of water policy reform. However, water institutions tend to be numerous, unwieldy and resistant to change. In many countries water management is dispersed over several ministries and agencies without adequate mechanisms to co-ordinate and reconcile needs and uses. This fragmentation reinforces the potential for conflicts between sectors over the use of water resources. Reviewing and evaluating water institutions is a major challenge, complicated by the fact that they are enmeshed with many other agencies and political groups.

"The priorities: capacity building and training, long term planning for the Nile Basin, enhance confidence among the Nile Basin countries, high priority for national and regional water projects, each country to form its own water plan which relates to the master plan as a whole."

Vision for the
Nile River Basin

Co-ordination between institutions:

Water institutions are so numerous in Egypt that it is impossible to 'map' them. Lebanon also has a highly textured set of water institutions including 22 water authorities and numerous other water agencies which are resisting recommendations to reduce their number. Thailand has eighteen organisations for managing water. The water institutions and customary water laws of Palestine are diverse and flexible reflecting the influence of Turkish, British, Jordanian and Israeli involvement making it difficult to formulate a new Palestinian Authority water law.

The action needed is to develop mechanisms to co-ordinate or take overall responsibility for water management. In several countries this process has started with the establishment of 'co-ordinating committees' or task forces on water. Co-ordinating committees have to be located at the highest administrative levels to be effective. Preferably, special 'apex' bodies should be made responsible for water, such as the proposed National Water Authority in Brazil and the Water Resources Organisation in Tamil Nadu, India. These bodies must be empowered to make independent allocation decisions and ensure that national water resource plans are implemented. High level apex bodies are equally vital for the often-neglected management of aquifers.

Similar mechanisms are needed at the local level. The decentralisation of water management functions to the lowest appropriate level (often termed subsidiarity) is now theoretically accepted as a sound management principle. However, this can only be effective if the human capacity and financial resources to handle the new responsibilities are available. A similar move towards integration and co-ordination between different water uses is required at this level, preferably focused on tangible water issues. This may involve strengthening existing local government functions or special water management boards.

The World Water Commission proposes that riparian countries should accept some form of 'restricted sovereignty' over their shared resource.

Actions leading to strengthening institutions:

- Establish water resources co-ordinating committees or independent apex bodies for the management of aquifers and surface waters and establish mechanisms for co-ordinating water uses at national level through the preparation of national water resource strategies and plans.
- Initiate laws that compel the integrated management of water resources, such as the 1997 River Law of Japan that combines flood management, water supply and environmental management.
- Review the mandates, structures, objectives and procedures of water management institutions and adapt and build capacity so that they can meet the challenge of IWRM.
- Facilitate the integration of water resource management at local level by dovetailing land use and water resource planning and provide adequate budgets and revenue generating abilities to sustain the local agency.
- Strengthen human resources capacity to fulfil the tasks devolved to the various institutions with special emphasis on training women.

Strengthening the management of shared waters

There are a two specific legal principles for shared waters, 'sovereignty' (or versions of sovereignty) and 'no harm', which accord with the interests of upstream and downstream riparians. There is also the compromise principle of 'equitable utilisation'. However, none of these principles have been made universally operational and they are impaired by the lack of third party jurisdiction for conflict resolution when there is no agreement between the concerned parties. The basis for agreeing co-operation over shared international rivers is thus limited. To overcome this problem, the World Water Commission proposes that riparian countries should accept some form of 'restricted sovereignty' over the resource. This concept is yet to be fully defined, but is intended to encompass the idea of equitable utilisation and co-operation in the use, development and conservation of shared waters for the benefit of all riparians. The basis for consensus would be strengthened by the reactivation and follow-up of the currently stalled work of the United Nations Convention on Non-Navigable Uses of International Watercourses.

Despite the potentially explosive nature of transboundary river management, the last decade has seen a number of positive developments around the world whereby co-operation mechanisms between riparian states in some major river basins have been developed and strengthened. The multi-national initiatives on the international rivers of Southern Africa, the bi-lateral agreements being discussed in the Jordan Basin, and the major shifts in perspective occurring in the Nile Basin bear witness to a move towards dialogue in international water affairs since the end of the Cold War. Similarly, substantial progress has also been made in South Asia on the Ganges, and in South East Asia on the Mekong. Most agreements are bilateral; some involve many partners. The Southern African Development Community (SADC) Protocol on Shared Watercourses is an example. Much remains to be done elsewhere but progress is slow.

The challenge is to build on these successes and initiate and firm up agreements on all transboundary waters, to prevent regional conflict and improve the management of these vital water resources. Shared aquifers need to be included in transboundary water discussions.

Actions required include:

- Promoting confidence-building measures among riparian countries, starting with the development of shared perspectives, data collection to form a factual basis for discussion and compatible information formats.
- Identifying water ambassadors with negotiating skills to start the required diplomatic initiatives.
- Establishing a means for adjudication and negotiation with the help of UN organisations or other international agencies.
- Establishing links between regional organisations, regional water partnerships and civil society that support the above measures and help in bridging the gap and breaking the ice.
- Developing a legal framework on which to negotiate agreements for shared aquifers.
- Following-up the work done on the UN Convention on Non-navigable Uses of Watercourses and establish an acceptable basis for the management of shared rivers using the principles of equitable utilisation and regional co-operation.

While there will be a unique solution for each river basin, effectiveness in river basin management depends on a number of common features.

Strengthening river basin and aquifer management

The lack of integrated water resource management is nowhere more visible than in the deplorable state of many of the world's rivers. The Vision records that 50% of the rivers in Europe and North America are seriously polluted and the situation is even worse in some developing countries where wastewater treatment facilities are lacking. Several of the large rivers of the world are no longer perennial. Of similar concern, but made worse by their invisibility, are the mining and pollution of aquifers vital to many people's livelihoods.

The challenge is to strengthen river basin and aquifer management in a manner that is acceptable and compatible to the overall administrative structure of a country and at the same time achieves a high level of effectiveness. While there will be a unique solution for each river basin, experiences have identified a number of common features promoting effectiveness in river basin management. Where these features are absent, river basin authorities lack political legitimacy and sustainability. These are:

- a high level of autonomy and enterprise of the management organisations,
- transparency, accountability and stakeholder participation in decision making,
- the availability of information and the capacity to use it to anticipate developments, and
- reliable, sustained financing.

The need for mediation among different users – often around single issues – and the resolution of upstream and downstream conflicts are driving a move toward pro-active river basin management. Many countries are creating institutional mediation structures that may take many forms. In France the *Agences de l'Eau* have joint responsibility for large hydrographic basins including financing, and set taxes according to the principles of 'polluter-pays' and 'user pays'. The planning and implementation of the necessary investments are carried out at the level of the smaller sub-basins where water development and management programmes *(Schéma d'Aménagement et Gestion des Eaux)* are set up. In the UK, basin management is the responsibility of the Environment Agency which is administratively divided according to groups of river basins.

Functioning river basin management systems must be established on all the main river basins within the next ten years.

At the same time as developing organisational structures for river basin management, it will be necessary to take stock of the quality of water in the rivers, and the historical and expected development of discharges and flood risks. This may then be followed by the development of a shared vision, with all stakeholders having unlimited access to data. The management of river basins must incorporate land use planning as activities such as deforestation and urbanisation have a direct impact on water resource availability and water quality.

Co-operative relations between users of shared waters are usually most difficult to achieve when they are most needed, such as when major dams or similar large infrastructure is involved. The interests of various groups or constituencies may be diametrically opposed and the process will often require strong political sponsorship. Awareness-raising and compensatory action may be needed, in addition to skilled diplomacy and well-informed negotiation.

Much work on river basin and aquifer management needs to be done and initial action is needed to:

- Establish partnerships between government and civil society to identify the most critical rivers in the region for priority action. Civil society can offer independent monitoring, raising awareness of river issues and lobbying for action.
- Promote confidence building measures between riparian countries, starting with the development of shared perspectives and compatible information formats.

Civil society, the private sector and river basin management

Civil society has in many instances given the impetus for improved river basin management. NGOs, such as the Save the Rivers Network, the Clean the Rhine Movement and many others have changed river management policies and practices.

Also commercial private enterprise has pressed the case for clean water supply from rivers. This happened for instance in the water supply concession in Lima, when no private operator was willing to put its reputation at risk because the bulk supply from the Rimac River was too unreliable.

Functioning river basin management systems must be established on all the main critical rivers within the next ten years. In some countries this may lead to the creation of dedicated organisations, in which case they must be staffed with competent people and have the resources and mandate to operate effectively. Intermediate steps to system effectiveness are outlined opposite. Community participation through catchment committees or water 'parliaments' as in France can help to ensure that the public authorities managing basins are accountable to all stakeholders.

Actions developed during the preparation of the Framework for Action are:

- A GWP Associated Programme has been developed by the International Basin Network Organisation (INBO), which builds linkages between existing and new or potential River Basin Organisations (RBOs).
- A proposed programme by the Dutch Government for the twinning of RBOs will allow staff from more established river basin organisations to provide advice and help to existing and emerging organisations in such fields as river basin policy and planning, operational management and analytical tools. The Dutch government has also prepared draft guidelines for river basin management.

Intermediate steps for creating and strengthening river basin organisations

- Design institutions acceptable to the formal and informal structures of the country (countries with strong municipal systems, grass-rooted local governments and established federal regimes are not amenable to models fit for other realities).
- Conduct appropriate fact-finding, awareness and negotiations campaigns, not a quick round of visits to justify the proposal of a blanket blueprint.
- After bargaining and negotiations with relevant stakeholders, develop an RBO work plan that provides incentives for integration and co-operation, and that has the potential to satisfy real and concrete interests of local people.
- Involve all relevant stakeholders, as in Water Parliaments in France, and not just the ones supporting a particular institutional design.
- Provide a 'seed' organization to initiate the development of agreed RBOs. Development will not automatically follow approval of an agreed RBO, support and planning will be required.
- Equip RBOs with best management practices and appropriate legal powers, status, and the financial resources to carry out their responsibilities.

"Service rates for use of the resource must guarantee an adequate economic remuneration; subsidy systems – when justifiable – must guarantee the principles of equality and universality for access to the resource. Financing and investment tools must be developed – including private sector participation – to meet proposed targets."

South America Vision

Realigning economic and financial practices

Realigning economic and financial practices is at the heart of the World Water Vision. It is essential to the achievement of water security and is a driving force for change and modernisation. Actions are needed in two separate but complementary areas: the economic sector, relating to the valuation of water; and the financial sector, concerned with charging for water. Incorporating economic valuation of water in national policies and establishing policies leading to full cost pricing should be included as a sub-set of the IWRM targets. These are discussed below and in *Investing for a secure water future*.

Valuing water

Although water is sometimes recognised as both an economic and social good, in many instances it is not used to maximum economic or social benefit. The notion of water as an economic good reflects the fact that water has different values in different uses. To avoid confusion it is important to distinguish between valuing and charging for water. Water's *value* is important in deciding on alternative uses of the scarce resource whilst *charging* is an economic instrument to recover costs and provide incentives for efficiency and conservation. Decisions on allocations should take the different values into account rather than rely on historical patterns. Because current water allocation is rooted in prior direct use, public good uses such as stream flows and eco-system protection are often inadequately reflected.

Instruments that promote demand management, poverty and health improvements, and water conservation should be given priority.

The recognition of water as an economic good is central to achieving equitable allocation. Water should be allocated to maximise its value to society, and reallocated from low value uses – low value agriculture in some cases – to higher value uses – basic drinking water supplies, some industries or eco-system protection.

National governments have a number of tools available to adjust their legislation and regulation to promote appropriate water reallocation. Tools include property rights instruments such as licensing, tradable rights, water rights reform and permit granting (see box). Clear legal structures and framework are also important. Decision-making tools include proper cost benefit analysis and environmental impact assessment. Demand assessment and market research help to improve decision-making in general and hence contribute to better water allocation.

Action to ensure economic efficiency include:

- Ensure that the value of water is fully recognised and that instruments that promote demand management, poverty and health improvements and water conservation are given priority.
- Apply economic instruments such as pollution charges to ensure the polluters pay towards the cost imposed on society by pollution.
- Include water and other natural resources in national accounts through the establishment of natural resource accounting or 'green accounts' (as for example in Norway). By treating water as a capital resource, policies focus on maximising the return on the investment while ensuring its long-term sustainability.

Property rights and water resource allocation

- Ensure that water rights are tradable – preferably separately from land rights to which they are often attached. This will make it possible to reallocate water to uses that give higher financial returns within the constraints of the water resource system. The reform of water rights in Australia may serve as an example.
- Allocate water that is unallocated with priority uses for the poor and the environment. This is necessary to avoid water being simply taken by the first or most assertive user, as is often the case with groundwater. The delineation of water and land regimes is important for securing livelihoods and improving efficient utilisation of resources.
- Establish and effectively implement permits for the use of all water resources – such as extraction from groundwater for any use.

Establishing sound finances

Equally important is the need to realign financial practices and introduce water *charges*. As advocated in the Vision, practices should be based on the *full economic costs* to recover capital and O & M costs, opportunity costs from alternative uses and economic externalities, such as environmental degradation and eco-system damage. As already stated, the value of water and the price for obtaining it are not the same thing although closely related. Water pricing ensures that users pay full service costs. The 'user pays' principle should be applied in all water use. In addition, the principle of charging should apply to pollution and those who pollute should pay for what they do – the 'polluter pays' principle. There are many examples of this principle in action: 20 years of pollution charges in the Netherlands have facilitated investment in wastewater treatment, and in China, pollution charges have provided revenues for environmental management. Both the 'user pays' and 'polluter pays' principles should be applied to return flows from agriculture and industry, and for groundwater and surface waters.

Revenue generation, sound and sustainable water management practices and 'water wise' behaviours should all be promoted by the application of these principles. They apply equally in the contexts of domestic, municipal, agricultural and industrial uses. The principles need to be backed up by systems for effective and honest revenue collection. Subsidies that encourage profligate use of water – whether for water services or for other inputs such as energy – should be progressively reduced. Cross-subsidisation to meet equity targets can be used, but should be carefully applied. UNDP indicates that 70% of the poorest of the poor are women; yet surveys show that women are more willing to pay for water than men as they recognise its value. Clearly more involvement by women will bring greater benefits to water service delivery. Sound financial management will also be needed to create the incentive for private investment in water services and ensure sustained quality of services. Greater transparency and financial accountability will contribute to the achievement of water security.

In Mexico City, the annual subsidy for operation and maintenance of water systems is equivalent to 0.5% of GDP.

Actions to support the effective introduction of pricing for water services include:

- Introduce pricing to facilitate full cost recovery and to encourage careful use. Organise participation of stakeholders in water allocation and pricing to gain support and acceptance of charging structures. Link pricing to benefits such as reliability of water supplies and the implied contract between supplier and user of water.
- Introduce economic instruments such as pollution charges to ensure that polluters pay towards the cost imposed on society by pollution.
- Establish mechanisms to protect the poorest and to ensure effective operation of pricing and charging systems including the elimination of corrupt practices. Establish welfare support systems such as water vouchers or stamps to support the purchase of water supplies, and the careful design of the services to ensure that that they are both effective and affordable.

Tariffs, fairness and support to the poor

There is now considerable experience with water charging and tariffs, and a growing understanding of the conditions which need to be met to make charges effective. It has been argued that water services need to be subsidised to protect the poor. In practice this means utilities cannot generate sufficient revenues to cover their operations and maintenance costs, let alone replacement and new investments. In fact, subsidies on water supply tend to benefit the rich – who have more reliable water services. Because of under-investment, the poor are not served, and they are often forced to take coping strategies through the acquisition of water from water vendors and their own wells and other informal sources. A more thoughtful approach is needed to water investment and water operations for the poor to ensure they have sustainable access to services rather than simply unsustainable subsidised provision.

The cost of subsidies is often substantial at the macro level; in Mexico City for example, the annual subsidy for operation and maintenance of water systems (excluding capital investment) is equivalent to 0.5% of GDP. Many believe that this money could be invested much more effectively to alleviate poverty rather than subsidise water flows to the rich.

Generating water wisdom

The active involvement of the private sector can encourage efficiency and transparency and significantly improve governance.

Imaginative approaches can be used to support tariffs to make investment more attractive to private investors, thereby obtaining both efficiency gains and improved service delivery – the whole point of the exercise from the water perspective. In Guinea-Conakry, as quoted in the Vision report, the World Bank is supporting tariffs to finance investment by a private company over a 10-year period until the delivery base builds up, service levels improve, and tariffs reach the required levels. Importantly, the roles of the Government as regulator and the utility operator as service provider are clearly demarcated.

The pattern of water financing is already shifting from governments to the private sector. This shift demands a parallel and fundamental shift in behaviour and expectation by both investors and users. The active involvement of the private sector can encourage efficiency and transparency and significantly improve governance. Government's role, meanwhile, changes to one of effective regulation, in the context of a legal environment that is both clearly articulated and effectively enforced.

Tariffs should:

- Maximise efficient allocation of the resource
- Be perceived as fair by water users and equitable across customer classes
- Bring in sufficient revenue to support the service and operations
- Provide adequate funds for stability in the event of surges or shocks
- Comply with regulations
- Promote resource conservation
- Be easily implemented both technically and administratively
- Ensure affordability by the poorest
- Ensure that the welfare role (which is that of government) and the business role (which is that of the utility managers) are not confused
- Be forward looking to provide revenues for future investments in water resources
- Include environmental costs reflecting ecological, recreational and environmental uses of water
- Be consistent with other government policies (eg development goals, poverty alleviation)
- Reflect characteristics and quality of service (eg water quality, supply reliability, differentiating for different uses and quality levels)
- Vary according to level of consumption

Jayashri Ghosh, Kadamtala Girl's School, Jalpaiguri, India

Generating water wisdom

Generating water wisdom means raising public awareness and building and sharing knowledge and capacity about water matters. The first step, as identified in the Vision, is to make people more aware of the importance of water, the threats it is under, and what improvements and corrective actions are within reach. Water knowledge needs to be generated, reviewed and tested, and then shared without restriction. Moving towards better water resources management and demand-driven service delivery means a major change of attitudes and development of different skills both technical and communicative. Considerable investment is needed in people – the fundamental resource.

A balanced water future in which targets can be met will not be possible without significant breakthroughs in water science and technology. There are many as yet unresolved questions in the field, such as climate change, the role of bio-technology in crop production, and eco-system water needs. Research in such high priority areas and stimulus for technological innovation are needed as the foundation for practical solutions to water problems. As far as possible, research should be results-oriented, with an emphasis on piloting innovation, demonstration and bottom-up research and development.

This chapter will discuss generating water wisdom under four headings:

- **Raising awareness of water issues;**
- **Investing in people;**
- **Promoting research, development and demonstration;**
- **Improving information generation and sharing.**

"The priorities: promote the dissemination of know-how; encourage the exchange of information and technologies; promote technical development of water management personnel at different levels; promote water resources and environmental issues among all decision-makers and the wider population, starting with primary schools."

South America Vision

Raising awareness of water issues

Participants in the Vision to Action process in many regions highlighted the need to raise public consciousness on sustainable water use and management. Hygiene education was deemed an especially important topic. People need to understand the threats to fresh water resources and the consequences of irresponsible and unsafe water behaviour to water users and custodians. Messages should be targeted to specific key audiences, such as farmers, industry, opinion leaders, youth and the general public. People need to think about what they are doing, every time they use water. Messages need to deliver practical ideas on safe domestic water supply and sanitation, on maintaining ecological values of water, on checking overexploitation or contamination of scarce water resources.

Building on considerable global experience in the power of public awareness, a wide-ranging *Water Awareness Initiative* is needed covering the following groups:

Involving children and young people:

The youth of today will be the leaders and implementers of 2025. If they are sensitised to the threats to a resource on which they depend, the consciousness of those around them will also be raised, now and in future. Education on water issues is fundamental to the future sustainability of the resource.

Safe and wise water behaviour should be an element in all school curricula. Education authorities should develop materials on local water issues and actions of direct relevance to children and their families. Help will be needed to prepare accurate and meaningful teaching materials, establishing

Religious leaders in Saurashtra, India, reversed a trend of groundwater depletion and motivated construction of 200,000 infiltration wells.

professional teacher training courses and networking assistance. The International Water Education and Training (WET) Initiative is an example of a source of such help.

UN organisations, notably UNESCO and UNICEF, are urged to support such an initiative. NGOs can supplement the outreach of public sector education. International organisations and academic bodies can help by providing research outputs and other materials. Hygiene education in schools is of particular importance.

New youth initiatives can draw on many successful activities around the world. Examples include aquatic restoration drives in Japan, water expeditions and research programmes such as the *Cintah Sungai Kita* campaign in Malaysia and the Water Watch Victoria Habitat Survey in Australia, and writing and drawing competitions such as those in Fiji and Namibia. Links should be established between groups and initiatives in different countries.

Water stewardship

A well-known multi-national company has adopted fresh water stewardship as one of its ethical objectives. One example is the impressive calendar on safe water use for primary schools in Sri Lanka which was distributed to all schools in the three national languages. This could be replicated elsewhere.

Reaching decision-makers and opinion leaders:

This target group includes political, business, administrative and religious leaders. Opinion leaders should be approached by water ambassadors, professionals and committed civil society groups, by briefings and advocacy. Many such openings have been made during the Vision Process, and these activities should continue after the World Water Forum (see also *The way forward*).

Business schools and civil administration training institutes should be approached to incorporate programme case studies on water security and sustainable water management in their curricula.

Since all the major world religions consider water as precious, religious leaders should be a particular target for involvement. Religious codes of behaviour often include rules on personal hygiene, as does Islam's *harim*, and even on water management such as strictures on groundwater abstraction. An example of the potential influence of religious inspiration on water behaviour is the groundwater recharge movement in Saurashtra in Gujarat, India. Support from religious leaders has helped to reverse a well-advanced trend of groundwater depletion and motivated the construction of nearly 200,000 infiltration wells and recharge structures.

Religious initiatives

Catholic bishops in north-western USA issued a document in 1999 urging people to view the Columbia river as a sacred source of life and a symbol of people's connection to the divine. This initiative exemplifies the actions that religious groups can take to preserve water resources through consciousness-raising.

Reaching out to women:

Women are active in two heavy water-use sectors – agriculture and fisheries – as well as being exclusively responsible for managing water at the household level. Women may therefore be more responsive to concerns regarding long-term safe and sustainable water use, and are a key target group for messages on hygiene, water saving in agriculture, the need for water quality conservation, and the protection of aquatic resources. There should also be a promotion of shared responsibility and authority between men and women for water management. Messages should take advantage of women's networks, women's educational institutions and women's associations. International organisations can help with technical expertise, examples, and advice on communications strategies. Water-related literacy campaigns, incorporating hygiene and water conservation messages, have the double advantage of providing education as well as water awareness.

"A massive awareness raising and advocacy programme must be instituted. Issues such as water conservation and land-use, must be made part of school curricula at all levels to develop a well-informed and motivated citizenry."

Vision for Southeast Asia

Reaching women in India

The Indian Self-Employed Women's Association (SEWA) has a membership of over 200,000 self-employed women. SEWA members have developed a water vision, and have set up Watershed Committees whose impact on tackling local water problems in many parts of Gujarat State has been significant.

Raising awareness of farmers:

With 70% of water resources used in agriculture, farmers are the main custodians of global water resources. Although farmers are often targeted for messages about many aspects of agriculture, there has been little outreach on the topic of local water management and water protection. Extension programmes should include local water management messages, as should the outreach programmes of private agro-chemical companies. Local experts will need to create well-crafted water messages in local languages.

Approaching industry:

Greater awareness, public pressure and legislation can help to encourage more responsible behaviour on the part of industries using large quantities of water and/or inclined to pour wastewater and pollutants back into water systems. Major polluters must develop messages and training programmes for their employees and agents, and develop methods for safe effluent disposal. The tourist industry should adopt codes of practices on water use, disposal and conservation, and make these known to commercial outlets and customers. The US Green Hotel Association is an example of a group currently operating a code of water conduct, and regulating and monitoring water-wise behaviour among its members.

The Water Awareness Initiative will act to overcome 'water blindness' in the building industry and to popularise building practices that encourage water conservation. Professional builders associations and architects associations should endorse water safe practices and where practical incorporate them in building codes. Professional associations and academic bodies can help by developing good building guidelines and encourage their use among members of building associations.

Groups in the industrial sector that have pioneered and adopted new modes of operations need to be recognised. The International Standards Organisations and national equivalents could develop 'water eco-efficiency' standards, along the lines of those tested by the World Business Council for

Chambers of Commerce can spread information on clean technologies among their members, and lobby for tax concessions on water-saving devices.

Sustainable Development and translate this into 'blue eco-labelling'. Countries should use blue eco-labelling to reward those products deemed water-friendly. Environmental performance practices included in the International Standard ISO14000 can be used to formulate water conservation and protection standards.

Paper industry

In Germany, pressure from the environment movement and polluter-pays legislation has prompted the pulp and paper industry to modernise its processes. This resulted in a reduction in industrial water use from 47 litres per kg. of paper in 1974 to 1.5 l/kg in 1995, with appropriate savings in waste and costs. Following the Forum more must be done to learn from, and replicate, such examples around the world.

Factor Four, Weiszacher et al, Earthscan, 1997

Existing clean technologies are often either not known or not accessible to industries around the world. Local Agenda 21 programmes are active in promoting cleaner production in industry. Local Chambers of Commerce can spread information on clean processing technologies among their members, and lobby for tax concessions on water-saving devices. Driven by good business practices and social responsibility, multi-nationals, particularly those with a global outreach, can do significant good in raising the profile of the water movement and delivering the message of wise water use while gaining ethical credibility.

Environmental measures in the Philippines

An environmental user fee has been imposed on establishments discharging wastewater into Laguna de Bay, the country's largest lake. The fee is composed of two elements: a fixed sum to cover inspection and monitoring expenses, and a variable cost based on the organic pollution carried by the wastewater measured as the total biological oxygen demand. As a result, a pollution reduction of 5.6 million kilograms of BOD – a reduction of 46% – was achieved in 1997 by the 535 industries and businesses around the lake.

Reaching the general public:

An aware general public can exert useful pressure for political reform in water resources management. To reach the public, material on water issues can be disseminated through news programmes and documentaries, but also as themes in dramas. For instance, Rand Water in South Africa, a supplier of drinking water, has a regular Saturday morning slot on the children's television channel (KTV). The water community should use well known celebrities to spread the water message, emulating the successful recruitment by UNICEF of goodwill ambassadors. The Water Supply and Sanitation Collaborative Council (WSSCC) is pioneering this approach.

Promoting water-wise products:

Consumers (corporate or individual) can make investments in a safe water future by buying water-wise products – if they have the option. To provide this opportunity, the following type of water-wise goods will need to be developed and energetically marketed:

- water conserving devices (low water consumption toilets, water restrictors, low-flow aerators, high-quality faucets and washers, self-closing taps, leak detectors, testing kits, water-saving dish washers and washing machines);
- low water pollution products (from safe detergents to water treatment systems);
- micro-irrigation facilities (drip, sprinkler and bubble systems);
- local drainage systems and safe water supply and sanitation equipment (safe taps and sanitary seals).

Demand and consumer awareness will need to be stimulated through marketing campaigns, build up of distribution networks, product development investment, smart subsidies and 'blue eco-labelling'. Local campaigns should collate information on water-wise products, promote water-wise concepts, and disseminate information through product directories and public advertisement. An example of effective action along these lines is the Water Wiser Product Directory (USA).

"A global research network 'Science for Sustainable Water Co-operation' contributes to technological changes a great deal. International science and technology co-operation can fill the lack of environmentally-friendly technologies which we used to have in Russia."

Russian Water Vision

Water wise campaigns

Campaigns can make a real difference in water-wise behaviour. Members of the association of Dutch Water Utilities (VEWIN) succeeded in reducing average per capita domestic water consumption from 148 to 124 l/day by making the public aware of water issues, and providing information on water saving appliances.

Investing in people

Knowledge alone is not enough. National and local water resource managers and service providers need to be able to use knowledge to design and manage effective water management systems, based on up-to-date concepts and principles (demand management, stakeholder participation, and appreciation of the ecological functions of water). Enabling individuals to use water-wise knowledge well will require programmes of training, capacity-building and human resource development. Policy-makers and politicians, whose decisions affect water management, must be kept informed and encouraged to apply water wisdom.

Challenges in capacity development

- To strengthen capacity development networks and promote curriculum reform.
- To raise the profile of women water professionals and develop the capacity of water professionals to be sensitive to gender issues.
- To generate knowledge and information about best practice to support the implementation of integrated water resources management.
- To familiarise water stakeholders with the concepts and benefits of new approaches to water management.

To support training, gender sensitisation and capacity-building, IWRM capacity-building networks should be developed.These networks should play a major role in:

- gathering, sharing and synthesising knowledge from a variety of disciplines on best practices;
- developing best practice tools and guidelines;
- building up understanding and consensus on new approaches;
- supporting national and local focal points for capacity building;
- training of trainers.

The dissemination of best-practice knowledge and of guidelines for new-style approaches is essential for rapid uptake of ideas and strengthening capacities.

CAPNET

With the help of the GWP, UNDP has recently established a capacity building network (CAPNET). The overall objective of CAPNET is to improve livelihoods and protect the environment, by promoting IWRM and effective service delivery concepts. CAPNET aims to strengthen the capacity of both institutions and individuals though a combination of networking, awareness creation, training and education, and the development of tools and materials. CAPNET will serve as a global network supporting existing regional and national networks and training institutions that are the ultimate capacity builders. The IWRM Toolbox will be an important instrument for supporting capacity building.

Training and curriculum reform is needed to enhance practical understanding of IWRM and demand-based approaches. Water management training institutes can help develop a new generation of water-wise professionals. As responsibility for water management is increasingly shared with users and local organisations, knowledge of and respect for community approaches must become an integral part of training. New curricula should teach a practical understanding of participatory decision-making.

The dissemination of best-practice knowledge and of guidelines for new-style approaches is essential for common understanding, rapid uptake of ideas and strengthening capacities. To get maximum benefit from such material there is a need for in-post practical training for water managers and service providers at all levels.

EC Guidelines

The European Commission has developed a major new set of Guidelines for water resources development co-operation: *Towards Sustainable Water Resources Management – A Strategic Approach*. Intended for use by water practitioners, the Guidelines represent an important contribution by the Commission to the global effort to reduce stresses on the world's supply of freshwater. The strategic approach proposed in the Guidelines is designed to bridge the gap between a wide-ranging set of policy principles based on the international consensus of Dublin and Rio, and their systematic operational practice at all stages of the programme cycle. The Guidelines are available in three languages, on the Internet and on CD-ROM.

Involving Women:

Except in a few parts of the world, water-related activities are marked by a dichotomy: while men and women are equal water users, professionals and decision-makers are predominantly male. Women typically occupy less valued positions in terms of decision-making and remuneration than men.

This unbalanced situation has many causes including gender stereotyping in terms of education and careers, innate conservatism and resistance to equal relationships in professions traditionally dominated by men, and the lack of gender sensitisation programmes to compensate for rigid attitudes and behaviours. Even when fully-qualified, women rarely have equal access to the labour market. As a result, few organisations involved in water resource management and water-related services yet have the capacity to mainstream gender dimensions of water supply, sanitation, waste disposal, irrigation or drainage programmes.

The challenge is to correct the gender imbalance in the profession and train professionals to take into account the different concerns of men and women in the design and management of services. the promotion of gender-sensitivity is part of a larger move towards demand-driven services and an associated shift from 'infrastructure' thinking to 'service' thinking.

Few organisations involved in water resources management and services yet have the capacity to mainstream gender dimensions.

The required actions are:

- To revise standard perceptions of technical careers and train teachers to enhance the interest of girls and boys in water-related careers. This will require the development of learning packages for primary and secondary schools and special teachers training.
- To promote water professional associations among women and female role models, and adopt strategies to encourage positive discrimination in new recruitment.
- To incorporate practical customer analysis, gender sensitive design, and multi-functional water use in the curricula and refresher training of water professionals.
- Enable resource centres to help national educational boards and water agencies develop appropriate programmes and ensure that buildings are suitable for female students and professionals.

All major national training institutes should have gender analysis as part of their educational package to increase the presence of women in water-related professions. Capacity building is essential so that women are able to perform managerial functions. This includes skills in financial management, community participation, leadership, confidence building and communications.

Women managers:

The effects of female participation in management on the women and men in communities are manifold. Recognition of women's management tasks and training for new tasks and skills has increased their status and self-confidence. Women in the Visayayas in the Philippines reported that their views are increasingly respected and their needs met with regard to time of meetings, design of water supply and design of latrines. They now believe that they can really contribute something for the good of the community and be 'partners in progress' and not 'for decorative purposes only'. In a project in Indonesia women grew in knowledge, self-confidence and leadership, and autonomous management of water systems increased.

Promoting research, development and demonstration

The focus has been on water issues in industrialised economies. The challenge now is to undertake similar research for issues affecting poorer economies.

Achieving the Vision will need new knowledge in a number of critical areas as underlined in most of the regional Vision to Action reports. Knowledge must also be translated into benefits to people. This in turn means that research must be problem-centred, and that findings are translated into practical solutions via pilot projects and demonstrations. It also requires that research reflects demand and is output-oriented. Research should be complemented by a thorough search for 'solutions in use', through grassroots experiments and new forms of action research.

As highlighted by the World Water Commission, technological solutions will play a major part in bringing water equations into balance. Much past cutting-edge research and development has been by the commercial sector, for example on cost effective desalination. While this has brought about many important innovations, the focus is largely on issues in industrialised and richer economies. The challenge now is to bring together public and private research and development interests to undertake similar research for water issues affecting poorer economies. Research must focus on innovative, low-cost and clean technologies to promote efficiency gains. It is equally important to find ways of getting solutions taken up and used.

There are many water-related research issues that must be addressed at the global level, such as global warming, public health, and energy conservation. Research in these fields, whatever its original inspiration, should address the implications of these phenomena for future water resources use and management.

The Vision exercise identified challenges to promote and facilitate public and private research in water-related priority areas; in particular water productivity; freshwater eco-system functioning; environmental sanitation; and water demand management. The research must be targeted at practical solutions to pressing problems and be accessible and applicable to the poorer countries of the world. It is essential that special measures are taken to ensure field research and the uptake of new innovations through pilot demonstrations and networking.

To increase investment in innovative solutions, it is recommended that a private sector led International Research Foundation or Water Innovation Fund is established, in partnership with international organisations.

Water productivity:

The link between land and water use is still poorly understood. Crop productivity should be studied in relation to the amount of water supplied to both high- and low-input producers. Links between the management of water deliveries (timeliness, reliability, crop production) should be studied, particularly in low-yielding and stagnating production systems such as the rice-wheat system in much of Asia. Water-efficient, and salt- and water-stress-tolerant crop varieties should be developed, including by the safe use of bio-technology. New crop varieties and husbandry techniques should dovetail with existing production systems and male-female farming roles in countries where most livelihoods depend on agriculture.

Combined agronomic and water management research by the Consultative Group for International Agricultuarl Research (CGIAR) centres should be strengthened. The CGIAR institutes have been conducting public domain agricultural research in partnership with national agricultural research systems, including research institutes and water agencies. Since many countries do not have specific inter-disciplinary irrigation or water management research organisations, the CGIAR centres, such as the International Water Management Institute (IWMI) and the International Food Policy Research Institute (IFPRI), often work with more specialised institutions in these countries, or assist irrigation management agencies to strengthen their own research capabilities. Multi-disciplinary programmes should be developed on water and food production interactions, which involve both agricultural and water management researchers.

In the same way as the World Health Organisation (WHO) works with pharmaceutical companies, water research centres and academic bodies should consider joint ventures with private agricultural research entities, such as budding bio-technology firms in emerging economies. This is likely to be workable in areas with potential commercial pay-off, such as cereals and horticultural crops. The Dutch government are preparing a twinning programme for food security between developed and developing countries to link institutions involved in research and water management.

Freshwater ecosystems research:

One of the greatest knowledge gaps preventing sound water resource management concerns the functioning of eco-systems and the seasonal water regimes required to sustain them. Good management at the eco-system and basin level is vital to a holistic water resources management approach. The needs of freshwater eco-systems is therefore a priority research area.

Cross-disciplinary research is also needed. Where possible, freshwater ecosystems research should be linked to pressing problems, such as freshwater fish stock declines, ecosystem rehabilitation, and alien weed infestations. An applied research facility – supported by a network of institutes – should be developed to support basic research and respond to requests for research findings by management organisations such as municipalities, irrigation departments, and river basin organisations.

"Research and development of crops resistant to drought, pests and salt is needed to reduce water use in agriculture. Other important research areas include clean technologies, groundwater recharge and rehabilitation, salt water intrusion, watershed hydrology. There is currently a poor understanding of water and land eco-system processes."

Southeast Asia Vision

Freshwater ecosystems research

The Co-operative Research Centre for Freshwater Ecology (CRCFE), in Canberra, Australia, addresses issues of current concern to the Australian water industry, include, environmental flows; the control of toxic blue-green algae blooms; the effects of excess nutrients in waterways; the control of alien species, native fish decline; floodplain and wetland ecology; and river and wetland rehabilitation.

One specific example illustrates the value of this problem-centred research. A toxic blue-green algae bloom extended for more than 1000km in the Darling River and was adversely affecting town and rural water supplies. This prompted immediate research to understand what caused the bloom and how such blooms could be prevented in the future.

Sanitation research:

Future sanitation research should focus on the further development of cost-effective, robust and low pollution systems. Special emphasis should be given to systems for the urban poor, and to a reduction in dependence on conventional water-profligate sewerage systems – especially in water-short environments. Sanitation research needs to further develop the wider aspects of environmental sanitation and such relatively new techniques as bio-remediation and ecological sanitation, and to focus on the rehabilitation of disused sewerage treatment facilities around the world.

A networked research programme is needed with participation from water supply and sanitation centres, financial institutes and private sector R&D units. The objective should be to develop sanitation systems and waste reuse

systems for local investment by individuals, communities and local private entrepreneurs. Technological research outputs need to be supported by financing programmes for the poor, such as micro-credit schemes, user shares and commercial services (see *Investing for a secure water future*).

Emphasis should be on the use of economic instruments, such as stepped pricing and tariff structures, to promote careful water use.

Dry sanitation

In northern Vietnam it used to be common practice to fertilise fields with excreta. As this pracitce could endanger health by the spread of pathogens, the health authorities started to promote the construction of double-vault dry composting latrines in which the pathogenic material in excreta was neutralised before the fertiliser was spread on the fields. Long and persistent health education programmes were undertaken as part of the campaign. More research in needed on similar ecological approaches to sanitation before they can be widely promoted; however, a pilot programme is underway in China.

Practical water demand management research:

Water agencies need to conserve and re-use water and deliver services at maximum efficiency. Research is needed to identify ways to reduce water demand. Possibilities include the development of techniques for leakage control and rehabilitation, and exploring market-based incentives and non-market measures (such as licensing, quotas and controls). Emphasis should be on the use of economic instruments to promote careful water use, such as stepped pricing and tariff structures and water saving measures as part of irrigation modernisation.

Demand management

The International Union for the Conservation of Nature (IUCN) is carrying out a major multi-country study on water demand management in Southern Africa to evaluate current policies and strategies. The first phase of the research is based on five country case studies which demonstrate the benefits of water demand management, identify best practices, and encourage information exchange. A proposed second phase of the research will involve pilot studies to demonstrate the benefits of adopting water demand management within an overall framework for integrated resource management.

The link between energy and water use and conservation is of great importance. Inefficient water use often has a direct energy cost; bad policies and unreliability tend to promote excessive and wasteful use. In parts of India, for example, excessive abstraction of groundwater is causing serious problems, largely due to the unsustainable policy of providing free electricity to farmers. This is also ruining the electricity utilities. Better quality, more reliable energy with full costs paid by the users, would greatly improve agricultural, municipal and domestic water service delivery.

Solar power and desalination offer considerable scope for providing water services as most of the world's population is situated close to the sea. More research and pilot trials are needed to develop energy-efficient and resource-conserving water and energy supplies, and to reduce current costs. Research is also needed to develop policies and mechanisms that promote the uptake of such technologies.

Improving information generation and sharing

As already discussed, good water governance requires thorough and accurate water data made widely available. Creating water wisdom requires that information is accurate, understandable, and easily accessible. A common understanding is needed between information providers and users as to what information is required to support the decision-making process. The need to present global water data in a comprehensible form is one spur for the proposed World Water Development Report (see *The way forward*). This should also guide information initiatives at regional, national and local level.

"Better comprehensive information on the Nile Basin environment as well as free accessibility for such information is needed."

Vision for the Nile River Basin

Closing the main information gaps:

During the Vision exercise a number of key information gaps were identified, such as insufficient knowledge about groundwater systems in many groundwater dependent environments, the limited understanding of the status of aquatic eco-systems and the environmental implications of water utilisation patterns. Information gaps have the effect of making important water issues invisible. Governments must make clear choices as to which information to collect; aiming to meet strategic requirements in water resources assessment and water services monitoring rather than producing low quality bulk data, particularly where financial resources are limited.

South Africa

In South Africa, a rational and reliable information system has been established to assist water resource planning, management and monitoring functions. Based on a needs assessments for all key functions, the system is tailored toward improved service provision. It also provides a sound knowledge base and an integrated reference system that is helping to co-ordinate and align the activities of many stakeholders. Information delivery has been established as an important output from contributory projects and programmes.

The development of standards and protocols at all levels:

Standards are needed to ensure data are comparable, of reasonable quality, and that, once collected, data is not classified or otherwise withheld from dissemination. There is also a need to establish regular mechanisms for publishing and disseminating water information locally, nationally, regionally and internationally. Publications should not only serve water managers but also provide a mechanism for users to assess the quality and standards of service they receive. Water information providers and research institutes should adopt such protocols and have pro-active public information policies. Non-governmental organisations are encouraged to undertake independent reality checks – to counterbalance the high unreliability of official data in many places.

Many poorer countries access the web and the globalisation of information provides a huge potential for reducing information gaps.

Water resources data:

In response to a declining ability to provide information about the status and trends of water resources, in the 1990s the World Hydrological Cycle Observing System (WHYCOS) was initiated. WHYCOS serves to supplement and enhance the quality and consistency of existing systems rather than replace them. Implemented through regional components (for example, in Southern Africa and the Mediterranean region) the aim is to improve information services for regional integrated water resources assessment, monitoring and management, as well as to provide a vehicle for national capacity building, technology transfer and training. The programme aims not only to improve information services and availability but also to contribute to collaboration and co-operation between nations and regions.

The establishment of networks for technology transfer:

New information technologies and networking facilities make it possible to gain access to information without establishing costly libraries and databases. The mutual exchange of data and information between different domains is particularly important in integrated water resource management and should be encouraged through shared definitions and standards. The GWP have recently created an 'Infonet' service for water conservation in agriculture co-ordinated by International Programme for Technology and Research in Irrigation and Drainage (IPTRID), and other networks are creating similar web-based services. The Euro-Mediterranean Information System on Know-how in the Water Sector (EMWIS) is an example of a regional network covering 27 countries and is disseminated in 15 languages. Many poorer countries access the web and the globalisation and democratisation of information provides a huge potential for reducing information gaps between industrialised and developing countries.

STREAM

The STREAM Programme, led by the International Reference Centre, has synthesised the lessons of four years of action research on community water management in 22 communities in six countries. The programme is also seeking to strengthen information capacity in the participating countries through various methods, including email conferences.