Chapter 4 - Methods and processes

This chapter focuses more sharply on how to carry out water policy reforms, and more precisely on what to do, consistent with the general principles discussed in the preceding chapter.

It begins by stressing the value of a holistic approach - one that recognizes the far-reaching and inter-sectorial character of decisions about water. It goes on to examine the components of a policy review, and some of the key processes and methodologies that it entails.

The various kinds of actions required are categorized. As part of the discussion on planning and analysis there are sections on information gathering, forecasting, modelling, integrated planning, natural resource accounting, and policy analysis matrices. Among legal and institutional reforms, the main topics are legal reforms, institutional reform and re-organization, and participation. Economic measures include macro-micro links, and the creation of incentives, which in turn break down into tariffs and pollution charges in various sectors, non-price measures, promotion of water markets, banks and auctions, and the use of prescriptive norms.

Under the subheading of projects and programmes there is a discussion of how the appraisal, selection and design of projects must adapt to the needs of a new strategy, with sections on cost-benefit and cost-effectiveness analyses, environmental assessment and financial management.

A holistic approach

The ICWE and UNCED called for a new approach to the assessment, development and management of freshwater resources. The proposed approach involves the management of fresh water as a finite and vulnerable resource and the integration of sectorial water plans and programmes within the framework of national economic and social policy (UN, 1992).

A more integrated and broader approach to water sector polices and issues is important because of water's special nature as a unitary resource. Rainwater, rivers, lakes, groundwater and polluted water are all part of the same resource, which means global, national, regional and local actions are highly interdependent (Rogers, 1992). Water use in one part of the system alters the resource base and affects water users in other parts. Dams built in one country frequently reduce river flows to downstream countries for years afterwards, thereby affecting hydro-electric and irrigation capacity. When a city overpumps a groundwater supply, streamflows may be reduced in surrounding areas. Some human actions at local levels may contribute to climate change, with long-term implications for the hydrological system worldwide.

BOX 4: POLICY ANALYSIS MATRIX	
Action categories	**Components**
1. PLANNING AND ANALYSIS	
Objectives: to collect data on the water sector; to analyse it in the light of national water needs; to formulate a national water strategy.	
Analytical framework	National water strategy
Information systems	Water resources assessment
	Data banks
	Monitoring systems
	Models
	Research
2. LEGAL AND INSTITUTIONAL	
Objectives: create the right 'enabling environment' for the strategy; set up a legal framework in which rights and obligations in respect of water are clear and which facilitates its rational use; set up institutions and management responsibilities consistent with the strategy; ensure appropriate regulations are in place.	
Legal framework	Laws clarifying ownership and rights
Institutional reform	New authorities
	Coordinating bodies
	Responsibilities of utilities
	Privatization
Management structures	O&M reviews
	Delegation, user groups
Regulations	Water quality
	Environmental standards
	Regulation of private sector
	Abstraction
3. ECONOMIC REGIMES	
Objectives: to ensure that macro-economic and sectorial economic policies support the water strategy; create specific incentives for the careful use of water.	
General economic policies	Agricultural support
	Food self-sufficiency
	Industrial promotion
	New settlement
Incentives	Prices
	Conservation
	Markets
	Trading
	Pollution charges

4. PROJECTS AND PROGRAMMES	
Objectives: to select, appraise and design projects and spending programmes systematically, and consistent with the national strategy.	
Public investment schemes	Project appraisal
Water efficiency programmes	Environmental assessment
Information campaigns	Financial management

Water policies, laws, projects, regulations and administrative actions often overlook these linkages. Governments generally tend to organize and administer water sector activities separately. Surface and groundwater resources are often managed by separate units; and water quality and quantity are the responsibilities of different sectors. Thus one department is in charge of irrigation; another oversees domestic water supply and sanitation; a third manages hydropower activities; a fourth supervises transportation; a fifth controls water quality; a sixth directs environmental policy; and so forth.

These fragmented bureaucracies make uncoordinated decisions, reflecting individual agency responsibilities that are independent of each other. Too often, government planners develop the same water source within an interdependent system for different and competing uses. This project-by-project, department-by-department and region-by-region approach is no longer adequate for addressing water issues.

A more integrated approach to assessment and planning obliges water managers to understand not only the water cycle (including rainfall, distribution, ecosystem interactions and natural environment and land-use changes), but also the diverse inter-sectorial development needs for water resources. A major thrust of national water resources policy is therefore the integration of sectorial activities that impinge on water resources management and development.

Categories of actions

In keeping with a holistic approach to the water sector, the various kinds of actions can be grouped into four main categories: planning and analytical; legal and institutional; economic regimes; and project and programmatic. Generally speaking, a water policy review will entail some actions in all these categories, but the balance of activities between each category will obviously vary from country to country, as will the detailed measures taken. These categories, with some of their respective components, are illustrated in Box 4, and further discussed in this section.

Planning and analysis

Methodologies and tools for water policy analysis

There is a danger of water policy reviews being 'technique-driven.' Certain methodologies - particularly those drawing on large data sets and entailing modelling and optimization simulations - are attractive to professionals and allure policy-makers because of their quasi-scientific basis. However, rather than the sophistication of a method it is more important to ask about its relevance to the specific objective in hand, and its credibility in particular social, political and economic contexts.

Data requirements

Water policy formation is very data-intensive. However, data on water supply tend to be poor, while information on demand is often based on gross estimates. This means that the construction and interpretation of, for instance, water supply and demand balances needs great care.

Hydrological information on water supply and water quality is expensive to obtain and interpret. The repercussions of major new structures and works have to be meticulously examined. The needs and attitudes of consumers have to be ascertained, by survey in some cases. However, data gathering should not become an end in itself. Decision-makers should always ask, "What is this information for?" and, "Is this the most cost-effective way of obtaining it?"

There are two main sets of information to be established to provide the basis for policy making, planning, implementation and monitoring of the results, namely, an inventory of resources (location, quantity and quality), and an inventory of current diversion and in-stream uses.

In gathering data on *resources,* there is likely to be a disparity between information on water supply, on the one hand, and water quality, on the other. While problems of water supply are widely recognized as an issue in water resource planning and management, the problems of water quality are insufficiently acknowledged. River quality is, for example, very complex and great simplifications are needed for practical planning purposes. As the worst quality at any point is far more significant than the best or average quality, it is important to have data on maximum or extreme values.

The inventory of current *diversion and in-stream uses* should cover aspects of location, quantity, quality and the state of information in each case. The most important categories are likely to include: urban and industrial water supply, conveyance and disposal of wastewater, agriculture, flood protection, aquaculture and fisheries, hydropower, navigation, tourism, recreation and amenity, protection of the human and natural environments, and defence.

Because of the size and longevity of many investments in the water sector, it is essential to take a long view of trends in the sector. *Forecasting future requirements* would normally mean taking 25- to 50-year scenarios of supply and demand. Extrapolating current and recent trends in demand is pointless if these are unsustainable, and if changes in behaviour are likely to be called for. Hence demand projects need to be **iterative:** if the first few demand and supply scenarios are clearly unworkable, scenarios including demand management and price elasticities should be introduced. In most cases it is unrealistic to assume unconstrained demand for water.

Obtaining the information

There are a number of aspects to consider:

Right of access to information: It may be readily available, or it may need persuasion or require compulsion to obtain. Holders of information on water may regard it as sensitive and want to impose confidentiality in its use.

Information requirements: Gathering and processing can be a huge task, so requirements should be kept to the minimum required for the strategy, and gathered cost-effectively. Data should be disseminated to those who really need them, to avoid duplication and wasted effort.

Information quality: Good quality information is essential. Data are often inaccurate and potentially misleading, unless an effective information system has been in place for some years. Forecasts based on misleading historic data will be false. The motives of those giving information should always be considered. Water users who expect to benefit from improved provision but not to pay for it will have an incentive to exaggerate their requirements.

Abbreviation and simplification: Specialists should reduce and simplify their information and, especially, tune it to the specific needs of policy-makers, to maximize its effective use. Generalists, for their part, must give the specialists clear guidance on what information they need.

Box 5 summarizes key questions to ask about water data.

BOX 5: CHECKLIST OF QUESTIONS ABOUT DATA

- How is access to the required information to be obtained? Are the owners of data obliged to divulge them? If not, how can they be persuaded to cooperate? Where information has to be bought, what is the cost, and what is the most cost-effective way of obtaining it?

- What are the minimum information requirements and how is information to be managed and disseminated to those who need it?

- What standards of information quality are required and how are they to be achieved?

- What requirements are there for simplification and condensation of information for policy making and planning?

- How is additional information gathering and monitoring to be planned, financed and implemented?

Modelling

Models can be physical (hydrological), economic, or combined. Physical models are intended to capture the complexity of a water system, and are very data-intensive. Economic models aim to represent the balance of supply and demand in a system. If price and demand elasticity are introduced as variables, future scenarios can be generated that may be useful for policy and investment purposes. Another use of models is to optimize the distribution of water among different purposes, by generating its value in different uses.

Modelling is a useful way of throwing light on problems important to policy-makers, e.g., the sustainable yield of an aquifer, long-term supply-demand scenarios with water pricing, or optimizing the use of a reservoir serving different users (power, irrigation, flood control, amenity, fishing, etc.), but it is naive to think that models can produce generally applicable policy solutions, since they are only as good as their underlying assumptions about laws, institutions and consumer behaviour. The same objections can be made to excessive reliance on integrated planning.

Legal and institutional reforms

Legal reform

In order to formulate a legal system appropriate to water management, a series of steps and actions is called for, as follows:

• collection of all legislation in force on, or related to, water resources development and management;

• analysis of such legislation and assessment for consistency with the policy options under consideration; detecting issues pertaining to established individual and communal rights and governmental powers; assessing the required adjustments in such rights and powers; and assessing the legislative drafting required to implement the new policy; and

• drafting, implementation and enforcement of required legislation.

It is first necessary to consider whether the proposed policy is consistent with existing legislation governing or regulating the use, development and conservation of water resources and other related natural resources (e.g., land, forests and fish) and the environment. If it is not, the next step is to consider what changes will be required, and at which hierarchical level of lawmaking (i.e., constitutional, Act of Legislature, ministerial regulation).

For instance, the proposed regulatory policy of water abstraction and use may require a modification of the rights to use water held by individual or corporate members of the public. This would entail decisions about the extent to which such rights would be subject to change, and what guarantees should be offered.

Policies may require modification or de-centralization of the powers or scope of authority of the governmental or paragovernmental bodies responsible for water resources management and development, or for related functions (i.e., public health preservation, environmental protection, management of lands and forests, or conservation of wildlife). The introduction of a water charging policy may require modification to legislation currently giving water a non-economic status, or a modification of the privileges enjoyed by given users' groups, such as farmers.

The policy review may imply new legislation - as opposed to amending legislation already in existence. Implications for substantive legislative drafting should be recognized, especially if privatization or the introduction of corporate status to water departments is foreseen. Mechanisms for assuring the public accountability or control of private and autonomous bodies can be legally complex.

If it is proposed to allow the transferability of water through marketing water rights, the key legal questions are whether water should be transferable separately from the land where it is used, and whether transfers would be free or controlled by the government. Box 6 summarizes key legal issues, and Box 7 lists legal prerequisites for irrigation.

Re-organizing the water sector

Water utility reforms would require suppliers to behave more like commercial undertakings. This will implies adoption of more active pricing, introduction of metering, tariff restructuring, improved cost-recovery, and greater self-financing. This will often entail managerial and organizational reforms. The drawing up of a contractual plan with the government has been employed in some cases.

Privatization is appropriate in some instances, though it can take many forms and full private ownership is an extreme - and rare - variant. The French model of concessions and lease contracts has influenced a number of developing countries, e.g., Côte d'Ivoire, Guinea, Malaysia, Morocco and Thailand. Regulated private companies also operate in Santiago de Chile and Guatemala City.

Participation: NGOs and water user associations

An increasing number of private sector groups, including water user associations and other NGOs, are taking over some public sector irrigation responsibilities. The inclusion of water users in irrigation planning, management and ownership is proving to be an effective method for increasing irrigation system efficiency in many cases. Studies throughout the world demonstrate that user participation in irrigation services improves access to information, reduces monitoring costs, establishes a sense of ownership of policy among farmers and increases transparency as well as accountability in decision making.

Water user associations are expected to increase in number and importance over the next decade as the stress on self-reliance increases. Already, governments are turning many aspects of public irrigation systems over to water user associations.

Well-documented examples can be seen in Argentina, Colombia, Indonesia, Mexico, Nepal, the Philippines, Sri Lanka, and Tunisia. In Indonesia, for example, the government had transferred more than 400 irrigation systems, covering 34 000 ha, to water user associations by 1992. In the future, as farmer financing becomes more commonplace, user groups will become even more powerful.

BOX 6: CHECKLIST OF SELECTED LEGAL ISSUES AND ATTENDANT LEGISLATIVE REQUIREMENTS IN WATER POLICY REVIEW AND REFORM

1. Does the proposed policy comport with existing legislation governing and regulating the use, development and conservation of water resources and other related natural resources (e.g., land, forests and fish) and the environment? If not, what changes will be required, at which hierarchical level of lawmaking (i.e., constitutional, Act of Legislature, ministerial regulation)? In particular:

1.1 Does the proposed regulatory policy of water abstraction and use require a modification of the rights to use water held by individual or corporate members of the public? If so, to what extent and under what guarantees will such rights be made subject to change?

1.2 Does the proposed policy require a modification of the powers or scope of authority of the governmental or paragovernmental bodies responsible for water resources management and development, or for related functions (i.e., public health preservation, environmental protection, management of lands and forests, or conservation of wildlife)?

1.3 Does any proposed water charging policy require

- modification of legislation conferring a non-economic status upon water?
- modification of the privileges enjoyed by given users' groups, such as farmers?

2. Does the proposed policy require new legislation - as opposed to amending legislation already in existence - to support it and, if so, what will attendant substantive legislative drafting requirements be? In particular:

2.1 Does the proposed policy promote the privatization of water services and, if so, what legat mechanisms will need to be written into the required legislation to reconcile the profit motivation of privatized services with the interest of the general public in dependable, up-to-standard and affordable levels of services?

2.2 Does the proposed policy promote corporatizing public water resources management and development bodies and, if so, what legal mechanisms will need to be written into the required legislation to ensure public accountability of the new corporate entities?

2.3 Does the proposed policy promote the transferability of water through a market mechanism of water rights and, if so

- will water be transferable separately from the land where it is used? and
- will transfers be free or controlled by the government?

NGOs can undertake a wide range of water-related functions, from developing projects for rural water supplies and minor irrigation to fostering water user associations for water management purposes. Some NGOs encourage farmers to try new technologies, for example the catchment protection and sprinkler irrigation techniques introduced by the Aga Khan Rural Support Programme in Gujarat, India.

Many NGOs stem from local initiatives and operate as independently funded and self-managed groups. These organizations bring fresh views, new ideas and participatory working methods to other areas of development policy and practice. Much of their success is attributed to their local knowledge as well as their interest in and experience of regional conditions. They have been particularity active in promoting the interests of poor and disadvantaged groups through articulate and forceful advocacy and service provision.

The local base of NGOs may allow them to reach vulnerable or remote groups which are exceptionally difficult to reach with conventionally conceived and managed public schemes. With their close local contacts and skills in group mobilization and cohesion, NGOs can provide the institutional leadership required to bring about socially acceptable solutions, and in some cases (e.g., the Philippines) serve as community organizations.

BOX 7: LEGAL. PREREQUISITES IN IRRIGATION MANAGEMENT

As pressures on water resources and public finances increase, legal and administrative systems need to respond to the new requirements. This process includes a number of legal and institutional issues.

Water rights security: a reliable quantity and flow of water of suitable quality, and protection from pollution, are basic requirements for irrigation development. The issue of legal security has been evolving from existing or potential water conflicts and is addressed through legal mechanisms for conflict resolution. Security of water rights is, however, also required for non-conflicting situations related to market transactions, such as the commercial transfer of water rights among users or when using water rights as collateral for bank credits. Water rights titles, through certain and clear legal instruments, we critical to prevent conflict and to stimulate market mechanisms for enhanced efficiency in water use.

Customary legal rules and practices need to be recognized in statutory law as they are significant, especially in the rural context, for regulating access to water and settlement of water conflicts. The traditional informal approaches are important, since formal resolution of conflicts through litigation in courts of law is often risky, expensive and inconsistent with local culture.

Water allocation to different users is normally effected through water licences, which should allow an adequate level of flexibility while preventing or minimizing water conflicts. When previously-licensed water is re-allocated to higher-valued uses (e.g., shifted from agricultural to industrial water uses), legal mechanisms that regulate re-allocation and define the compensation to displaced licence holders are required.

Transferability of water use rights is particularly important for irrigation, so as to encourage investment in water-saving practices and permit alternative, higher-value uses of the saved water. However, to curb speculation in water rights, especially when water is scarce, irrigation water is commonly considered to be appurtenant to the irrigated land. Purely market-driven transfer systems are rare, and actual practices, to be consistent with public policy objectives and water plans, are often limited to transfers under the direct control of government water administrations.

Establishment of security of land tenure and of ownership rights, with land reform and redistribution in response to objectives of social justice, offer the opportunity to replace forms of tenure such as tenancy and sharecropping, which inhibit development and hinder the efficient and sustainable use of irrigated land. To support the transition from traditional to modem agriculture, legal mechanisms are required for a gradual transition from customary rights into modern and tradable titles.

Cost recovery is often restricted by legal and institutional obstacles such as farmers' exemption to levies, charges and service fees. inadequate authority to collect and enforce the charges, and lack of budgetary and institutional mechanisms to keep collected revenues in the irrigation subsector. Within the same objective of retrenchment of government's responsibilities, proper legal authority and enabling institutions should be established to transfer government responsibility to the users. The extent of the transfer of physical irrigation works to the users or their retention by the government, and the terms and the conditions for their use. need to be regulated. Users' groups need to be legally established and to be tailored to the scope of the functions of the users' associations.

Control of water pollution from irrigation raises legal issues on how much legitimate property rights of cultivators can be restricted, in relation to land under cultivation and agricultural practices and whether and what kind of compensation should be given.

Economic measures

Macro-micro links

Improving water resource management requires recognizing how the overall water sector is linked to the national economy. Equally important is understanding how alternative economic policy instruments influence water use across different economic sectors as well as among local, regional and national levels and among households, farms and firms. For too long, many water managers have failed to recognize the connection between macro-economic policies and their impact on, for example, technical areas such as irrigation.

Macro-economic policies and sectorial policies that are not aimed specifically at the water sector can have a strategic impact on resource allocation and aggregate demand in the economy. A country's overall development strategy and use of macro-economic policies -including fiscal, monetary and trade policies - directly and indirectly affect demand and investment in water-related activities. The most obvious example is government expenditures (fiscal policy) on irrigation, flood control or dams.

A less apparent example is trade and exchange rate policy aimed at promoting exports and earning more foreign exchange. For example, as a result of currency depreciation, exports of high-value, water-consuming crops may increase. If additional policy changes reduce export taxes, farmers are provided with an even greater incentive to invest in export crops as well as in the necessary irrigation.

National development strategies can directly influence water allocation and use in other ways. In the case of a food self-sufficiency strategy, the government may subsidize water-intensive inputs to encourage farmers to produce more rice. By providing financial incentives for rice producers, the government is influencing the demand for water and private irrigation investment through price policies.

Apart from the direct effects on water use resulting from such price policies, the increased demand for irrigation water also has inter-sectorial, intra-sectorial, distributional and environmental implications. The agricultural sector is provided with an economic advantage in access to water vis-a-vis the industrial sector (inter-sectorial); water used for rice gains an economic advantage over water used for other crops (intra-sectorial); rice producers with more land and access to water gain over those with less land and water (distributional); and increased pesticide and fertilizer use are likely to affect water quality (environmental).

Sectorial policies affect water use and allocation in non-agricultural sectors in a variety of ways. For example, in the western USA, 70 to 80 percent of the region's water yield results from snowmelt from the high-elevation forests, many of which are under public jurisdiction. Water yields are significantly affected by timber harvest policies on these lands. Rangeland management policies on lower elevations also alter vegetation conditions and thus affect the rate of evapotranspiration, in turn affecting streamflow and groundwater recharge. In such cases, it is important for downstream, city water managers to recognize, understand and become involved through policy measures in the decisions and incentives of other sectors such as livestock and forestry (see Box 1: Mountain development).

With the continuing importance of structural adjustment and stabilization programmes, many developing countries are implementing fundamental changes in macro-economic and sectorial polices. Typical adjustment programmes call for a greater reliance on markets, more open trade, fiscal austerity, a phasing out of producer and consumer subsidies (in input and product markets), and generally higher exposure leading to changed cropping policies. Budget-reducing measures imply increased competition among and within sectors for the funding for new water projects. In these situations, the overall economic, social and environmental implications of choices must be carefully addressed.

For example, when governments must choose between financing either irrigation projects or hydro-electric power projects, there is an additional social opportunity cost of the irrigation water in countries that are dependent on imported energy sources. At the same time, when water scarcity keeps some farmers on uneconomical lands such as steep catchments, the country suffers twice: once in terms of reduced production compared with what would be possible with irrigation; and again in terms of erosion and resource depletion, with erosion possibly shortening the life of existing waterworks.

In most countries, pressure has increased not only to modify investment allocations but also to recognize and accommodate new demands for water. The direct implications for water managers include fewer capital investments in new water projects, the elimination of irrigation subsidies, increased efforts to recover costs and more emphasis on demand management to improve the efficiency of existing supplies.

Creating incentives

The best intentioned and designed reforms in the water sector may be frustrated if key economic factors work against them. For example, the benefits of rational pricing of irrigation water may be negated by artificially high farm-support prices. Penalizing wasteful industrial water use by pricing and effluent charges will be nullified by high protection on the output of heavy industry or by 'soft' budget constraints enabling parastatals to pass on increased water charges and fines to their sponsoring ministries. Hence, in those countries where water is becoming the scarce factor of production, action in the water sector should be consistent with other key economic factors.

The permissive effects of enabling conditions may be sharpened by the creation of incentives for the more rational use of water. These may be positive or negative, market or non-market. Those considered below are: tariffs; pollution charges; water markets; and non-market inducements.

Although *water tariffs* are in widespread use in countries at all stages of development, they are usually seen as a means of cost recovery rather than a way of actively managing demand. The principles of economic tariff setting are well established and accepted, and are similar to those in use in the power sector. They can be summarized as setting prices according to Long Run Marginal Costs. This usually entails adjusting the structure of tariffs to include a fixed and variable element, with the latter rising for successive increments ('progressivity').

There is evidence of enough elasticity of demand in the household sector to make tariffs an effective instrument for water demand management. A consensus is emerging from a variety of empirical studies that the price elasticity of demand for water by households falls in the range -0.3 to -0.7, implying that a 10 percent increase in prices leads to a fall in demand of between 3 and 7 percent (Winpenny, 1994). A pre-condition of economic tariffs is metering, which is not always feasible or sensible.

BOX 8: ISSUES IN IRRIGATION PRICING IN DEVELOPING COUNTRIES

From a selective review of recent literature on irrigation water pricing in developing countries, it is evident that efficient market pricing of water is not taking place. There is wide diversity involved in the objectives, constraints and conditions, socio-economic, political and institutional setting and other physical and engineering aspects of irrigation development across countries, across regions within a country and even across projects within a region. Each irrigation project therefore needs to be managed differently to use irrigation water efficiently and to attain the different goals and objectives. This in turn means that there must also be a de-centralization of control so that irrigation managers can be efficient at the project level. Unfortunately, in most developing countries, there is too much centralization in the control and management of irrigation projects, which results in the use of uniform rules, regulations and policies concerning the provision and pricing of irrigation services that do not suit all projects equally. This state of affairs results in inefficient functioning of the irrigation system. So what is urgently needed to move faster toward an efficient market-oriented irrigation water allocation and pricing mechanism is the de-centralization of control so that decisions are taken at the project level. Even though this process would lead in the short run to non-uniform pricing of irrigation water across projects and regions, in the long run it would lead to a more efficient pricing structure across projects and regions and set in motion the competitive forces that will ultimately lead to optimal utilization of water resources.

(Sampath, 1992: 975)

Setting economic charges for water may also be the best way of discouraging industrial water pollution, by penalizing excessive water intake. In an unpublished study by D. Gupta and R. Bhatia in 1991 of two private Indian fertilizer companies of a similar size, the one paying a high price for its municipal water achieved a unit water consumption per tonne of nutrient production only 40 percent of that in the other company, which depended partly on its own wells and partly on low-priced public supplies.

The application of *pollution charges* proportional to the volume and quality of effluent is more rare, but has been shown to be effective in reducing water intake as well as discharge. In three industries in São Paulo, Brazil, the introduction of an effluent charge led within two years to a 40 to 60 percent reduction in water consumption (quoted in Bhatia, Cestti and Winpenny, 1994).

In irrigated agriculture, the use of pricing to encourage efficient use of water is desirable in principle, though fraught with practical problems. Many governments subsidize water as an instrument of food policy. The subsidy to irrigation water becomes capitalized in the price farmers pay for their land. It is impractical to meter water supplied to large numbers of small farmers, who in any case receive a variable quality of service.

In practice, irrigation charges, where they are recovered at all, tend to be based on the area irrigated, the type of crop, the length of irrigation time, and other proxy measures. Although these methods should not be decried if they contribute to cost recovery - essential to provide funds for O&M (operation and maintenance) - they do not encourage efficient use of the water.

This explains the growing interest in 'devolved' solutions, such as measuring and pricing water delivered to an entire village or water users' association, and relying on the latter to recover costs from users and ensure the most efficient use of the water. Alternatively, groups of small farmers, or one large farmer who sells to others, can be metered.

The greater devolution of control over pricing and other key irrigation decisions would lead, in the short run at least, to greater variation in water prices among different projects and regions. But this may be a price worth paying if it leads to greater recognition of the value and opportunity cost of water, and improved cost recovery (Sampath, 1992).

The availability of *groundwater* is a complication in pricing surface irrigation water. If the latter is fixed too high, there will be an incentive for increased pumping from aquifers. Once this exceeds the aquifer's natural recharge rate, mining occurs, which can have external costs for society. Heavy pumping from one well may lower the aquifer for all other users of wells in the area. Apart from the short-term costs, the process may be irreversible if the water table becomes contaminated, or if land subsidence occurs.

For such reasons, the coordinated management of surface water and groundwater is vital, especially in areas such as south Asia, where groundwater supplies a large part of the irrigated area. An additional complication in managing groundwater is that the aquifer is a common property resource. In the absence of penalties, individual users have an incentive to overexploit the resource, since the costs fall on all users. By the same token, no one user has an incentive to abstain from use, since someone else would benefit from this abstinence.

The essential choices for managing groundwater are therefore some form of control by the community of users, or measures imposed by the state. Apart from informal agreements, which are only feasible in small homogeneous communities, the choice of measures is between:

• prices and charges (e.g., volumetric charges based on metering pumping rates, taxes and price adjustments for fuel or electricity);

• quantity-based controls (permits for new wells, taxes on pumps, specifications for pumps, pumping quotas); and

• transferable pumping entitlements (quotas that can be bought and sold within a group of users).

In view of the problems with monitoring and enforcement, quantity-based approaches may be superior to pumping charges, and can yield economically efficient solutions (FAO, 1993a).

The *conjunctive use* of surface water and groundwater should be part of any irrigation management scheme where the two sources are available. For instance, surface supplies might provide a regular base supply, topped up with groundwater to satisfy the peak demands of crops.

There are various types of *water markets.* Their common feature is that water can be bought and sold, thus enabling it to find its highest value use. Groundwater markets are long-established and widespread in certain parts of Asia, e.g., Gujarat in India, and in Bangladesh. Farmers sell water surplus to their requirements to those in deficit. Surface water markets exist in some western states of the USA and in eastern Australia, either to transfer water from low-value irrigated farming to urban consumers, or to redistribute water within agriculture. Sometimes the transfers are semi-permanent arrangements, e.g., the efforts of the Los Angeles Metropolitan Water Authority to acquire long-term water rights from its agricultural neighbours.

Water auctions, although unusual, are well-established in parts of Spain, and have been tried in Australia. *Water banking* has also been tried: as a response to the recent drought, the state of California bought up water rights from farmers to hold in reserve for urban and industrial use (and most of the stock was drawn down for these purposes).

Despite the value of economic instruments in improving the efficiency with which water is used, there will always be a role for *non-market devices,* often working in tandem with economic measures. Education and publicity campaigns can help create, among the public, awareness of the need for water conservation, though the message will be powerfully underlined by the use of tariffs. In water pollution, some contaminants are so dangerous that they should be banned - pollution charges are not enough. The only feasible response to short-term water supply emergencies may be to ration supplies and ban wasteful uses.

Certain societies have successfully used *prescriptive norms,* based on 'best practice' or reasonable usage in each case, reinforced by penal charges for users exceeding these norms. In Tianjin, China, norms are set for industrial consumers based on regular detailed water audits, and users who exceed their quotas pay a penal water charge of up to 50 percent above the normal level (Bhatia, Cestti and Winpenny, 1994). A similar approach has been used in Israeli agriculture.

Projects and spending programmes: projects vs policies

The process of water policy review is likely to culminate in drawing up, revising or implementing projects and programmes entailing public expenditure. It is therefore important that the structure of public capital budgets, the choice of projects, and the way they are designed and carried out, are consistent with the overall strategy. After some general remarks, this section discusses four processes that are particularly relevant in project choice and design: cost-benefit analysis, cost-effectiveness analysis, environmental assessment, and financial management.

The impact of the kind of reforms suggested in earlier chapters would be to produce an enabling environment in which better decisions about water were made. Some of these decisions would be made by private individuals, farmers and companies - e.g., in response to regulations, pricing, or the development of water markets. No further action would be required of the state.

Policy reforms may substitute for projects. In the event of an emerging water shortage in a sector or region, the government has the broad choice of introducing demand-management and conservation policies, or investing in new supply schemes. In this sense, projects may represent the 'easier' option, at least in so far as they are more popular with the public and avoid difficult changes in consumer behaviour. The national water strategy in England and Wales adopted the key policy that water resources development should not be demand led (NRA, 1994).

However, a new strategy will typically involve both policy reforms and projects and spending programmes. A number of non-conventional projects are likely to be considered, such as canal lining and leakage reduction measures, urban projects to reduce unaccounted-for-water, subsidies for the use of water-efficient consumer devices, mounting public information and advice campaigns, etc. Projects carried out in related sectors may also have a close bearing on water supply, e.g., catchment area and watershed management, afforestation, hill farming schemes, anti-erosion measures, flood-control devices, etc.

FIGURE 2 - Supply curve for conserved water in Beijing (quantity conserved vs. discounted cost of conserved water) (Hufschmidt *et al.,* 1987)

Industrial sector

Domestic sector

Cost-benefit analysis

Cost-benefit analysis (CBA) has been widely used in the water sector since the 1930s to select projects and check their viability in a systematic way. In essence, the costs of a project (capital equipment, land, operating, maintenance, periodic replacement, etc.) are entered in each year in which they are incurred. Likewise for benefits, whether they are sales, cost savings, or non-marketed attributes (such as flood control) which are valued indirectly. Financial values of both costs and benefits are adjusted to reflect their underlying scarcity value, and the difference between the future streams of costs and benefits is discounted to obtain a present value.

In the context of water policy review, CBA practice needs to be modified and extended in several ways:

• By applying to both supply-augmenting and demand-management measures in a consistent way. Benefits of the latter include, for instance, savings in the cost of supply, while their costs comprise the forfeit of benefits from using water. This implies some measurement of water benefits.

• The efficiency criterion should be supplemented by the others discussed in Chapter 3, namely efficacy, equity, environmental, fiscal, acceptability, feasibility, and sustainability.

• Both costs and benefits should be extended to include economic measures of environmental impacts, following environmental impact assessment (see below).

Cost-effectiveness analysis

Cost-effectiveness analysis (CEA) is applicable where benefits cannot be adequately measured. CEA is also useful in comparing alternative, or cumulative, ways of attaining a given level of benefits. CEA can yield the discounted economic *costs of achieving a unit of conservation.*

Figure 2 illustrates the results of an exercise into cost-effective ways of meeting Beijing's future water requirements without major investments in new supply sources. It was discovered that one-third of industrial water consumption could be saved by adopting three measures: more recycling of industrial cooling water, recycling of power plant cooling water, and wastewater recycling. On a discounted basis, these measures were ranked in the above order. They were all substantially cheaper than the obvious next project to develop supply.

In the domestic sector, it was found that four techniques could save 15 percent of consumption, and each of them was cheaper than the alternative of augmenting supply. These were improving conservation in public facilities, programmes for the reduction of leakage, recycling air-conditioning cooling water, and installing water-efficient flush toilets. If the costs - appropriately discounted - and amount of water saved by these measures are arrayed as in the graphs in Figure 2, they form a 'supply curve' of conserved water.

Environmental assessment

The water sector is simultaneously a major perpetrator and victim of environmental change. The provision of water often entails drastic interference with natural hydrological systems (e.g., dams, reservoirs, river diversions, aquifer depletion), but, equally, water is polluted by the waste from other sectors, and irrigation and urban water supplies are vulnerable to upstream activities, and the deterioration of watershed slopes. Water is inextricable from the environment and the precondition of any important decision in this sector is an understanding firstly, of its own environmental effects, and secondly, of how environmental change triggered by other forces will affect this sector.

Many agencies have developed environmental assessment guidelines and procedures. Water poses particular difficulties in that it is a cross-cutting issue arising in a number of other sectors, hence no single checklist can suffice. In assessing how water will be affected by developments in other sectors, the relevant checklists and assessment guidance for those sectors should be consulted, such as in the World Bank's Sourcebook (World Bank, 1991), or the guidelines currently being prepared for publication by FAO (FAO, in press).

For decisions on water development *per se,* using a checklist such as that in Box 9 would alert the analyst to the main potential risks and issues. Where information on a potentially important topic is not available, this indicates the need to commission an *Environmental Impact Assessment* (EIA). Decision-makers should equip themselves with the facts about the type of environmental impacts at stake, their potential seriousness, how they could be mitigated and at what expense, and whether there are alternative ways of achieving the same objectives with less environmental risk.

Also, non-physical measures and implementation of new policies, such as structural adjustment and water sector reform may have significant impacts upon the environment. EIA of the implications of a particular policy element can provide an effective preventive tool if implemented at each stage of policy formulation in an reiterative procedure. Environmental assessment of policy could be a part of policy management monitoring, as discussed briefly in Chapter 5.

Financial management

The need for improved financial management in practically every water regime results from several converging factors: poor financial management and inadequate cost recovery have left most utilities decapitalized and underfunded; the cost of new supply schemes is growing in real terms; more stringent environmental standards are driving major investments in water quality improvement; and many old systems, such as sewers, are in urgent need of renewal.

These factors point to the importance of:

- cost control within organizations; a improved pricing and charging systems;
- better collections from users and more stringent penalties;
- developing models for commercializing existing utilities; and
- looking at options for privatizing services.

This in turn requires attention, *inter alia,* to the following topics:

- Tariffs - incentives, fairness, simplicity and efficiency of collection.
- Proportion of income to come from charges.
- Powers to raise capital from various sources and by various means.
- Rules for investment of funds - issues such as balance between risk and yield.
- Accounting principles, standards and practices.
- Budgetary control principles and practices - e.g., cost centre and profit centre accounting.
- Value-for-money and other audits - principles and practices.

BOX 9: CHECKLIST FOR ENVIRONMENTAL IMPACT OF WATER DEVELOPMENT PROJECTS				
IS THE PROJECT LIKELY TO:		**Yes**	**No**	**Not known**
1.	affect any natural feature, surface water hydrology, surface water quality, soils, erosion, geology, climate or water resource adjacent to the activity area?			
2.	affect wildlife or fisheries?			
3.	affect natural vegetation?			
4.	affect or eliminate land suitable for agricultural or timber production?			
5.	affect commercial fisheries or aquaculture resources or production?			
6.	affect the quality of water resources or catchment areas within or adjacent to the activity area through change in the water supply downstream of irrigation or through human or animal toxins?			
7.	affect air quality in the activity area or adjacent areas?			
8.	require relocating the existing population, community facilities, and housing?			
9.	lead to changes in the supply of, or demand for, infrastructural items?			
10.	cause substantial change in income and traditional source of livelihood of existing population?			
11.	include provisions to investigate the impact on regions where resettlement is occurring?			
12.	result in potential conflicts or affect physical, demographic or attitude/value cohesion?			
13.	affect archaeological sites or structures of historic or cultural significance?			
14.	induce or exacerbate erosion in the watershed area?			
15.	exacerbate water rights conflicts?			
16.	provoke a significant reduction in downstream flow, impairing aquatic life or endangering wetland water supply?			
17.	create or exacerbate insect disease hazards?			
18.	be designed without prior consultation or participation of affected populations?			
19.	provoke a shift in crop pattern in the region?			
20.	provoke a shift from low-input to high-input farming practices?			
21.	ignore provisions for post-project monitoring?			
22.	require long-term extension services?			
23.	be formulated outside the framework of a global strategy for development?			
24.	induce new migration towards the projects area (around reservoirs)?			
25.	be implemented in the absence of a training programme on techniques for more efficient water use?			
26.	create or exacerbate soil salinity problems?			
27.	be designed without adequate drainage facilities?			

Source: A guide to the environmental assessment of irrigation and drainage projects in developing countries (FAO, in press)