INTEGRATED WATER RESOURCES MANAGEMENT FOR RIVER BASIN ORGANISATIONS

TRAINING MANUAL

Cap-Net UNDP

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FOREWORD

The purpose of this training material is to improve efficiency and effectiveness in the application of integrated water resources management (IWRM) for sustainable management and development of water resources. The training is particularly targeted at the staff of river basin organisations (RBOs).

Sustainable management of water resources is an important goal being adopted at national and international level in a bid to address water shortages, inequity, pollution and many other water problems. One of the key changes being adopted follows from the recognition that upstream/ downstream effects require management using a basin approach. As a result many countries are introducing new institutional arrangements for water resources management, including organizations to manage water resources at the basin level – (RBOs).

Creating new structures, or changing old ones, to meet the goals of integrated water resources management is not easy and there is evidence that the introduction of new river basin organisations does not run smoothly in many countries. In addition there is widespread uncertainty about what it means to implement the IWRM approach to water resources management on the ground.

Following from a series of case studies on River Basin Organisations (see box) Cap-Net has developed a foundation training programme for the management of water resources. The approach has been to focus on the key functions essential for sustainable management of water resources and they represent the core responsibilities of a water management agency. Organisations tasked to carry out these functions at the river basin level may or may not be called RBOs.

The initial target for these materials is the national level as it is believed that progress with trans-boundary water resources management is dependent upon appropriate structures and systems at national level.

To assist in determining progress toward sustainable management of water resources the training is anchored around a draft set of output indicators. These indicators are related to the main water management functions and assist the RBO to assess progress and determine effectiveness of its activities. One particular benefit is the opportunity for the RBO to adjust the indicators to match the priorities and state of development of the basin. These indicators may be seen as supplementary to those developed in South East Asia which focus mainly on organisational performance. (Makin et al, 2004[1])

The manual is presently in its first draft and is structured to address each of the key water management functions. It is expected that this approach will assist RBOs to identify strong and weak performance areas and take appropriate action to continue progressive improvement in water governance.

Paul Taylor, Director, Cap-Net

1 http://www.adb.org/Documents/Events/2004/NARBO/Benchmarking/NARBO-Benchmarking-Discussion-Notes.pdf

Case studies on RBOs - Summary

The case studies[1] and the subsequent workshop discussions presented an opportunity to assess the progress of RBOs in implementing IWRM. The first broad conclusion is that there is a lack of clear understanding as to what constitutes an RBO and the central functions of water resources management in a river basin.

The enabling environment of laws and policy were problematic in some cases with overlapping jurisdiction or unresolved policy issues but this was considered to be minor compared with other issues such as level of autonomy.

River basin organisations are expected to be managers of the water resources in the basin addressing competing demands and bringing together the views of the different stakeholders to identify and address priority issues. However the studies found problems of lack of autonomy for the RBO and lack of recognition of the role of stakeholders which limited their opportunities to be heard and participate in decision making.

The lack of autonomy was also evident in financial management where in most cases the RBO was not yet in a position to receive generated funds affecting not only the viability of the organisation but also the ability to use economic instruments as a water management tool. The ability to set charges for various water services was centralised, absent or did not result in revenue to the RBO. This affects key elements of IWRM principles including the ability to use financial tools to address equity issues.

On the operational side, in general the RBOs were unable to take on the broad water management objectives required for IWRM and tended to focus on priority issues of each basin. This was explained as due to a lack of human and financial resources as well as the pragmatic need to address urgent issues. RBOs are not well developed at the present time to implement the IWRM approach and lack not only capacity but also influence – again partly as a result of the lack of autonomy and delegated responsibility.

Other challenging issues include the lack of monitoring and enforcement as well as the limited capacity of the RBOs. The role of women was completely absent and in all cases political involvement had both benefits as well as problems. A widespread lack of understanding of the rationale for the introduction of river basin organisations, the meaning of IWRM and the goals of sustainable development of water resources also impacted negatively on progress.

Capacity gaps are widespread and lie both inside the RBO and outside. Indicators and benchmarking were identified as one important means to focus attention on those areas of greatest importance and impact.

1 http://cap-net.org/sites/cap-net.org/files/RBO%20Performance.doc

Acknowledgements

This training manual has been developed by Paul Taylor, Rikard Lidèn, Wangai Ndirangu, and Lee Jin. The programme was developed from a series of case studies in Mexico, Kenya, Sri Lanka and Malaysia and a planning workshop held in Sri Lanka. The case study authors Carlos Diaz Delgardo, Wangai Ndirangu, M.I.M. Mowjood and Lee Jin together with Klaas Schwartz, Paul Taylor, Arlene Inocencio; Eng Jayasinghe; and Vijay Parapinje participated in the planning workshop. Klaas Schwartz and Wim Douven compiled the case study findings into a summary report available on the Cap-Net web site.

The institutions contributing to the case studies and the content of the training materials are UNESCO-IHE, Nile IWRM-Net, LA-WETnet, Lanka CapNet, AguaJaring, SWECO and IWMI.

Cap-Net would like to acknowledge the various contributions mentioned above as well as the feedback from participants of the first training course that served to improve the materials significantly. Any omission or error is the responsibility of Cap-Net.

These materials are freely available for use, adaptation and translation as desired and can be downloaded from the Cap-Net web site or requested on CD together with all of the resource materials and Powerpoint slides. When using the materials please give appropriate acknowledgement to the source.

Content

Module 1: Introduction to Integrated Water Resources Management

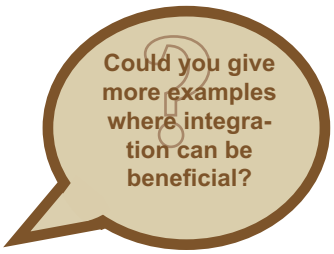
Learning objectives

- Appreciate the need for reforms to the way water is being managed.
- Understand the main elements of an IWRM approach to sustainable management of water resources.

1. What is Integrated Water Resources Management?

At its simplest, integrated water resources management is a logical and appealing concept. Its basis is that the many different uses of water resources are interdependent. That is evident to us all. High irrigation demands and polluted drainage flows from agriculture mean less freshwater for drinking or industrial use; contaminated municipal and industrial wastewater pollutes rivers and threatens ecosystems; if water has to be left in a river to protect fisheries and ecosystems, less can be diverted to grow crops. There are plenty more examples of the basic theme that unregulated use of scarce water resources is wasteful and inherently unsustainable.

Integrated management means that all the different uses of water resources are considered together. Water allocations and management decisions consider the effects of each use on the others. They are able to take account of overall social and economic goals, including the achievement of sustainable development. This also means ensuring coherent policy making related to all sectors. As we shall see, the basic IWRM concept has been extended to incorporate participatory decision-making. Different user groups (farmers, communities, environmentalists) can influence strategies for water resource development and management. That brings additional benefits, as informed users apply local self-regulation in relation to issues such as water conservation and catchment protection far more effectively than central regulation and surveillance can achieve.



Management is used in its broadest sense. It emphasises that we must not only focus on development of water resources but that we must consciously manage water development in a way that ensures long term sustainable use for future generations.

Integrated water resources management is therefore a systematic process for the sustainable development, allocation and monitoring of water resource use in the context of social, economic and environmental objectives. It contrasts with the sectoral approach that applies in many countries. When responsibility for drinking water rests with one agency, for irrigation water with another and for the environment with yet another, lack of cross-sectoral linkages leads to uncoordinated water resource development and management, resulting in conflict, waste and unsustainable systems.

2. Why IWRM?

Water is vital for human survival, health and dignity and a fundamental resource for human development. The world's freshwater resources are under increasing pressure yet many still lack access to adequate water supply for basic needs. Growth in population, increased economic activity and improved standards of living lead to increased competition for, and conflicts over, the limited freshwater resource. Here are a few reasons why many people argue that the world faces an impending water crisis:

- Water resources are increasingly under pressure from population growth, economic activity and intensifying competition for the water among users;
- Water withdrawals have increased more than twice as fast as population growth and currently one third of the world's population live in countries that experience medium to high water stress;
- Pollution is further enhancing water scarcity by reducing water usability downstream;
- Shortcomings in the management of water, a focus on developing new sources rather than managing existing ones better, and top-down sector approaches to water management result in uncoordinated development and management of the resource;
- More and more development means greater impacts on the environment; and
- Current concerns about climate variability and climate change demand improved management of water resources to cope with more intense floods and droughts.

3. Key Issues in Water Management

3.1 Water governance crisis

Sectoral approaches to water resources management have dominated in the past and are still prevailing. This leads to fragmented and uncoordinated development and management of the resource. Moreover, water management is usually in the hands of top-down institutions, the legitimacy and effectiveness of which have increasingly been questioned. Thus, weak governance aggravates increased competition for the finite resource. IWRM brings coordination and collaboration among the individual sectors, plus a fostering of stakeholder participation, transparency and cost-effective local management.

Box 1.1: Water Crisis - Facts

- Only 0.4% of total of global water in the world is available for humans.
- Today more than 2 billion people are affected by water shortages in over 40 countries.
- 263 river basins are shared by two or more nations.
- 2 million tonnes per day of human waste are deposited in water courses.
- Half the population of the developing world are exposed to polluted sources of water that increase disease incidence.
- 90% of natural disasters in the 1990s were water related.
- The increase in numbers of people from 6 billion to 9 billion will be the main driver of water resources management for the next 50 years.

3.2 Securing water for people

Although most countries give first priority to satisfying basic human needs for water, one fifth of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation. These service deficiencies primarily affect the poorest segments of the population in developing countries. In these countries, meeting water supply and sanitation needs for urban and rural

areas represents one of the most serious challenges in the years ahead. Halving the proportion of the population lacking water and sanitation services by 2015 is one of the Millennium Development Goals[2]. Doing so will require a substantial re-orientation of investment priorities, which will be much more readily achieved in those countries that are also implementing IWRM.

3.3 Securing water for food production

Population projections indicate that over the next 25 years another 2-3 billion people will need food. Water is increasingly seen as a key constraint on food production, equivalent to if not more crucial than land scarcity. Irrigated agriculture is already responsible for more than 70% of all water withdrawals (more than 90% of all consumptive use of water).

Even with an estimated need for an additional 15-20% of irrigation water over the next 25 years - which is probably on the low side – serious conflicts are likely to arise between water for irrigated agriculture and water for other human and ecosystem uses. IWRM offers the prospect of greater efficiencies, water conservation and demand management equitably shared among water users, and of increased recycling and reuse of wastewater to supplement new resource development.

3.4 Protecting vital ecosystems

Terrestrial ecosystems in the upstream areas of a basin are important for rainwater infiltration, groundwater recharge and river flow regimes. Aquatic ecosystems produce a range of economic benefits, including such products as timber, fuel wood and medicinal plants, and they also provide wildlife habitats and spawning grounds. The ecosystems depend on water flows, seasonality and water-table fluctuations and are threatened by poor water quality. Land and water resources management must ensure that vital ecosystems are maintained and that adverse effects on other natural resources are considered and where possible reduced when development and management decisions are made. IWRM can help to safeguard an “environmental reserve” of water corresponding with the value of ecosystems to human development.

3.5 Gender disparities

Formal water management is male dominated. Though their numbers are starting to grow, the representation of women in water sector institutions is still very low. That is important because the way that water resources are managed affects women and men differently. As custodians of family health and hygiene and providers of domestic water and food, women are the primary stakeholders in household water and sanitation. Yet, decisions on water supply and sanitation technologies, locations of water points and operation and maintenance systems are mostly made by men.

The Gender and Water Alliance cites the example of a well meaning NGO that helped villagers to install pour-flush latrines to improve their sanitation and hygiene, without first asking the women about the extra two litres of water they would have to carry from distant sources for every flush. A crucial element of the IWRM philosophy is that water users, rich and poor, male and female, are able to influence decisions that affect their daily lives.

2 The Millennium Development Goals are an ambitious agenda for reducing poverty and improving lives that world leaders agreed on at the Millennium Summit in September 2000. For each goal one or more targets have been set, most for 2015, using 1990 as a benchmark. More information can be found on the UNDP website at http://www.undp.org/mdg/.

4. Water Management Principles

A meeting in Dublin in 1992[3] gave rise to four principles that have been the basis for much of the subsequent water sector reform.

Principle 1: *Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.*

The notion that freshwater is a finite resource arises as the hydrological cycle on average yields a fixed quantity of water per time period. This overall quantity cannot yet be altered significantly by human actions, though it can be, and frequently is, depleted by man-made pollution. The freshwater resource is a natural asset that needs to be maintained to ensure that the desired services it provides are sustained. This principle recognises that water is required for many different purposes, functions and services; management therefore, has to be holistic (integrated) and involve consideration of the demands placed on the resource and the threats to it.

The integrated approach to management of water resources necessitates co-ordination of the range of human activities which create the demands for water, determine land uses and generate waterborne waste products. The principle also recognises the catchment area or river basin as the logical unit for water resources management.

Principle 2: *Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.*

Water is a subject in which everyone is a stakeholder. Real participation only takes place when stakeholders are part of the decision-making process. The type of participation will depend upon the spatial scale relevant to particular water management and investment decisions. It will be affected too by the nature of the political environment in which such decisions take place. A participatory approach is the best means for achieving long-lasting consensus and common agreement. Participation is about taking responsibility, recognizing the effect of sectoral actions on other water users and aquatic ecosystems and accepting the need for change to improve the efficiency of water use and allow the sustainable development of the resource. Participation does not always achieve consensus, arbitration processes or other conflict resolution mechanisms also need to be put in place.

Governments have to help create the opportunity and capacity to participate, particularly among women and other marginalised social groups. It has to be recognised that simply creating participatory opportunities will do nothing for currently disadvantaged groups unless their capacity to participate is enhanced. Decentralising decision making to the lowest appropriate level is one strategy for increasing participation.

Principle 3: *Women play a central part in the provision, management and safeguarding of water.*

The pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. It is widely acknowledged that women

3 The International Conference on Water and Environment, Dublin, Ireland, January 1992.

play a key role in the collection and safeguarding of water for domestic and – in many cases – agricultural use, but that they have a much less influential role than men in management, problem analysis and the decision-making processes related to water resources.

IWRM requires gender awareness. In developing the full and effective participation of women at all levels of decision-making, consideration has to be given to the way different societies assign particular social, economic and cultural roles to men and women. There is an important synergy between gender equity and sustainable water management. Involving men and women in influential roles at all levels of water management can speed up the achievement of sustainability; and managing water in an integrated and sustainable way contributes significantly to gender equity by improving the access of women and men to water and water-related services to meet their essential needs

Principle 4: *Water has an economic value in all its competing uses and should be recognised as an economic good as well as a social good.*

Within this principle, it is vital to recognise first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Managing water as an economic good is an important way of achieving social objectives such as efficient and equitable use, and of encouraging conservation and protection of water resources. Water has a value as an economic good as well as a social good. Many past failures in water resources management are attributable to the fact that the full value of water has not been recognised.

Value and charges are two different things and we have to distinguish clearly between them. The value of water in alternative uses is important for the rational allocation of water as a scarce resource, whether by regulatory or economic means. Charging (or not charging) for water is applying an economic instrument to support disadvantaged groups, affect behaviour towards conservation and efficient water usage, provide incentives for demand management, ensure cost recovery and signal consumers' willingness to pay for additional investments in water services.

Treating water as an economic good is an important means for decision making on the allocation of water between different water use sectors and between different uses within a sector. This is particularly important when extending supply is no longer a feasible option.

5. Water Use, Impacts and Benefits

5.1 Impacts

Most uses of water bring benefits to society but most also have negative impacts which may be made worse by poor management practices, lack of regulation or lack of motivation due to the water governance regimes in place.

Each country has its priority developmental and economic goals set according to environmental, social and political realities. Problems and constraints arise in each water use area, but the willingness and ability to address these issues in a coordinated way

is affected by the governance structure of water. Recognising the inter-related nature of different sources of water and thus also the inter-related nature and impacts of the differing water uses is a major step to the introduction of IWRM.

Table 1.1: Impact of water use sectors on water resources

	Positive Impacts	Negative Impacts
Environment	• Purification • Storage • Hydrological cycle	
Agriculture	• Return flows • Increased infiltration • Decreased erosion • Grondwater recharge • Nutrient recycling	• Depletion • Pollution • Salinisation • Water logging • Erosion
Water supply & sanitation	• Nutrient recycling	• High level of water security required • Surface and groundwater pollution

5.2 Benefits from IWRM

Environment benefits

- Ecosystems can benefit from applying an integrated approach to water management by giving environmental needs a voice in the water allocation debate. At present these needs are often not represented at the negotiating table.
- IWRM can assist the sector by raising awareness among other users of the needs of ecosystems and the benefits these generate for them. Often these are undervalued and not incorporated into planning and decision-making.
- The ecosystem approach provides a new framework for IWRM that focuses more attention on a system approach to water management: -protecting upper catchments (e.g. reforestation, good land husbandry, soil erosion control), pollution control (e.g. point source reduction, non-point source incentives, groundwater protection) and environmental flows. It provides an alternative to a sub-sector competition perspective that can join stakeholders in developing a shared view and joint action.

Agriculture benefits

- As the single largest user of water and the major non-point source polluter of surface and groundwater resources, agriculture has a poor image. Taken alongside the low value added in agricultural production, this frequently means that, especially under conditions of water scarcity, water is diverted from agriculture to other water uses. However, indiscriminate reduction in water allocation for agriculture may have far-reaching economic and social consequences. With IWRM, planners are encouraged to look beyond the sector economics and take account of the implications of water management decisions on employment, the environment and social equity.
- By bringing all sectors and all stakeholders into the decision-making process, IWRM is able to reflect the combined “value” of water to society as a whole in difficult decisions on water allocations. This may mean that the contribution of food production to health, poverty reduction and gender equity, for example, could over-ride strict economic comparisons of rates of return on each cubic metre of water. Equally, IWRM can bring into the equation the reuse potential of agricultural return flows for other sectors and the scope for agricultural reuse of municipal and industrial wastewaters.

- IWRM calls for integrated planning so that water, land and other resources are utilised in a sustainable manner. For the agricultural sector IWRM seeks to increase water productivity (i.e. more crop per drop) within the constraints imposed by the economic, social and ecological context of a particular region or country.

Water supply and sanitation benefits

- Above all, properly applied IWRM would lead to the water security of the world's poor and unserved being assured. The implementation of IWRM based policies should mean increased security of domestic water supplies, as well as reduced costs of treatment as pollution is tackled more effectively.
- Recognizing the rights of people, and particularly women and the poor, to a fair share of water resources for both domestic and household-based productive uses, leads inevitably to the need to ensure proper representation of these groups on the bodies that make water resource allocation decisions.
- The focus on integrated management and efficient use should be a stimulus to the sector to push for recycling, reuse and waste reduction. High pollution charges backed by rigid enforcement have led to impressive improvements in industrial water-use efficiencies in the industrialised countries, with benefits for domestic water supplies and the environment.
- Past sanitation systems often focused on removing the waste problem from the areas of human occupation, thus keeping the human territories clean and healthy, but merely replacing the waste problem, with often detrimental environmental effects elsewhere. Introduction of IWRM will improve the opportunity for introduction of sustainable sanitation solutions that aim to minimise waste-generating inputs, and reduction of waste outputs, and to solve sanitation problems as close as possible to where they occur.
- At a practical local level, improved integration of water resource management could lead to greatly reduced costs of providing domestic water services, if for instance more irrigation schemes were designed with a domestic water component explicitly involved from the start.

6. Implementing IWRM

The case for IWRM is strong – many would say incontestable. The problem for most countries is the long history of sectoral development. As the Global Water Partnership puts it:

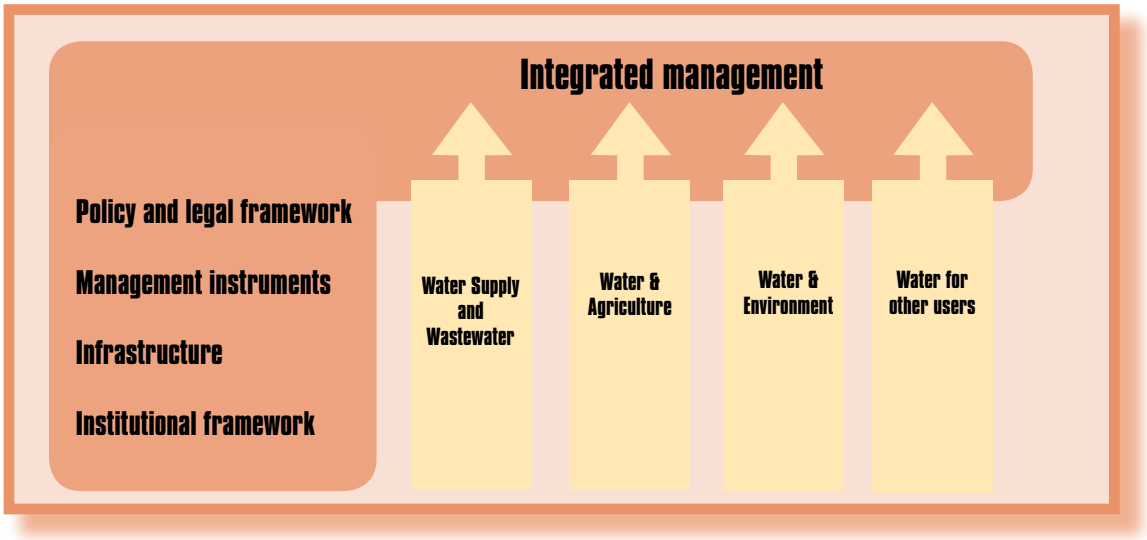
> *"IWRM is a challenge to conventional practices, attitudes and professional certainties. It confronts entrenched sectoral interests and requires that the water resource is managed holistically for the benefits of all. No one pretends that meeting the IWRM challenge will be easy but it is vital that a start is made now to avert the burgeoning crisis."*

IWRM is, above all, a philosophy. As such it offers a guiding conceptual framework with a goal of sustainable management and development of water resources. What it does demand is that people try to change their working practices to look at the bigger picture that surrounds their actions and to realise that these do not occur independently of the actions of others. It also seeks to introduce an element of decentralised democracy into how water is managed, with its emphasis on stakeholder participation and decision making at the lowest appropriate level.

All of this implies change, which brings threats as well as opportunities. There are threats to people's power and position; and threats to their sense of themselves as professionals. IWRM requires that platforms be developed to allow very different stakeholders, often with apparently irreconcilable differences to somehow work together.

Because of the existing institutional and legislative frameworks, implementing IWRM is likely to require reform at all stages in the water planning and management cycle. **An overall plan** is required to envisage how the transformation can be achieved and this is likely to begin with a new water policy to reflect the principles of sustainable management of water resources. To put the policy into practice is likely to require the reform of water law and water institutions. This can be a long process and needs to involve extensive consultations with affected agencies and the public.

Figure 1.1: IWRM and it linkages to the subsectors



Implementation of IWRM is best done in a step-by-step process, with some changes taking place immediately and others requiring several years of planning and capacity building.

6.1 Policy and legal framework

Attitudes are changing as officials are becoming more aware of the need to manage resources efficiently. They see too that the construction of new infrastructure has to take into account environmental and social impacts and the fundamental need for systems to be economically viable for maintenance purposes. However, they may still be inhibited by the political implications of such a change. The process of revising water policy is therefore a key step, requiring extensive consultation and demanding political commitment.

Water legislation converts policy into law and should:

- Clarify the entitlement and responsibilities of users and water providers;
- Clarify the roles of the state in relation to other stakeholders;
- Formalise the transfer of water allocations;
- Provide legal status for water management institutions of government and water user groups;
- Ensure sustainable use of the resource.

Bringing some of the principles of IWRM into a water sector policy and achieving political support may be challenging, as hard decisions have to be made. It is therefore not

surprising that often major legal and institutional reforms are only stimulated when serious water management problems have been experienced.

6.2 Institutional framework

For many reasons, developing country governments consider water resources planning and management to be a central part of government responsibility. This view is consistent with the international consensus that promotes the concept of government as a facilitator and regulator, rather than an implementer of projects. The challenge is to reach mutual agreement about the level at which, in any specific instance, government responsibility should cease, or be partnered by autonomous water services management bodies and/or community-based organisations.

The concept of integrated water resources management has been accompanied by promotion of the river basin as the logical geographical unit for its practical realisation. The river basin offers many advantages for strategic planning, particularly at higher levels of government, though difficulties should not be underestimated. Groundwater aquifers frequently cross catchment boundaries, and more problematically, river basins rarely conform to existing administrative entities or structures.

In order to bring IWRM into effect, institutional arrangements are needed to enable:

- The functioning of a consortium of stakeholders involved in decision making, with representation of all sections of society, and a good gender balance;
- Water resources management based on hydrological boundaries;
- Organisational structures at basin and sub-basin levels to enable decision making at the lowest appropriate level; and
- Government to co-ordinate the national management of water resources across water use sectors.

Web References

Cap-Net, 2003. Integrated Water Resources Management. Tutorial available at: http://www.archive.cap-net.org/iwrm_tutorial/mainmenu.htm

GWP Background paper No. 4. Integrated Water Resources Management available at: http://www.gwpforum.org/gwp/library/TACNO4.PDF

EXERCISE

Integrated Water Resources Management

Purpose: To draw out the progress with IWRM in the region/ country and action at river basin level.

Activity: 30 minutes

Provide participants with cards and marker pens. Standard advice is one idea/sentence/bullet per card. Each person completes a card for each question:

- Has river basin management of water resources been introduced where you live?
- What is the biggest challenge for implementing IWRM in the basin.

The participant will stand up, state the country and river basin/ organisation they represent and read the card which will then be displayed on a wall.

Facilitator

Organise the cards on the wall e.g. by country, status, common challenges.Summarise the results of the two questions at the end of the session.

Module 2: Water Resources Management Functions at the River Basin Scale

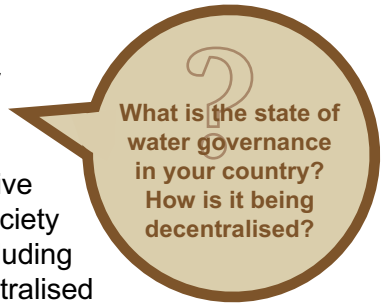
Learning Objectives

- Learn the main basic functions for water resources management which need to be performed at the river basin scale to implement IWRM.
- Discuss institutional arrangements and introduce a process-thinking to conduct the water resources management functions.
- Appreciate that it takes time to fully perform water resource management functions and that the goals have to be set in relation to what can realistically be met.

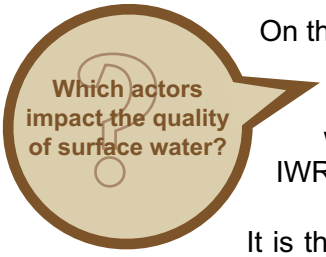
1. Introduction

Most countries try to decentralise water resources management by delegating responsibility and resources. The reason is that local organisations and communities have better knowledge of the water and socio-economic situation and also are the most affected by decisions taken on how to manage the resource. Centralised national or regional governments have difficulties to allocate and regulate water in a river basin as they are unaware of local interests and priorities. Government should, however, provide the rules and establish a framework for the water management in a river basin (GWP, 2003).

The boundaries for a river basin provide a natural unit for water resources management. A river basin is a closed region where water management directly affects the inhabitants and other stakeholders of the basin. Although, the river basin may cover different administrative units there are thus incentives for these units to cooperate. A basin society with local know-how and with representatives of all stakeholders, including governmental bodies, is thus the ideal governing institution for de-centralised water resources management.



Water resources management is one part of the overall management of the environment and the preservation of ecosystems, which is a prerequisite for sustainable development. Water resources management therefore needs to be coordinated with other disciplines and sectors that affect the water resources or are affected by how well the water is managed.



On the river basin scale there are thus many actors that have roles and responsibilities for management of the environment and society, which are all linked to the status of the water resources. For successful implementation of IWRM all these actors have to be involved.

It is therefore logical that IWRM on the river basin scale should be focussed on a set of basic water resources management functions. This module thus includes a description of the basic water resources management functions (Section 2) and introduces water management objectives as a way for performing these functions (Section 3). These functions and water management objectives are further elaborated in Modules 4-11. This module further discusses the

institutional arrangements options that exist for conducting the functions (Section 4) and gives a stepwise approach for building the institutional capacity for this (Section 5).

2. Basic Functions for Water Resources Management

The suggested basic functions for water resources management in a river basin are presented in Figure 2.1 and Table 2.1 gives a definition of these functions. To illustrate the functions a number of activities have been exemplified for each of the functions. Flood and drought management are not addressed in these materials and have been given separate attention by Cap-Net.

Figure 2.1: Basic functions for water resources management

Table 2.1: Functions of water resources management in a river basin

Function	Example of activities
Stakeholder participation – Implementing stakeholder participation as a basis for decision making that takes into account the best interests of society and the environment in the development and use of water resources in the basin. [Module 4]	• Develop and maintain an active stakeholder participation process through regular consultation activities. • Provide specialist advice and technical assistance to local authorities and other stakeholders in IWRM.
Water allocation – Allocating water to major water users and uses, maintaining minimum levels for social and environmental use while addressing equity and development needs of society. [Module 5]	• License of water uses including enforcement of these.
Pollution control – Managing pollution using polluter pays principles and appropriate incentives to reduce most important pollution problems and minimise environmental and social impact. [Module 6]	• Identify major pollution problems • License and manage polluters.
Monitoring of water resources, water use and pollution – Implementing effective monitoring systems that provide essential management information and identifying and responding to infringements of laws, regulations and permits. [Module 7]	• Carry out hydrological, geographical and socio-economic surveys for the purposes of planning and development of water resources. • Develop, update and maintain a hydrometric database required for controlling compliance of water use allocation.

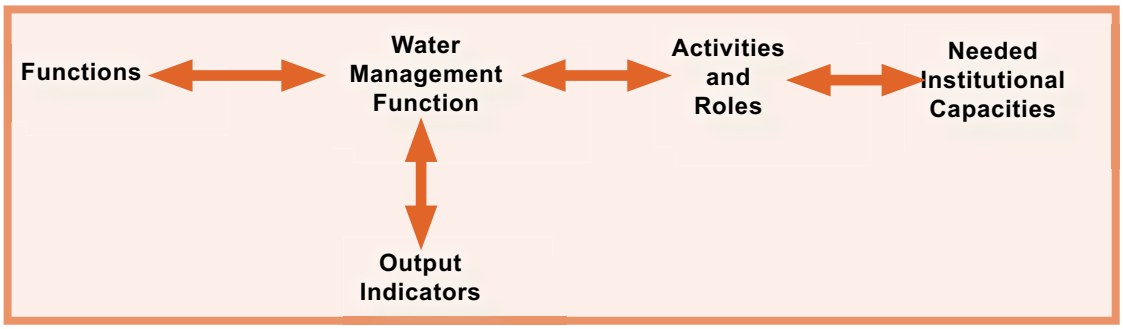
Information management – Providing essential data necessary to make informed and transparent decisions for development and sustainable management of water resources in the basin. [Module 8]	• Define the information outputs that are required by the water managers and different stakeholder groups in a river basin. • Organise, co-ordinate and manage the information management activities so that the water managers and stakeholders get the information they require.
Economic and financial management – Applying economic and financial tools for investment, cost recovery and behaviour change to support the goals of equitable access and sustainable benefits to society from water use. [Module 9]	• Set fees and charges for water use and pollution.
River basin planning – Preparing and regularly updating the Basin Plan incorporating stakeholder views on development and management priorities for the basin. [Module 10]	• Conduct situation analysis with stakeholders. • Assess future developments in the basin.

The water resources management functions comprise a general framework for implementing IWRM for any river basin in the world. For any specific country, region or river basin some of the functions may be more relevant than others. However, for an inhabited river basin with competing water demands all these functions need to be performed to achieve sustainable management of the water resource and to improve livelihoods. In most countries the water resource management functions are guided by the national water laws and policies. Typically these are regulatory functions. Water allocation and pollution control in Table 2.1 are direct examples of such regulatory functions. The other functions may be partly regulatory but also serves as support for each other. For example, the functions of financial and information management are essential to enable the implementation of all regulatory functions.

3. Water Management Objectives as a Way of Performing the Functions

Functions of water resources management are very complex tasks and may involve many different activities conducted by many different players. They can also be implemented to a different level of ambition. To successfully perform these functions with limited resources therefore requires careful planning.

An important step for conducting the functions is to formulate relevant water management objectives related to each function. These water management objectives should delineate the functions into more manageable and understandable parts. Whereas the functions are general, the objectives should take the specific conditions of the river basin and the institutional resources into account. The water management objectives thus set the goal for the water resources management in the basin and lay out the strategy for how to implement the functions.



The water management objectives guide the activities to be carried out and the roles and responsibilities to be given (Figure 2.2). The activities and roles determine the needed capacity to meet the objectives.

Have you set objectives for any of these functions in your RBO?

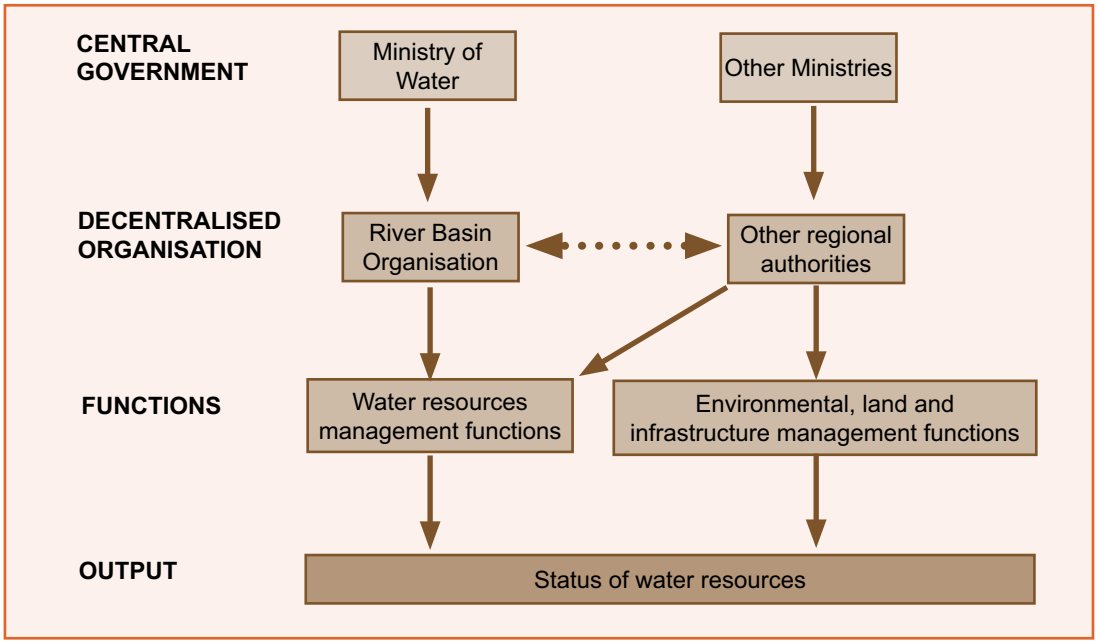
Because of often limited financial and human resources of the institutions responsible for water resources management the process may be constrained by the institutional capacity, which means that the capacity governs the possible activities to carry out and thus which objectives that can be fulfilled. A water management objective that is not realistic to fulfil within a reasonable time frame is not serving any purpose.

The water management objectives should further be formulated to be measurable so that output indicators can be linked to each of them. Through regular monitoring of these indicators there will be feedback on how well the objectives are being fulfilled and whether the performance of the function is proceeding according to plan. The setting of water management objectives should therefore also take into account the physical possibility and institutional capacity to monitor these indicators.

4. Institutional Arrangements for Performing the Functions

There is no blue-print for designing an organisational framework to meet the water management objectives and to exercise all the water resources management functions. An important aspect is that there are many institutions as well as water authorities that must be involved in conducting water resources management (Figure 2.3).

Figure 2.3: Institutional arrangement for performing the water resources management functions



The structure and organisational framework are dependent on the national policies. Normally a river basin organisation (RBO) has regulatory functions as discussed in Section 2. Regulatory responsibilities related to the water resources management functions may, however, also be given to other institutions than to the regional water authorities. Examples are pollution control that may be the responsibility of the Ministry of Environment or flood and drought management that may be within a general disaster management framework run by Local Government.

For an RBO it is therefore important to avoid dual responsibilities. If other institutions have the regulatory responsibility the RBO should act as a stakeholder and interact with these institutions in the best way possible.

As indicated in Figure 2.3 there are also related management areas, which directly influence the water resources but which are not part of the basic water resources management functions. An example is land management guiding agricultural fertilizer usage and soil conservation measures, both of which affect quality of the water resources. Also in this case the RBO must act as a strong stakeholder and interact with the relevant ministry or institution.

Box 2.1: Separated Water Management Functions

- In Kenya the Tana Water Resources Management Authority under the Ministry of Water and Irrigation is responsible for the implementation of IWRM in the Tana River basin. However, the responsibility for pollution control and soil conservation is vested with the National Environment Management Authority and the Ministry of Natural resources, respectively. Coordination between the different water resources management functions is made through the basin stakeholder forum, the Tana Catchment Area Advisory Committee.
- In Malaysia the Selangor Waters Management Authority (SWMA) under the Selangor State Government has been given the powers to protect, regulate and manage the water resources in the Sungai Langat River Basin. SWMA is responsible for licensing and enforcing of water allocation and also does the monitoring of water abstraction. However, basin planning is made by the Ministry of Natural Resources and Environment under the Federal Government, supervised by a steering committee in which SWMA is represented.

5. Stepwise Approach to Conduct the Functions

As a first step to establish an institutional arrangement for performing the water resources management functions, the roles and responsibilities of the different local institutions must be defined. Which institution has the responsibility for each function and how should the other organisations support the responsible institution.

As the second step each institution, e.g. the RBO, must define clear water management objectives for the functions it is responsible for and how they should interact with other responsible organisations. These water management objectives should preferably be presented, discussed and clarified in a process involving the major stakeholders of the river basin. This will create ownership and acceptance of the functions and objectives. The water management objectives should be part of the River Basin Plan so that they are clearly recognised and adopted at appropriate levels.

As a third step the institutions should identify the activities and necessary institutional capacity to meet the water management objectives and to conduct the functions set in the statutes. To conduct the third step a simple activity and capacity matrix approach can be used (Figure 2.4). Such a matrix can be used to analyse the factors, steps, requirements and links necessary for capacity to be present for a certain objective.

The capacity matrix is created by first identifying the activities for producing the final output for the objective. For example, if the water management objective is disseminated knowledge of the water resources, the initial activity could be to monitor river runoff in the field, the second activity to deliver the data on a regular basis to the main office, the third activity to quality assure and store the data, and the fourth activity to analyse and present the data in an understandable way to the stakeholders.

For each of these activities the necessary human skills, organisational and financing support and external links must be defined. If one of the intermediate activities is not fulfilled because of insufficient capacity it means that the organisation lacks the ability to meet the objective. The capacity matrix is therefore a good tool to work backwards to find all factors necessary for meeting the water management objectives and implementing the functions.

In the case where resources are not sufficient to build capacity for all water management objectives; it is important to prioritise the individual objectives. By decreasing the number of objectives resources may be released for fulfilling other. If instead resources are cut generally and evenly over the organisations (that is often the case) there is a large risk that the institutional capacity fails for all basic water resources management functions.

The development of an institutional arrangement for conducting all water resources management functions is a long and on-going process. It is long because in almost all cases financial resources are not sufficient and it is thus necessary to introduce measures in a step-wise approach. It is also a never-ending process since changes occur (naturally or by human influence) in the river basin that forces water management priorities to be reformulated. An adaptive development process is therefore essential.

Figure 2.4: Matrix for identifying activities and factors necessary for an RBO to meet the water management objectives

Objective	**Factors**			
Water Management Objective	**Human skills & abilities**	**Organisational support**	**Financial Support**	**External Support**
Final activity to meet the objective	**Capabilities** • Technical skill • Administrative skill • Managerial skill • Knowledge • Conflict resolving and consensus building ability **Efforts** • Will & motivation • Drive & energy • Concentration • Work ethic • Efficiency	**Resources** • Staff • Technical facilities • Office facilities • Equipment • Transport • Spares • Fuel • Service & maintenance **Specified objectives** • Vision • Values • Policies • Strategies • Interests **Management** • Planning • Designing • Sequencing • Mobilising	**Resources** • Government budget • Generated income • Grants from donors **Budget items** • Salaries • Investments ✔ equipment ✔ vehicles ✔ materials etc. • Running expenses ✔ Fuel ✔ Spares ✔ Communication ✔ Rental etc.	**Input from other water organisations** • National and bi-lateral authorities • Water Supply Services • Universities **Stakeholder fora** • Basin committees or councils • Local Governments • Water users **Cross-sectoral support** • Governmental ministries • NGOs
Intermediate activity				
Intermediate activity				
Initial activity/ boundary for producing the output				

6. Lessons

A review of river basin water resources management world-wide reveals that implementation of IWRM is still in its early stages. The river basin organisations are still looking for their role and responsibilities and struggle with limited human and financial resources. There are examples of well performing RBOs but common problems exist (Box 2.2).

Box 2.2: Common RBO problems

Case studies of river basin organisations in different parts of the world gave the following conclusions:

- No clear role;
- Lack of autonomy;
- Poor recognition among stakeholders;
- Lack of human and financial resources;
- Lack of adaptive management; and
- Inadequate cross-sectoral coordination.

http://cap-net.org/sites/cap-net.org/files/RBO%20Performance.doc

With this perspective the lessons are:

- River basin management should be focussed on the water resources management functions;
- Different actors may have the responsibility for performing the water resources management functions;
- The RBO must work as a regulatory body for functions it has been given responsibility for, but also act as an active stakeholder to promote actions in the areas outside of its jurisdiction; and
- Conducting the water resources management functions are a long and on-going process and must be made at a rate corresponding to the available resources.

Web References

GWP, 2003 Effective Water Governance, Global Water Partnership Technical Committee, TEC Background Papers No. 7 available at:
http://www.gwpforum.org/gwp/library/TEC%207.pdf

Cap-Net (2007) Performance and Capacity of River Basin Organizations, Cross-case Comparison of Four available at:
RBOs. http://cap-net.org/sites/cap-net.org/files/RBO%20Performance.doc

EXERCISE

Water Resource Management Functions

Purpose: To demonstrate how water resources management functions are managed in a basin.

Activity: Work in river basin groups. (1 hr)

- Task 1: Choose one of the key water resources management functions in your river basin. Who has the responsibility for this and which other governmental organisations need to coordinate with the responsible institution?
- Task 2: Formulate the most prominent water management objectives relevant for implementing the above function in your river basin!
- Task 3: Choose an output indicator for each of the water management objectives!

Report back

Summarise the outcome of the discussions (30 minutes).

Facilitator

Ask whether the water management objectives are realistic. Check whether the indicators measure the objective.

Module 3: Using Indicators to Measure Progress and Performance

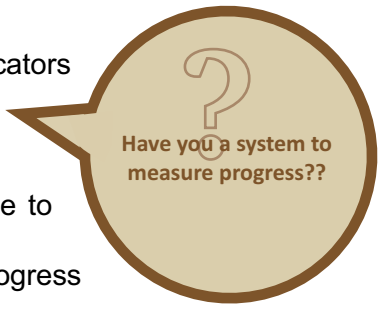
Learning Objectives

- Understand how indicators can be applied to measure progress with IWRM and facilitate cooperation between river basins.
- Appreciate the use of indicators to establish goals and measure performance.

1. Introduction

Integrated Water Resources Management (IWRM) has been the basis of water sector reforms in many countries and has been widely proposed as a process or an approach to guide countries towards more sustainable management of water resources. Reforms in water resources management have been carried out to manage water at the river basin level or catchment level because of the importance of up stream – downstream relationship of water resources.

The question that arises very quickly when addressing sustainable management of water resources, whether through an IWRM approach or not, is "how do we know progress is being made?" This is a very important question as it links to the suitability and effectiveness of laws and institutions and also the strategies and approach being used. Given the core principles behind the IWRM approach of Economic efficiency, social equity and environmental sustainability we have no way to make these visible and test them unless there is a method to answer the question posed above.



Indicators are one approach to measure progress. In this module indicators are used to measure the expected 'outcomes' of water resources management and not the process. The term **'minimum indicators'** is used in recognition that:

- It is better to start with a small set of indicators that are feasible to monitor and to improve over time; and
- There are many other indicators that could be used to measure progress beyond this basic level.

This module will:

- Define indicators and how they are used;
- Present the criteria for the development of indicators;
- Relate the minimum set of indicators to water resources management functions; and
- Propose a minimum set of indicators for measuring progress towards sustainable management of water resources.

2. Indicators and their Use

Indicators provide an effective tool to measure progress and performance.

An indicator is the **representation of a trend** tracking the measurable change in a system over time. Generally an indicator focuses on a small, manageable set of information that gives a **sense** of the bigger picture.

From this it can be seen that:

- There is no need to measure everything; and
- The choice of indicator is important as to whether it gives sufficient 'sense of the bigger picture'.

Indicators have not been applied very much for the measurement of the performance of water resources management although they have been used very successfully in water utilities. Two important uses in water utilities have been a) to keep stakeholders informed of the performance of the utility and b) to help the utility identify action areas.

Well selected indicators can assist the manager of water resources to maintain a focus on the important work areas and take strategic decisions to address problem areas.

IWRM emphasises the integrated approach to water resources management, bringing together various stakeholders or interest groups to participate in management decisions on water. It can therefore be seen that indicators of IWRM may also serve an important function of keeping stakeholders informed of progress and performance of the water resources management system, enhancing transparency, trust and commitment whilst also assisting the RBO to focus action on priority areas.

Box 3.1: Water utilities in Zambia

After reforms to water utilities in Zambia and the creation of a regulatory agency all water utilities now report on the same set of indicators annually. The information is publicly available and therefore allows the public, the regulator and the utility to see the current situation and to compare performance between utilities. They also allow the comparison of progress from year to year. The benefits in terms of service delivery have been significant.

(http://www.nwasco.org.zm)

2.1 Use of indicators

Water sector reforms have been driven by the concern for more efficient use of water resources to speed socio-economic development whilst taking into account the needs of future generations. These laudable goals are meaningless unless there is some process to establish whether any progress is being made to achieve them. Introducing indicators to report on the situation immediately provides a benchmark against which future reports can be measured.

Indicators are useful to:

- Measure progress over time against various water management objectives providing information relevant to policy;
- Measure performance against a target to evaluate the effect of policy
  actions and plans;
- Present information to the public or stakeholders in a simplified way; and
- Identify areas for increased attention by an organisation.

Can you give an example for each use and suggest other benefits from using indicators?

The benefit of this to the RBO is that successes or weaknesses in the water management system may be tracked allowing an appropriate response to be justified to decision makers and implemented.

Indicators have two core functions:

- To provide system information to inform the RBO, the public and policy makers; and

- To translate data into policy relevant information. That is, they describe, show trends and communicate the results of implementing objectives.

It is evident that indicators have to be developed to measure the specific issues considered important. For the purposes of addressing implementation of the IWRM approach and the goal of sustainable management of water resources this module takes water resources management functions as the starting point. Indicators discussed in this document therefore relate directly to water resources and only indirectly to the organisation(s) responsible for managing the water resources.

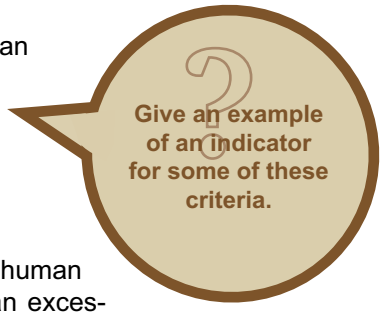
3. Criteria for Developing Indicators

The most important point in developing indicators is not to be too ambitious. *Start with what can be realistically done or else failure is guaranteed.*

Indicators may change with time to reflect the status of the river basin. For example at an early stage of water resources management it may be enough to record the numbers of polluters with permits. Later when all polluters are licensed then it may be more appropriate to look at compliance with licenses and water quality objectives for the river.

Several criteria can be identified for choosing indicators. Not all indicators may comply with all criteria and criteria may change for different circumstances. In our context of addressing water resources management an overarching criterion is that the indicators relate to river basin water management objectives and are:

a) Simple, easily measured, understood and applied
The data used for indicators should be in a format that is easy to use, can be measured using standard techniques, explained using established principles, and easily used for analytical purposes. The more complex the indicator the less useful it will be. The data collected should be reliable and collected using standard, defensible methods.



b) As few as necessary
The capacity to measure and report is usually limited by financial and human resources, especially in developing countries. Being burdened with an excessive number of indicators may mean that the system fails to achieve the expected benefits or does not work at all.

Indicators reduce the number of measurements and parameters that normally would be required to give an exact description of a situation. As a consequence, the number of indicators and the level of detail contained in the indicator set need to be limited. A set with a large number of indicators will tend to clutter the overview it is meant to provide.

c) Use existing information where possible
It is preferable that the information needed to measure an indicator is available through existing data sources and monitoring programs or that data collection can occur through existing programs. This will improve the cost effectiveness of the system.

d) Relate at the appropriate scale
An indicator should be related to the specific situation it is "indicating" information about. The indicator should be measurable at an appropriate scale, both temporally and spatially. For example, if a monthly time step has been chosen as the temporal scale for assessing water quantity then all of the indicators chosen for this parameter, be they baseflow, stream flow etc. should have data that are available on that same temporal scale or another indicator considered. Similarly at the spatial level if data are expected to represent the river basin then the indicator information has to be collected at that level.

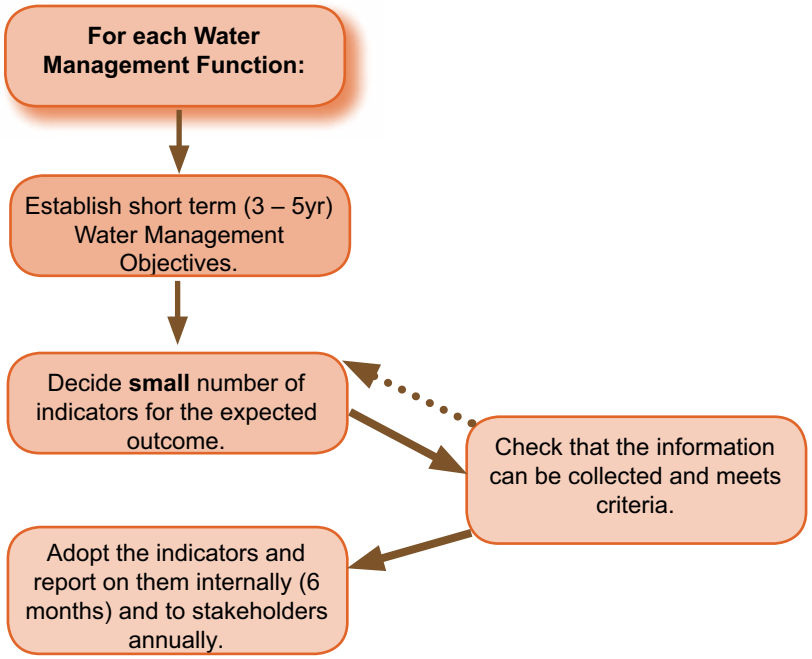
e) Detect change

The indicator should be able to detect change and thus be useful for identifying progress with a management objective or performance of a system or the River Basin Organisation. If the indicator does not reflect change because it was poorly selected or the situation has changed then another indicator should be identified.

f) Comparable, repeatable and defensible between sites and times

IWRM is implemented using a set of common principles and the progress and performance of IWRM implementation is best measured using indicators that are comparable between river basins and even between countries. This will improve transboundary water resources management as well as national measures of progress with water sector reform.

Figure 3.1: Summary of the process for developing indicators



g) Suitable for integration

IWRM is an integrating approach. This is one of the most difficult aspects of IWRM yet is most likely to be achieved using indicators that can be integrated at a particular scale. For example bringing together indicators on water quality, water availability and allocation on a map of the river basin serves a particularly valuable method of integrating information into a visual format to influence stakeholders and decision making. Integrating information from different organisations may be necessary to give an overall perspective on IWRM.

4. Minimum Indicators for Water Management at River Basin Level

Water management objectives may vary for each basin according to circumstances and progress with improving water resources management. A sample set of water management objectives has been drawn from the internationally accepted principles of IWRM and based upon the situation of a relatively young RBO. Following from the discussion above and the key functions of water resources management discussed elsewhere in this manual a draft set of basic indicators has been developed (Table 3.1). The indicators represent the expected result from the implementation of each water management function. In each of the subsequent modules of these materials the water management objectives and indicators are discussed.

This has been developed as a tool from which an RBO can build its own set of indicators that match the stage of development of the basin.

Undoubtedly there will be some areas that the RBO is performing well and beyond the indicators shown in Table 3.1. There will also be other areas where performance is not so good. In the context of sustainable management of water resources one weak function area can have a negative effect on all the others and a goal for the RBO is to achieve satisfactory performance across all the functions.

4.1 Example of pollution management

Controlling pollution takes time and there may be many obstacles. A first ambition level should be set that is realistic and so the water management objective for pollution control may be:

- *The extent of the pollution problem in the basin is known and progress being measured;*
- Minimum indicators can be chosen from what will be readily available through a monitoring system or through the administrative system for example:
  - ✔ *Polluters licensed according to the regulations (measured by the number of permit/ license holders); and*
  - ✔ *Extent and seriousness of surface water pollution (measured by samples or by complaints),*

The first indicator reports on the outcome of the pollution management process as demonstrated by the number of registered polluters in the basin and the information is therefore readily available if the system has been established.

The second indicator requires a monitoring system to be set up and therefore is more demanding. However an assessment of the pollution problem is essential and the question is therefore only one of scale – how many sample points and how many parameters to measure and how often to measure. Over time the system may become more sophisticated and have more historical data so that the water quality objectives can be adjusted and the indicator more specific.

Starting to collect and report on the indicators sets the base-line for future comparison and therefore a basis to assess progress in the basin.

5. Lessons

- Indicators are useful tools for measuring progress and motivating action in specific areas.
- Indicators should be limited to those that can reasonably be measured within the resources of the RBO. Start small, build up gradually.

Web References

Hooper, 2006 Key Performance Indicators of River Basin Organizations. Criteria for ranking indicators available at:
http://www.on.ec.gc.ca/water/water-use/indicator-crit-e.html

Walmsley, J. Carden, M. Revenga, C. Sagona, F. &M. 2001. Indicators of sustainable development for catchment management in South Africa – Review of indicators from around the world available at:
http://www.wrc.org.za

Makin, I.W., Parks, Y.P. & Linklaen Arriens, W. 2004. Supporting the development of effective and efficient River Basin Organizations in Asia. A discussion of the application of organizational benchmarking approaches available at:
http://www.adb.org/Documents/Events/2004/NARBO/Benchmarking/NARBO-Benchmarking-Discussion-Notes.pdf

EXERCISE
Indicators

Purpose: To encourage thinking about the indicators in the context of each river basin and what data is being collected.

Activity: Each river basin represented in the course is asked to do 'homework' each night and report on its own data for the indicators of water resource management functions presented that day.

Task – For the indicators presented at the end of each module answer the question 'Can your river basin report on this indicator?'

Report back: The facilitator will ask for feedback each morning.

Facilitator: Select two river basins to report back. Collect answers from all river basins and summarise results.

Table 3.1: Minimum Indicator Set for Water Resources Management

Function	Water Management Objectives	Progress indicator	Unit/definition
WATER ALLOCATION Allocating water to major water users and uses, maintaining minimum levels for social and environmental use while addressing equity and development needs of society.	Major water users are known and are managed through a licensing (or permit) system.	Number of surface and groundwater users licensed according to the regulations.	Number. Number of licenses issued. May be further subdivided by use.
	Water allocation is in line with sustainable use, economic efficiency and social equity principles.	Water allocation criteria include use efficiency, economic benefit and social goals.	Review. Examine allocation criteria for compliance with IWRM principles.
		% of time environmental and social reserve is maintained in major water courses.	%. Number of records from water resource monitoring stations with flows lower than the reserve divided by the total records x 100. A determination of the reserve is required.

Function	Water Management Objectives	Progress indicator	Unit/definition
POLLUTION CONTROL Managing pollution using polluter pays principles and appropriate incentives to reduce most important pollution problems and minimise environmental and social impact.	The extent of the pollution problem is known and progress being measured.	% of surface water quality samples complying with water quality objectives.	%. Number of samples below set standard. Simplest approach is to base the determination on measurements of a few key water quality parameters.
		% of ground water quality samples complying with water quality objectives.	%. Number of samples below set standard. Simplest approach is to base the determination on measurements of a few key water quality parameters.
	Major polluters are known and are managed through a licensing (or permit) system.	Number of polluters licensed according to the regulations.	Number. Number of licenses issued.

Function	Water Management Objectives	Progress indicator	Unit/definition
BASIN PLANNING Prepare and regularly update the Basin Plan incorporating stakeholder views on development and management priorities for the basin, and using it to inform the annual work plans of the RBO.	Basin planning synthesises technical and social priorities for the basin and acts as a basis for action and accountability to the stakeholders.	Water management activities driven by Basin plan.	Review. Examine the link between the basin plan and current water management activities.
		Stakeholder priorities reflected in the basin plan.	Review. Examine the basin plan for stakeholder consultation and content.

Function	Water Management Objectives	Progress indicator	Unit/definition
MONITORING Implement effective monitoring systems that provide essential management information and identify and respond to infringements of laws, regulations and permits.	The water allocation system is effective and permits are being complied with.	Proportion of water allocation permit holders complying with permit conditions.	%. From monitoring visits the number not complying with conditions divided by the total number of visits.
	The Pollution control system is effective and permits are being complied with.	Proportion of water pollution permit holders complying with permit conditions.	%. From monitoring visits the number not complying with conditions divided by the total number of visits.
	Knowledge of water resource availability is a basis for management.	Number of water resource monitoring stations producing reliable data.	Number. Number of stations with reliable data records.
		Total water storage capacity.	M^3. The water storage capacity in artificial storage structures above a minimum size (say 5,000 M^3).
		% groundwater monitoring stations with declining water levels.	%. Comparison of water levels over a 5 year period.

Function	Water Management Objectives	Progress indicator	Unit/definition
ECONOMIC AND FINANCIAL MANAGEMENT Applying economic and financial tools for cost recovery and behaviour change to support the goals of equitable access and sustainable benefits to society from water use.	Water use efficiency improving through use of economic and financial instruments.	Charges and fees for water allocation favour the poor and efficient water use.	Review. Examine for the application of economic and financial tools in water allocation
		% revenue received.	%. Total revenue divided by the total amount billed.
	Pollution reducing through use of economic and financial instruments.	Pollution charges give incentive to reduce pollution.	Review. Examine for the application of economic and financial tools in water pollution.
		% revenue received.	%. Total revenue divided by the total amount billed.

Function	Water Management Objectives	Progress indicator	Unit/definition
INFORMATION MANAGEMENT Provide essential data necessary to make informed and transparent decisions for development and sustainable management of water resources in the basin.	Essential information is processed and packaged at the right level for specific managers and stakeholders to support transparent decision making and to gain commitment and political support for the	Data base is established in formats compatible with other river basin organisations.	Review. Data base is transferable across basins in the country and for transboundary systems.
		Water management information is available to managers and other stakeholders as required.	Review. Examine availability of basin data and reports on water resource management indicators.

Function	Water Management Objectives	Progress indicator	Unit/definition
STAKEHOLDER PARTICIPATION Implement stakeholder participation as a basis for decision making that takes into account the best interests of society and the environment in the development and use of water resources in the basin.	Effective cooperation between government agencies with responsibilities for water management or water use in the basin	Number of meetings of Government agencies with water interests to consult and collaborate on water management.	Number. Number of formal or *ad hoc* meetings at interagency level.
	Stakeholder participation is institutionalised in the management of the river basin.	Formal stakeholder structures established with clear roles and responsibilities in water resources management.	Review. Examine basin water management structure for stakeholder organisations and allocated management roles.
		Basin stakeholders (male and female) represented in decision making bodies at all levels.	Number. Representatives from stakeholders serving in government water management structures.

Module 4: Stakeholder Participation

Learning Objectives

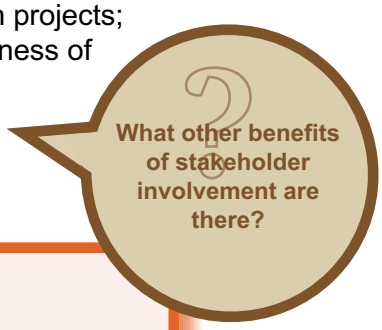
- Learn how to identify and categorise stakeholders.
- Consider different stakeholder structures and responsibilities in water resources management.
- Get guidance on how to maintain stakeholder participation over time.

1. Introduction

The notion that stakeholders should have a say in the management of the water resources on which they depend is one of the building blocks of the concept of integrated water resources management. (IWRM) Integrated water resources management has found its way into the national water policies and water laws of many countries and consequently so has the concept of stakeholder participation.

Why do we need stakeholder participation? The main reason is that only the stakeholder interest in, and acceptance of, the water resources management system make it possible to implement in reality. Several benefits from stakeholder participation can be found:

- It leads to informed decision-making as stakeholders often possess a wealth of information which can benefit water resources management;
- Stakeholders are the most affected by lack of water resources or poor management decisions on water resources and they are therefore able to prioritise actions in the basin;
- Consensus at early stages of development projects can reduce the likelihood of conflicts which can harm the implementation and success of such projects;
- Stakeholder participation can reduce costs and improve effectiveness of water resources management; and
- The involvement of stakeholders can build trust between the government and civil society, which can possibly lead to long-term collaborative relationships.



Box 4.1: What are my first objectives?

My water management objectives for Stakeholder Participation in the basin are:

- Ensure stakeholder participation is institutionalised in the management of the basin water resources.
- Establish effective cooperation between government agencies with responsibilities for water management or water use.

The activities associated with these objectives (Box 4.1) emphasise creation of links between different governmental bodies, especially on policy issues, and creation of a structure of stakeholder organisations addressing water resources management.

This module will give an overview on how stakeholders should be involved in water resources management and describe how to identify and mobilise stakeholders. We also look at stakeholder structures in the basin and the roles and responsibilities that they may have and finally some pointers are given to maintain active participation.

2. Where and how should Stakeholders be Involved?

In countries where water reforms have taken place and water laws have been revised it is often found that stakeholders are identified in the water law and have the possibility to contribute to water management through legal stakeholder structures. This provides an important platform for their formal involvement and collaboration with water management organisations of government.

Stakeholder involvement is much more than public hearings to get feedback on governmental directives or regulations. It is about identifying the public concerns and values and developing broad consensus on plans and new reforms. It is also about utilising the vast amount of information and knowledge that stakeholders hold to find workable, efficient and sustainable solutions to good management of the water resources.

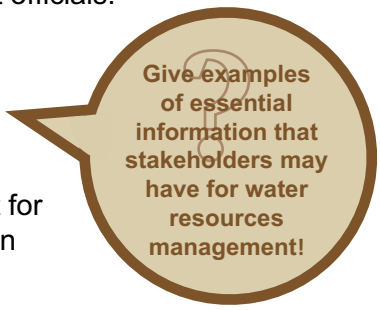
Stakeholders live in the basin and are directly affected by decisions on water resources management either as holders of allocation permits or as water consumers and participants in basin economic and social development. In general stakeholders should be involved in all parts of the water resource management process. Some functions of water resources management where stakeholders play an essential role are given in Table 4.1.

Table 4.1: Possible stakeholder roles in water resources management

Water Management Function	Stakeholder roles
Basin planning	Problem identification, priority setting, situation analysis, approval.
Water Allocation	Advisory, monitoring and reporting, decision making.
Pollution control	Monitoring, reporting, permitting

The roles and responsibilities in some countries will be determined by law. For example in Zimbabwe stakeholder Catchment Councils are empowered to actually take the water allocation decisions whereas in South Africa the Catchment Management Agencies can be delegated such powers by the Minister when they have developed the necessary capacity. In many other countries such decisions are not even made at the basin level and are made at national level by central government officials.

To develop IWRM plans and plan for development projects a large amount of data and information are needed. It is important to make sure that there is no data and information with the stakeholders that have been omitted. The local knowledge of stakeholders is for them obvious and if this is not taken into account it will build mistrust for the managing authority both because the stakeholders have not been engaged and because the authority seems incompetent.



Monitoring of water use and pollution effluent is in practice impossible without participation of stakeholders. The measurements of all water abstractions and effluent discharges by a centralised organisation would require an enormous amount of human and financial resources. Monitoring should therefore be built on self-monitoring, which reduces the demand on RBO resources.

For a river basin organisation to carry out the main water resource management functions of river basin planning, water allocation, pollution control and monitoring effectively it requires a participatory approach. One of the main functions of an RBO is therefore to create a stakeholder participation process in the river basin. This process involves the identification, mobilisation, organisation and capacity building of stakeholders but

also, which is more difficult, to maintain the level of involvement over time. As indicated above, the different parts of water resources management may need different ways of stakeholder involvement. The RBO must also take this into account when designing the stakeholder participation.

3. Stakeholder Inventory and Mobilisation

3.1 Stakeholder inventory

A first step for an RBO is to identify and group the stakeholders in the river basin.

In identifying the key stakeholders the following questions should be considered:

- Who are the potential beneficiaries from water management decisions?
- Who might be adversely impacted?
- Have vulnerable groups who may be impacted been identified?
- Have supporters and opponents of changes to water management systems been identified?
- Are gender interests adequately identified and represented?
- What are the relationships among the stakeholders?

Although the above questions are fairly straight-forward the initial identification of stakeholders is not easy. One problem is often to define the system boundaries. Water affects society in many ways and the socio-economic development of a major river basin in a country may affect stakeholders on the national and even international scale.

A second problem is one of representation - it is not possible to consult everyone and for formal stakeholder structures there is need for representation to be legitimate. It is therefore important at an early stage to categorise the stakeholders. These categories should recognise the different interests and provide the basis for determining representation in water management structures.

One common way to categorise stakeholders is as follows:

1. **Water users** defined as those who need a water-use permit according to the water law and policies. They may be subdivided by competing use such as farmers, utilities, industry, mining, local government, hydropower and so on;
2. **Governmental institutions** that according to their public service role have a stake in water management in the river basin. It is particularly important to identify government institutions that have influence or impact on water management such as agriculture (land use), environment (land use, pollution management, ecosystem health) so as to engage them in policy development; and
3. **Civil society** and its non-governmental organisations.

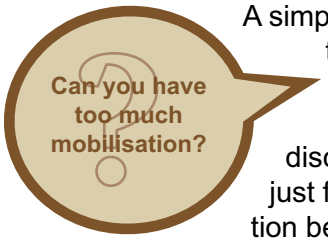
Depending on the status of the basin and the RBO the next steps may be to raise awareness of the stakeholders in coming changes to water resources management, to engage them in structures for water management, or just to consult with them on specific proposals. The purpose will determine the scale dand outcome of the next activities.

An actual inventory of stakeholders in the basin is demanding and should not be underestimated. In many river basins, especially where communication is poor, finding all stakeholder groups is cumbersome and requires much time. It is also important to note that for many stakeholders the inventory is the first time they come in contact with the RBO. Moreover, in countries with large part of informal water outtakes a visit or interest from a governmental body is not always seen as positive.

The inventory must therefore be made with care and include information exchange. This further demands resources as the RBO representatives must take their time to answer questions from the stakeholders. This first meeting with the stakeholder may determine the relation between the RBO and the stakeholder for a long time and may thus affect how successful the future stakeholder participation process will be.

3.2 Stakeholder mobilisation

Stakeholder mobilisation may take place at any time for specific reasons. It is common to mobilise people to provide information or to contribute to a planning process and when, as is often the case, there is no further contact they will not be very receptive in the future. It is important to be honest to yourself as well as to the community what the expectations are as often stakeholder participation is carried out just to say it has been done. Is the intention behind the mobilisation manipulative participation (Table 4.1) or self-mobilisation?



A simple and direct way of mobilising the stakeholders is to invite them to come to workshops in which more information about the RBO is provided, and in which problems or other situations with respect to water resources management in the sub-basins are heard and discussed. Again these types of early contacts are very important not just for organising the stakeholders but also to build the long-term relation between the stakeholders and the RBO.

Figure 4.1: Types of stakeholder participation

	CHARACTERISTICS
Manipulative participation	Participation is simply a pretence
Passive participation	People participate by being told what has been decided or has already happened. Information shared belongs only to external professionals
Participation by consultation	People participate by being consulted or by answering questions. No share in decision-making is conceded and professionals are under no obligation to take on board people's views
Participation for material incentives	People participate in return for food, cash or other material incentives. Local people have no stake in prolonging practices when the incentives end
Functional participation	Participation is seen by external agencies as a means to achieve project goals, especially reduced cost. People may participate by forming groups to meet predetermined project objectives
Interactive participation	People participate in joint analysis, which leads to action plans and the formation or strengthening of local groups or institutions that determine how available resources are used. Learning method is used to seek multiple viewpoints.
Self-mobilization	People participate by taking initiatives independently of external institutions. They develop contacts with external institutions for resources and technical advice but retain control over how resources are used

SOURCE: Dalal-Clayton B, Bass S (2002)

Mobilisation may be through information material distribution, visits to communities, participation in community meetings or by bringing representatives to a specific meeting. Again the actual means and scale of the stakeholder participation intervention should be determined by the expected outcome of the process.

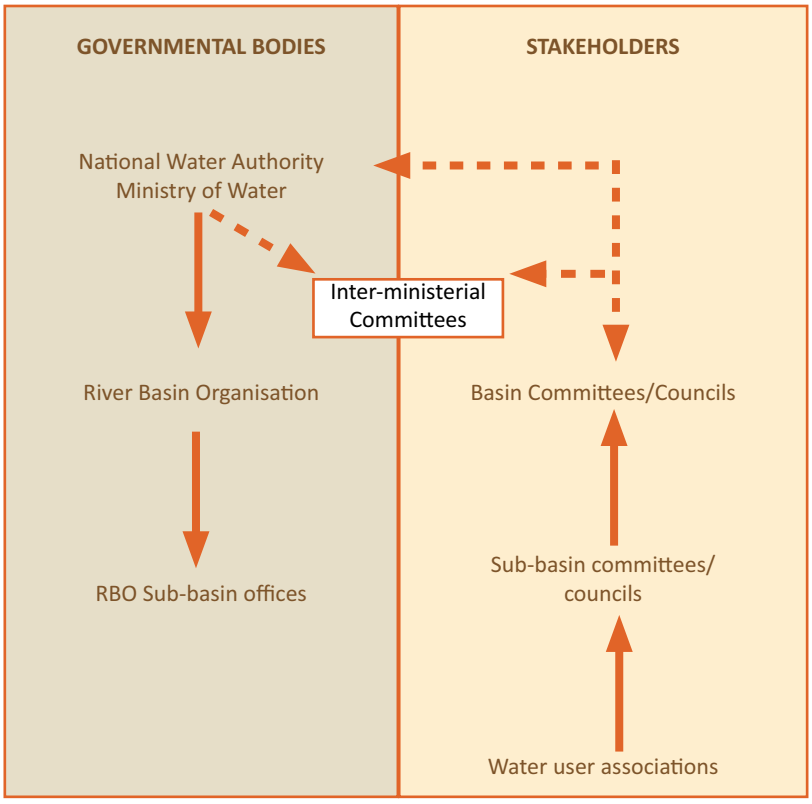
4. Stakeholder Organisation and Structure

4.1 Formal stakeholder structures

Depending upon the specific legal situation new water management systems usually define some structure for stakeholder participation. This is particularly important as a formal stakeholder structure makes the work of the RBO much easier, limiting the need for continued stakeholder mobilisation and ensuring a formal and regular link to the stakeholders. In many countries stakeholders are given a legal status and will create their own entity in a river basin. In other countries the stakeholders have only an advisory function.

There is no blue-print for how to build the structure of stakeholder fora. Figure 4.2 shows the possible links between governmental bodies and stakeholder organisations at different levels. For large river basins there is a practical need for introducing sub-basin committees or similar. Each of these sub-committees has a number of representatives in the main river basin committee. Likewise, stakeholders belonging to a certain sector may have a branch organisation (e.g. water user associations, farmer unions) that is represented in the sub-basin or basin committees.

Figure 4.2: Possible links between stakeholders and governmental bodies



If there are no guidelines in the national water law or policies the stakeholder forum should basically be decided by the stakeholders themselves. Because the stakeholders normally are diversified with different backgrounds, education and interest it is, however, recommended that the RBO takes a leading role in the building process.

For the RBO to take this leading role it is beneficial to understand the stakes of different interest groups among the stakeholders, where they wish to participate, and what their expectations and skills are. It is also good to understand the power and key stakeholders and the relationships between them. In situations where the stake-

holder structures have decision making power there is usually a formal process to identify the membership and the representation of different stakeholder groups.

It is important to clarify early on the **roles and responsibilities** of the stakeholder structures in the water resources management process. The water management objectives for the basic functions of the RBO will give guidance. The objectives on basin planning, water allocation, pollution control and monitoring will determine the need and level of stakeholder involvement. For example the water users may be given the responsibility to do monitoring on the local scale under supervision of the RBO. In this case the structure of the stakeholders must be designed to enable easy communication on the local scale. Another example is that the objectives for basin planning may require consensus among the major stakeholders on water development plans. In this case formal stakeholder structures are invaluable.

Box 4.2: Stakeholder responsibilities

In Zimbabwe sub-catchment councils have the responsibility to monitor water usage by permit holders. They are legally allowed to raise a levy to cover the costs of this task. Catchment councils, made up from chairpersons of sub-catchment councils, have responsibility to allocate water and also to prepare Basin plans with the support of the RBO (ZINWA).

The funding for the Catchment Council comes from the water allocation fees paid to the Zimbabwe National Water Authority (ZINWA).

In such basin committees an essential issue is representation: how are different stakeholder groups represented in the central forum. Procedures and guidelines must be clarified on how different groups are represented and how these representatives are selected and replaced from time to time. Clear and documented rules for this are important to obtain equitable participation.

4.2 Government as a stakeholder

Cross-sectoral coordination deserves a special mention under stakeholder participation. Coordination between different sectors often means the cooperation, or at least exchange of information, between different governmental ministries and departments. It is therefore closely linked to the water management objective of effective cooperation between government agencies with responsibilities for water in the basin.

As indicated in Figure 4.2 inter-ministerial committees are located in between the columns for stakeholders and governmental bodies. This is because many governmental organisations may be managing water resources, users of water resources or have responsibility for programme areas that directly impact on water resources management. Local Governments are in many cases responsible for the water supply and sanitation and are therefore in the category of water user. At the same time Local Government is obviously an important stakeholder when it comes to water resources allocation or basin planning for development.

The Environment Agency is another example as a partner to an RBO in that they often have responsibility for water pollution management – the RBO is then a stakeholder to influence how the Environment Agency sets policy and implements this programme. Agriculture may establish policies and programmes on land management, cropping or irrigation that directly affect the management of water resources in a basin and again the RBO should see itself as a stakeholder in the policy decisions of the Ministry of Agriculture.

For an RBO it is therefore essential to coordinate its work with other ministries, either through inter-ministerial structures or directly with corresponding local departments of other ministries. This coordination is in many cases needed in parallel with the RBO interaction with the basin committees where there may be ministry representatives. If this coordination is neglected the RBO risks to be limited in its possibility to manage the water resources effectively.

Stakeholder participation must therefore normally be carried out at several levels.

5. Maintaining Active Participation

Despite the long and difficult process of mobilising and organising the stakeholders, the largest challenge for an RBO is probably to maintain active stakeholder participation in a river basin. A key is to ensure that the stakeholders see the benefit of their participation. For many stakeholders water resources management may seem only negative since they suddenly are faced with restriction of water abstractions and effluent discharges or demands on self-monitoring. In addition they have to take time from their own work activities and means of getting an income. In this perspective, it is a large responsibility of the RBO to provide and present concrete benefits of being involved in the water resources management process in the river basin.

Below are a number of guidelines to keep in mind for promoting active stakeholder participation:

- **Information dissemination** – Information is enormously important to keep up the stakeholders' interest for water resources management and to create a sense of local ownership of the process. A variety of information tools are available (workshops, information leaflets, web pages, visits and consultations on the ground, etc) and is described in detail in another part of this manual. A particular activity is to ensure that stakeholders are kept informed of the status of water resource management in the basin through regular reports on key indicators;
- **Capacity building of the stakeholders** – Stakeholder participation is often hampered because the capacity of the stakeholders is too low or some stakeholders know much more than others. It is important to recognise that there are stakeholders in every basin that are knowledgeable people but others may need to be brought to a similar level for effective participation. The RBO should have an active capacity building programme for new members to be sure that they have the exposure and support to enable them to perform the responsibilities they are tasked with;
- **Giving responsibility and clear roles** – Without responsibility and clear roles no-one will continue to attend meetings;
- **Parallel development of the water resources** – Concrete development of the water resources and addressing problems in the basin is key for promoting participation. Water resources management basically aims at improving the accessibility to water which gives socio-economic development and better living conditions for the stakeholders. Development projects are not just a sign of that the water resources management gives something back to the stakeholders, it also gives opportunity to discussion and participation while it is being developed. It is therefore important for RBOs to, as much as possible, coordinate development projects with the participatory process. A long delay between planning and decision and the commencement of actual development on the ground is very de-motivating for stakeholder participation; and

- **Providing services** – The RBO often sits on a large knowledge and information base that is valuable for the stakeholders. Examples may be river flow statistics for design of small weirs or water outtakes, rainfall statistics and soil type information for agriculture planning, groundwater aquifer characteristics, etc. Especially in situations where the RBO needs the stakeholders' participation for monitoring it is essential to offer valuable data in return.

6. Lessons

- Stakeholder participation, especially in the early stages, needs a lot of resources.
- Without active lobbying, women's representation becomes low in the stakeholder fora.
- The large stakeholders dominate and set the agenda, which make the small-scale stakeholders uninterested to participate.
- The immediate needs for rural small-scale stakeholders are normally not considered in large-scale river basin management.

Box 4.3: HOW ARE YOU DOING?

Measure progress with stakeholder participation in your basin:

- Are Government agencies in the basin with water interests consulted for collaboration on water management?
- Are formal stakeholder structures in place with clear roles and responsibilities in water resources management?
- Are basin stakeholders represented in decision making bodies of the basin?

Web References

US EPA, Engaging and Involving Stakeholders in Your Watershed available at: http://www.epa.gov/owow/watershed/outreach/documents/stakeholderguide.pdf

UNESCO (2003) Participation, Consensus building, and Conflict management Training Course available at: http://unesdoc.unesco.org/images/0013/001333/133308e.pdf

Dalal-Clayton B. Swiderska K, Bass S (2002) Stakeholder Dialogues on Sustainable Development Strategies. Lessons, Opportunities and Developing Country Case Studies. Environmental Planning Issues No 26, November 2002. International Institute For Environment and Development. London, United Kingdom available at: http://www.poptel.org.uk/nssd/pdf/epi26.pdf

EXERCISE
Stakeholders

Purpose: To raise the awareness about stakeholder issues and challenges of real stakeholder participation in basin management.

Activity: Organise a debate between those in favour of stakeholder participation and those against. In favour - argue why stakeholders should be involved in water resources management in the basin and the extent of involvement. Against- argue why stakeholders should NOT be involved in water resources management in the basin.

Facilitator: Ask the participants to choose which side they want to be on. Allow 15 minutes for each group to prepare their lines of argument. (Allow 30 minutes for the debate and 15 minutes for summing up.)

Module 5: Water Allocation

Learning Objectives

- Learn the basic elements of water allocation and the links to other RBO functions.
- Get a basic understanding of system analysis.
- Understand how to develop procedures for water permits.

1. Introduction

Access to clean water is a human right and is vested in the law of most countries. The right to groundwater and surface water is also commonly linked to the ownership of land. As water resources have become more scarce in many parts of the world there is a common view emerging that management of water resources needs to be improved.

In river basins where there is water scarcity, or will be in the future, there is a need to regulate the water usage to ensure sustainable, equitable and efficient utilisation of the resource. The regulation of the water resources is normally made through a permit or licensing system, which enable the government or state authorities to allocate the resources taking into account all stakeholder interests, including the environment. In countries with abundant water resources this may not be needed but with the increased pressure on the water resources, both in terms of quantity and quality, this is becoming a rare situation.

Box 5.1: WHAT ARE MY FIRST OBJECTIVES?

My water management objectives for Water Allocation in the basin are:

- Ensure major water users are known and are managed through a licensing or permit system.
- Implement water allocation in accordance with sustainable use, economic efficiency and social equity principles.

This module outlines how water allocation is conducted through a permit or license system. Section 2 gives an explanation of equity and defines the water management objectives. Section 3 describes the fundamentals of water resources system analysis, which water allocation is often based on, while Section 4 gives guidance on how to develop water permits.

2. Water Management Objectives in Water Allocation

Water allocation is about allocating water to users and uses while maintaining necessary levels for basic human needs and the environment. In water scarce regions, equitable and reasonable utilisation of the water resources is one of the key parts of IWRM and is normally expressed explicitly as a water governance principle in international and national water laws and policies.

Equity in this sense does not mean that everyone should be given an equal amount of water. It means that everyone has fair opportunities to access, use and control of the water resources. It also means that everyone must take the responsibility for the negative side effects of abstracting water so that no part of the society will be disadvantaged.

2.1 Water resources management objectives

In regions of water scarcity or competition the first water resources management objective linked to allocation is therefore to have a water permit system in place to enable the authorities to control water usage (Figure 5.1)

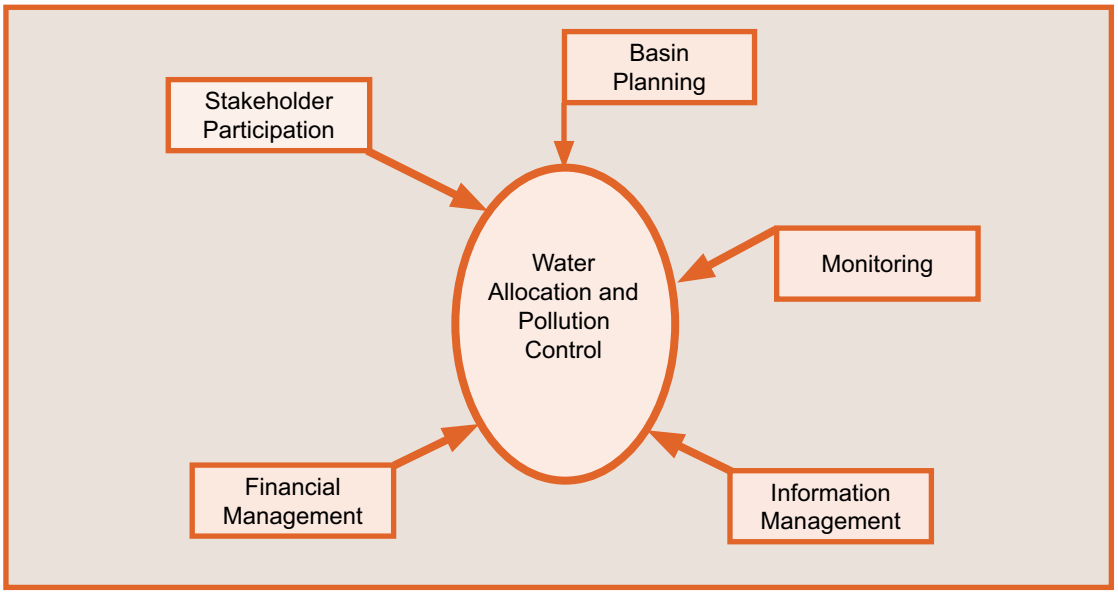
This allocation system or procedure is also the appropriate vehicle to implement other water management objectives related to equity and efficiency. (Box 5.1)

The first water management objective identifies the need for an allocation system and the second water management objective prescribes some of the criteria that should be used when making allocation decisions.

2.2 Linkage to other water management functions

Water allocation is, together with pollution management in many ways the centre of the RBO's work (Figure 5.1) supported by other functions.

Figure 5.1: The water allocation and pollution control functions are dependent on input from the other functions



Basin planning provides the setting for water allocation. It provides the naturally available surface and groundwater resources and the environmental flow requirements. It also gives present and projected future socio-economic conditions, water demand and infrastructural development. All this information is the basis for how much water is needed and how much can be allocated in the river basin. Financial management gives the tools to encourage and, if necessary, force efficient use of water. In especially water-scarce regions this function is fundamental for sustainable water use.

Stakeholder participation and information management give transparency and ownership to the decided allocation. This is a prerequisite for the water users to respect the allocation system. Through participatory activities coordination between different water uses is also made possible. Monitoring of water use and water resources is necessary to enforce the water allocation.

If water policies have been developed, which is normally done on the national scale, and all these other functions are in place, the water resources management function of water allocation boils down to one difficult element: to develop procedures for authorising water licenses or permits.

3. Water Resources System Analysis

One of the fundamentals of water allocation (and pollution control) is that any form of abstraction, transfer, storage or other influence on a natural stream has effects in the entire downstream river system.

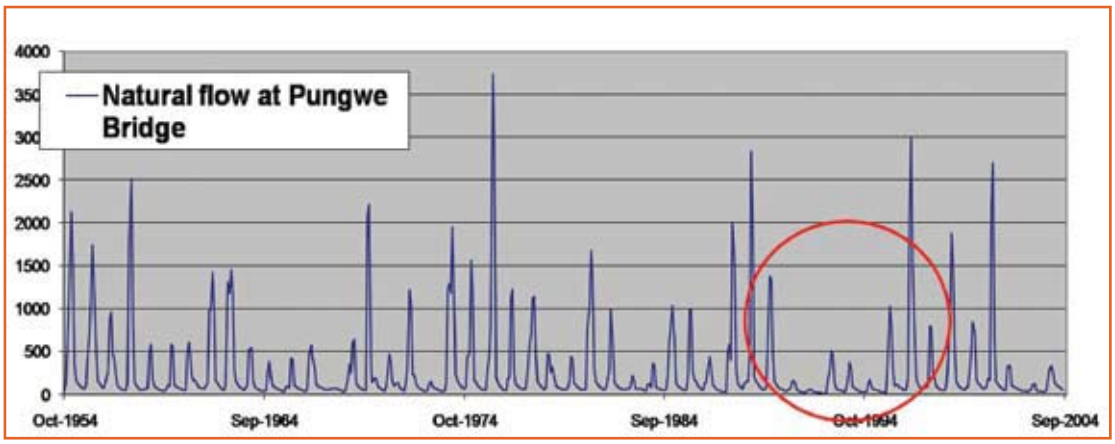
To analyse the effects of a new requested activity in a river for authorisation purposes, the whole river system must therefore be analysed as one unit. This is normally called **system analysis**. Although, this may seem like a technically simple exercise, it is not, and the lack of understanding of the principles of system analysis is one of the main obstacles for equitable water allocation in river basins. Before discussing procedures for water permit it is therefore important to go through some of these principles.

The main principles that have to be understood by the RBO and have to be educated to the stakeholders are:

1. Water allocation has to take into account the temporal variation of river runoff;
2. Water allocation must be made on the appropriate scale;
3. Water allocation is influenced by the assumed future socio-economic development, especially in water-scarce regions; and
4. Water allocation is in almost all cases based on uncertain input data and can therefore not provide guarantees.

Figure 5.2 shows an example of a natural flow variation in a river basin. What is important to understand for the stakeholders is that what governs the guaranteed water at a certain point in the river is the minimum flow for an infinite long period with natural variation in rainfall and runoff. In a system with storage dams, this occasion of minimum yield does not have to be the same as the day or month with the lowest natural runoff. A longer period of semi-dry conditions may in this case be governing the ensured yield. Because of the temporal variation in river runoff the allocated water must therefore be associated with a certain probability of supply for the user. For example urban water supplies are normally given a higher probability of supply than agricultural water hence the raw water costs more and the urban utility is given preferential access in times of shortage.

Figure 5.2: The long-term available water resources of a river basin are governed by the dry periods

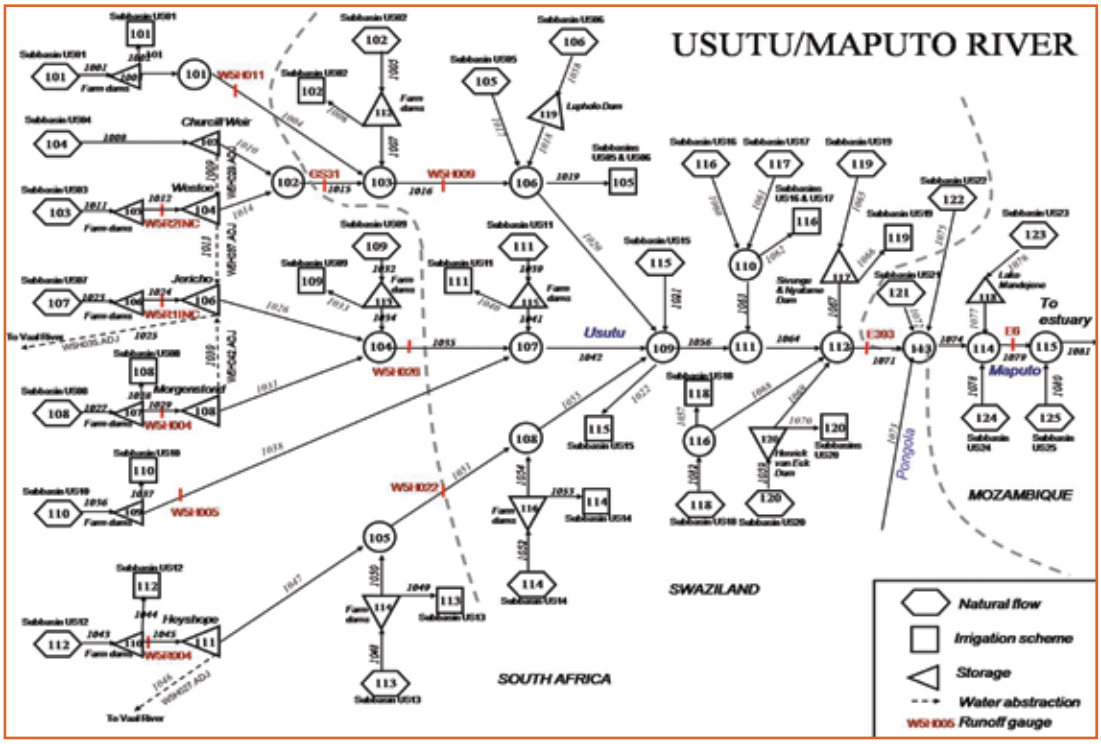


System analysis is to compare all water demands in a river basin with the water availability in the system, both for existing and future water conditions, as well as with current and possible future water infrastructure. Even in river basins that are little committed in terms of water use the system normally becomes very complicated.

When analysing a water permit application it is therefore essential to choose the correct scale. This scale has to be chosen so that effects of the water abstraction on downstream stakeholders are not overlooked but at the same time keeping the system small enough to be workable and understandable. Again for individual stakeholders, the explanation that his/her abstraction is only one of many and that the accumulated effects of all abstractions may be affecting others located very far away is important to accept water allocation decisions.

Proverb:
Many small streams create a large river.

Figure 5.3: The Maputo River basin in Mozambique, Swaziland and South Africa is still committed to a limited degree. A system analysis conducted however reveals that the description of allocated water in the river basin is very complicated.



Groundwater resources are an important part of the system analysis. Although normally small compared to surface water resources, the availability of groundwater does not vary as much with the seasons. During dry periods, which govern the allocated amount of water, the contribution from groundwater may be significant.

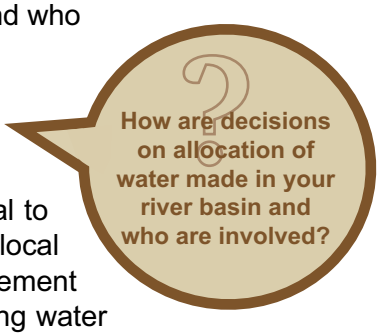
An essential part of the system analysis is to predict the future socio-economic development. In general terms, the more development, the more water demand although improved economic conditions also provides for water demand management. The assumed economic development thus directly influences how much water can be allocated to guarantee a sustainable situation also during future conditions. Since socio-economic development is very difficult to forecast, the normal procedure is therefore to do system analysis under different **scenarios**. This means that the decision on water allocation also has to include a choice of which scenario of economic development to adopt.

The final principle that must be acknowledged by all stakeholders is that system analysis is not an exact science. There are many examples where different analyses have come up with totally different safe yields, which have caused conflicts between stakeholders. The reason for this is the inherent uncertainty in the inputs for the system analysis: hydrology, groundwater yields, water uses, future development, etc. Thus a water permit procedure must take into consideration this uncertainty.

4. Water Permits

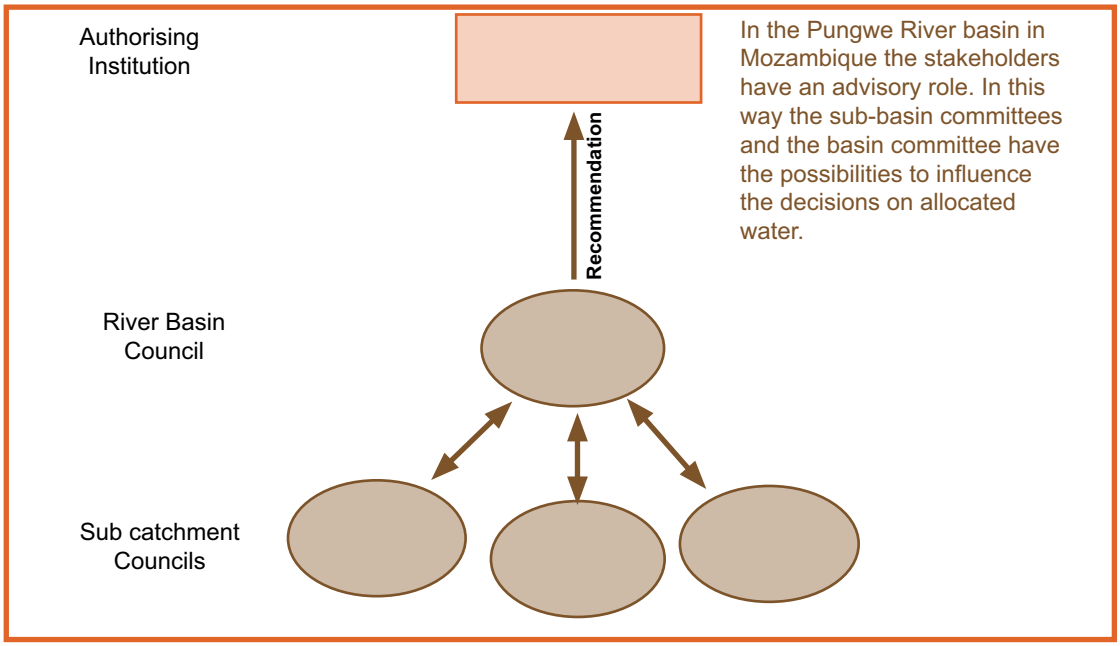
Considering the difficulties of allocating water by taking everything into account, as described in the previous chapter, the water management objectives may be seen as a guide to priority setting for implementing water allocation. A situation where all major water users are known and are registered at the RBO is a very important first step. Water allocation is based on the principal that everyone in the river basin is involved. The existence of water users that by-pass the rules will inevitably mean that the allocation system will fall apart.

The next step is to give all major users a permit to abstract water or build storage. This permit may be with or without limitations. In a river basin with abundant water resources it may be sufficient to allow open permits as long as they are registered and provide monitoring information. In most cases, however, water resources are not abundant and the permit must therefore be conditioned with limitations in use, etc. How this permit system is structured is often controlled by the national water law. In many cases the water law gives a minimum abstraction for which a water permit is needed, what institution has the authority to approve such permit and who has the regulatory responsibilities.



If stakeholder participation in the water allocation process is not, or only partly,directed by the water laws the structuring of stakeholder fora is an essential task for the RBO. Even if the central RBO is the institution assigned with authorising the permits it may be beneficial to create a decentralised organisation where the decision is taken at a local scale and with participation of the stakeholders. To strive for management at the lowest appropriate level, is therefore recommended delegating water allocation to local authorities, water user groups or stakeholder committees.

Box 5.2: Example from Mozambique



In the Pungwe River basin in Mozambique the stakeholders have an advisory role. In this way the sub-basin committees and the basin committee have the possibilities to influence the decisions on allocated water.

When the responsibilities and participatory structure of the permit system are in place the next step is to develop general rules and principles for water allocation. These rules should be established in conjunction with the stakeholder structures.

4.1 Allocation Criteria

Besides prioritisation of different sectors, the rules and criteria of water allocation should address major issues such as:

- Acceptable probability of supply for different sectors and users;
- Legal certainty – period of time the permit is valid;
- Public review mechanisms and possibility for stakeholders to challenge new permits or the misuse of permits;
- Conflict resolution or appeal mechanisms;
- Levies and fees for application and abstracted water volumes; and
- Definition of extreme conditions, e.g. droughts when special rules may apply.

The basic information that needs to be included in an application for a water permit and which provides the base for the approving process is:

- Where is the water abstracted and from what source;
- How much and when is water abstracted;
- How is water abstracted; and
- What is the abstracted water used for.

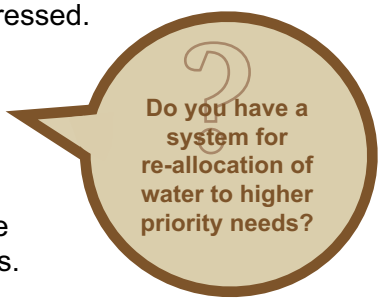
The general rules and principles must guide how this information is analysed. A full system analysis for the entire river basin is in practical terms impossible to conduct for every water permit application. The rules must therefore provide guidance for what procedure to follow depending on the type of abstraction.

In certain cases, e.g. in parts of the river basin with no water scarcity or if the water abstracted is small in volume, the approval procedure may be simplified. On the other hand if a significant storage is to be built with large outtakes and altering of the river regime a full system analysis must probably be made covering all downstream river reaches.

As a minimum a hydrological assessment must be made for all water permit applications where the abstraction is compared with the available water resources taking into account water use for basic human needs and environment.

The next step involves a comparison with the available water resources taking all other outtakes into account. This analysis involves prioritisation, reliability of supply and certification issues of water and is therefore much more complicated. This step is where the water management objective of equity and social priorities is addressed.

Allocation mechanisms should be applied that promote efficient use and favour uses that have greater impact on social and economic development. These criteria may be more difficult to apply initially but will become necessary as water resources become more limited. This has been one of the main drivers for some countries to adopt the market approach to water allocation allowing the sale of water permits.



The setting of criteria for water allocation should include all the above issues; prioritisation, reliability of supply and efficiency of use. At the same time it must be simple enough to be applicable and understandable for the stakeholders.

4.2 Management Tools

Since system analysis is very complicated to conduct a way to handle this is through regular river basin studies where the basin is analysed as a whole and the results are presented in the basin plan. In such case the basin plan includes directives on which sectors are prioritised in different parts of the river basin and to what level. As long as the water permit applications fall within the basin plan a simplified authorisation process can be applied.

The technical tools needed for an RBO for a water permit system include:
- Geographical Information System (GIS);
- Hydrological modelling tools;
- System analysis modelling tools

The GIS is a fundamental tool for water allocation where the water users' locations are stored and displayed in a map format. The GIS can also be linked to databases giving details on the stakeholders, type of water use, abstraction volumes, permit status, etc. Hydrological models are needed since observed river runoff in general never covers sufficient detail needed for water allocation. Experience is that models must be updated continuously for doing the basic analysis of new water permits required by the water management objectives. System analysis tools are needed at least for doing the regular basin analysis and plans.

For an RBO it is therefore important to have access to these tools and to build up an institutional capacity for using them. The tools need to be used on a regular basis to be accurate and to maintain the human skills.

5. Lessons

Many river systems of the world are already over-utilised because of lack of water allocation systems. Experience of water allocation in river basins has also shown that large stakeholders use their power and political influence to favour themselves. Economic instruments for steering the abstractions to more beneficial use of the water are still very rarely applied.

The major lessons therefore are:
- In a water scarce river basin, all major water users should be known and should have a permit.
- Clear guidelines and criteria must exist for how and by whom water allocation decisions are taken.
- These guidelines and criteria shall take into account the fundamental basics water use: sustainability, equity and efficiency.

Box 5.3: HOW ARE YOU DOING?

Measure progress with water allocation in your basin:
- Are surface water users licensed according to the regulations?
- Are groundwater users licensed according to the regulations?
- Do water allocation criteria include requirements for use efficiency, consider economic benefit and social goals?
- Is the environmental and social reserve maintained in the river?

Web References

United Nations, 2000, Principles and practices of water allocation among water-use sectors, Water Resources Series, No. 80, United Nations available at: http://cap-net.org/sites/cap-net.org/files/wtr_mngmnt_tls/78_water_allocation.pdf

EXERCISE
Water Allocation

Purpose: To share experience on water allocation systems and criteria.

Activity: Break into three groups and discuss for 45 minutes.

For river basins represented in the group -

- Discuss how the water allocations are made and the existing water allocation criteria and analyse whether the criteria address the IWRM goals of equity, economic efficiency and sustainability;
- Propose improved allocation criteria.

Report back: 30 minutes.

Facilitator: It is possible that there are minimal criteria for allocation, discuss the implications of this.

Module 6: Pollution Management

Learning Objectives

- To establish a basis for water pollution management.
- To understand approaches and options including steps for planning pollution control measures.
- Derivation of management interventions, tools and instruments needed to fulfil the pollution control objectives.

1. Introduction

Water resources management entails two closely related elements, i.e. the maintenance and development of adequate quantities of water of adequate quality. Thus, water resources management cannot be conducted properly without paying due attention to water quality.

Managing water pollution is clearly one of the most critical challenges to sustainable management of water resources. Without urgent and properly directed action, many countries and particularly developing countries face mounting problems as water resources become more contaminated. Pollution is increasing rapidly with urbanisation, industrialisation and population growth, yet many countries have inadequate institutional and legislative systems to address the problem effectively.

Box 6.1: WHAT ARE MY FIRST OBJECTIVES?

My water management objectives for Pollution control in the basin are to:

- Measure the extent of the pollution problem and the progress being made.
- Ensure major polluters are known and are managed through a licensing or permit system.

This module discusses:

a) The framework for action on pollution;
b) The process of preparing a pollution control plan; and
c) Implementation.

2. Legal and Regulatory Framework

2.1 Water management objectives for pollution Control

Empowered by the national legislation the managing organisation needs to establish water management objectives for pollution that are feasible within the intended time frame and are measurable (Box 6.1). The initial objectives will revolve around the need to understand the scale and scope of the problem and start to control the sources of pollution.

Pollution control objectives require supportive legislation, policies and institutions - institutions that will assume the responsibilities for issuance of permits, coordination etc. Often the primary responsibility for pollution control lies with another authority other than the water management agency. Moreover, policy statements regarding water pollution control may be found scattered within the legislative framework in connection with the establishment of environmental legislation, but also within the framework of water resources management, and some other aspects within the public health regulation.

The River Basin Organisation or the water management authority may take the role of a stakeholder when discussing with the agency responsible for pollution management. Clearly mechanisms for multi-stakeholder participation are essential.

2.2 Principles for pollution management

In establishing the legal and regulatory environment for pollution management there are several important principles or guides to be applied:

i) Prevent rather than treat: Clean up of polluted sites and water bodies is generally much more expensive and challenging than applying measures to prevent pollution from occurring in the first place;
ii) Use the precautionary principle: Establishment of a causal link between the substance and pollution may take a very long time to establish and often is too late;
iii) Apply the polluter-pays-principle: Costs of pollution prevention, control and reduction measures should be borne by the polluter. This is an economic instrument ensuring that costs are distributed fairly and encouraging changes in polluter behaviour. To the extent possible pollution control should be financed from revenues paid by polluters;
iv) Apply realistic standards and regulations: Standards must be achievable and the regulations enforceable otherwise they result in more harm than having no standards and regulations, because they create an attitude of indifference, both among polluters and administrators alike;
v) Balance economic and regulatory instruments: RBOs will best achieve results by a mixture of regulations aimed at predictable goals and economic incentives for polluters to modify their behaviour;
vi) Apply water pollution control at the lowest appropriate level: Decisions or actions for water pollution control should be taken as close as possible to those affected but adapted to administrative and technical capacity at that level, in full consultation and involvement of affected groups; and
vii) Establish mechanisms for cross-sectoral integration: Pollution control requires co-operation, co-ordination and information exchange across water-related sectors, such as health, agriculture, environment and forestry.

2.3 Types of pollution

Broadly, pollution may be classified in two categories:

a) Point source pollution that refers to sources that is easily recognisable. The common characteristic of point source discharges is that they are identifiable and are the easiest to monitor and control; and
b) Non point source pollution or diffuse pollution refers to pesticides or fertilisers from agricultural fields; urban run-off and erosion from poor land use practices and other similar situations. This is much more difficult to identify and control.

2.4 Pollution control approaches

A pollution control program may approach the problem from the perspective of water quality criteria for the receiving water bodies (water body control) or by placing a limit to the volume and/or strength of the discharges entering the environment (effluent/emission control).

In case of managing quality of receiving water bodies this is technically demanding and difficult to manage. The first priority in establishing a pollution management system should be to manage point source pollution and once this is effective to turn attention to non point sources and receiving water quality.

a) Regulation of point sources

Point source pollution is most often controlled through a system of licences or permits. These regulate and set conditions for discharge of polluting substances into the environment. The permit system should contain incentives to reduce or stop discharges altogether and this may be done through a combination of the fees plus education or financial support for movement to better technology or recycling.

b) Regulation of non-point source pollution

In order to manage non-point source pollution the relationship between pollution and land-use activities must be established. This will often require a geographical information system to hold and to relate data associated with land use (e.g. cropping intensity, vegetation clearance and soil erosion information). Evidently, control of non-point pollution sources will rely heavily on coordination with other sectors for example agriculture and urban authorities and cooperation in policy setting.

c) Community monitoring

One approach to pollution control is to engage the community. In practice any regulatory agency has difficulty in monitoring the large geographic areas necessary to control pollution. The impact of pollution is usually felt at the community level and therefore they are a logical resource to use. Ways in which they may be involved are:

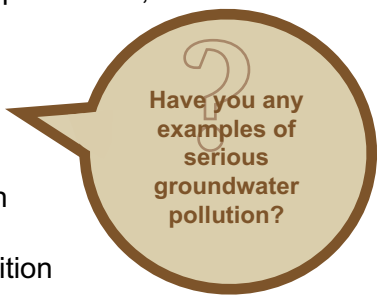
- Holders of pollution permits may be required to report their own discharges and also the quality of the receiving water on a defined frequency;
- Water user associations and other groups can be encouraged, and given means to report episodes of pollution; and
- Schools can be provided with kits to assess river health and the state of the catchment to both raise awareness of pollution risks and to stimulate response by the appropriate authorities.

2.5 Groundwater protection

Groundwater requires a special mention because it usually requires special efforts to protect it from pollution. General pollution control for discharges and measures taken to prevent non-point source pollution on land can apply equally to groundwater protection; practically any activity on the surface can have an effect on the quality of underground water. Being out of sight, it is not always apparent that damage has been, or is being, done to the groundwater resource and yet clean-up of groundwater pollution is expensive and may take hundreds of years.

The need to prevent groundwater pollution is therefore important because of the long term impact as well as the dependency on groundwater resources for many drinking water supplies.

The concept of groundwater pollution risk is based on the interaction between the potential pollution load and the vulnerability derived from the natural characteristics of the strata. Critical areas for groundwater pollution are determined by comparing the vulnerability map with a potential contaminant load map drawn up on the basis of records of industrial activity, urban development, mining activities, waste disposal sites, and agricultural field.



The framework for groundwater pollution control requires measures such as:

- Identification of threats to groundwater from point or diffuse sources, and by both conservative and degradable pollutants in the basin;
- Classification of groundwater in terms of vulnerability and definition of source protection zones; and
- Policies and strategies on how polluting activities may be controlled to reduce or to eliminate the risks.

6

Box 6.2: Applying a mix of regulation and economic instruments

Prior to 2006 the majority of businesses in Kigali disposed of their wastewater on-site Growing concern for groundwater quality drove the city authority to forbid underground disposal of wastewater and issued a time-bound notice to major businesses to attain minimum effluent standards before discharging to the storm water drains. Stiff consequences were specified for non-compliance. National government in consultation with Rwanda Environmental Management Agency, have provided tax waiver on purchase of technology that protected the environment. A good number of the polluters have complied and because the effluent standards were very stringent, many have opted to re-use the water for non-potable purposes.

3. Planning for Pollution Control

Pollution control planning comprises the following elements:

- Identification and initial analysis of water pollution problems and future predictions;
- Define management objectives and strategy;
- Derive management interventions, tools and instruments needed to fulfil the pollution management objectives; and
- Establish an action plan for implementation, monitoring and updating of the plan.

3.1 Problem identification and analysis

The first step is identification and assessment of existing and potential water quality problems. The objective of the assessment is not to solve the problems but to identify and list the problems, and to identify priority areas within which more detailed investigations should be carried out.

Box 6.3: Impact of pollution

Hartebeesport dam in the North Western Province of South Africa was completed in 1924 and is an important source for water supply and irrigation water for commercial farms downstream. Gradually, discharges from wastewater treatment plant and municipal areas around Johannesburg and Pretoria have increased the pollutant levels in the feeding streams, and eventually resulted in algal blooms and high pollutant levels in the dam water. This change in the water quality has rendered dam water unsuitable for tobacco farming. Consequently, the farmers downstream of the dam were forced to alternative crops. A nearby water supply treatment facility also indicated that it now costs much more to treat water.

a) Categorisation of water quality problems

Identified water quality problems may fall into different categories requiring application of different management tools and interventions for optimal resolution of the problems.

For example, if a problem exists at the basin scale it might be necessary to consider imposing general effluent standards, regulations or other relevant measures. In contrast, if the problem is limited to a small geographic region it might only be necessary to consider local regulation or intervention to settle a dispute.

It may also be useful to categorise water quality problems as either "impact issues" or "user-requirement issues". Impact issues are those that result in environmental damage or impact for example on the health of the community downstream. User-requirement issues are those which derive from an inadequate matching of user-specified water quality requirements (demand) and the actual quality of the available resources (supply) (Box 6.3).

b) Prioritisation of action

Even if all existing and potential water quality problems could be identified it is not feasible to solve them all at once and priorities have to be established.

The process of assigning priority to water quality problems requires a management decision and some important aspects to be considered include:

- economic impact
- human health impact
- impact on ecosystem
- duration of impact
- type of pollution
- geographical extent of impact

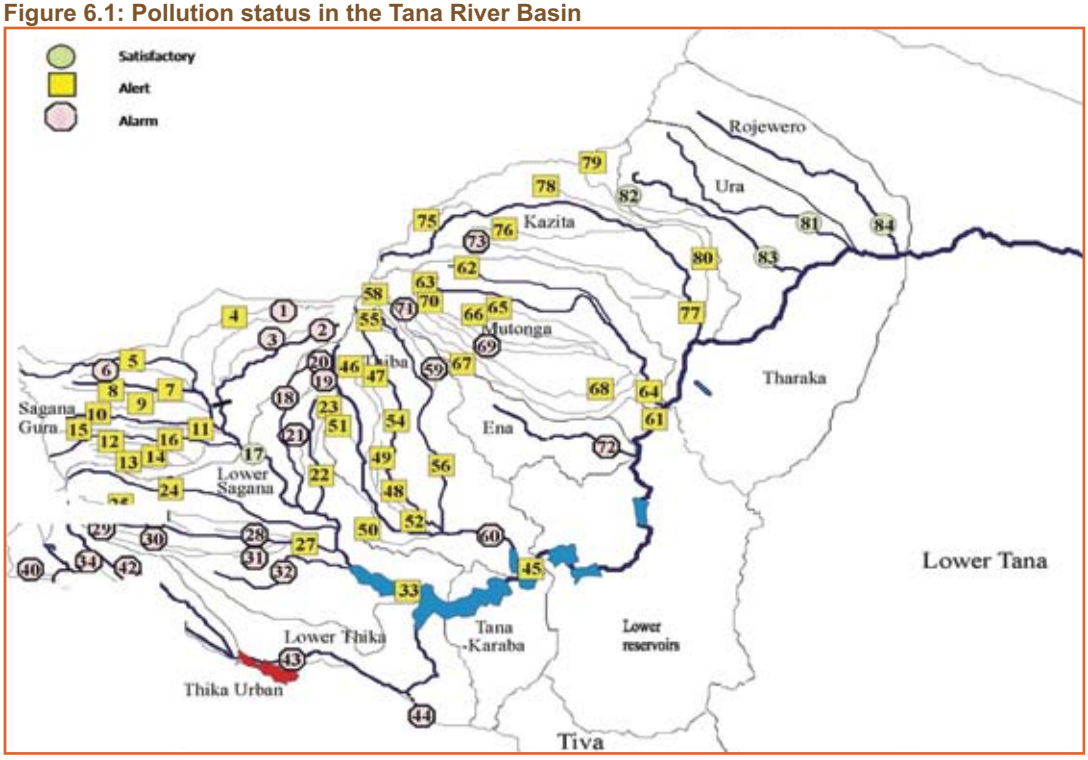
As an example, the uncontrolled growth of water hyacinth in a water body may lead to a deterioration in water quality from oxygen depletion, may also hamper navigation, affect fishing and increase the cost of water supply treatment with considerable economic consequences. Thus, based on this simple analysis, combating the proliferation of water hyacinth should be given a higher priority than might be indicated by purely environmental considerations.

Box 6.4: Pollution is a political issue

It is sometimes easy to set up the pollution management system but often difficult to implement. One of the main reasons for this is that government is the regulator but often the most significant polluter. In South Africa the management of pollution is the responsibility of the Department of Water Affairs and Forestry. They find it very difficult, if not impossible, to prosecute another arm of government, the Local Authority, who are responsible for much of the pollution occurring from inadequately treated sewage.

For ease of communication with stakeholders and measuring progress it is common that the quality of water resources in a basin is classified using a simple colour coding on a map. This is a very effective tool to mobilise support from politicians and others to the action plan.

Figure 6.1: Pollution status in the Tana River Basin



3.2 Management objectives and strategy

Establishing objectives for water pollution control, is essentially a definition of the contribution to the ultimate goal which might only be achievable after some considerable time due to financial, human or other constraints. The more separated the objective is from the initial situation the more difficult it is to achieve because a lot of assumptions and uncertainties need to be included.

a) Objectives

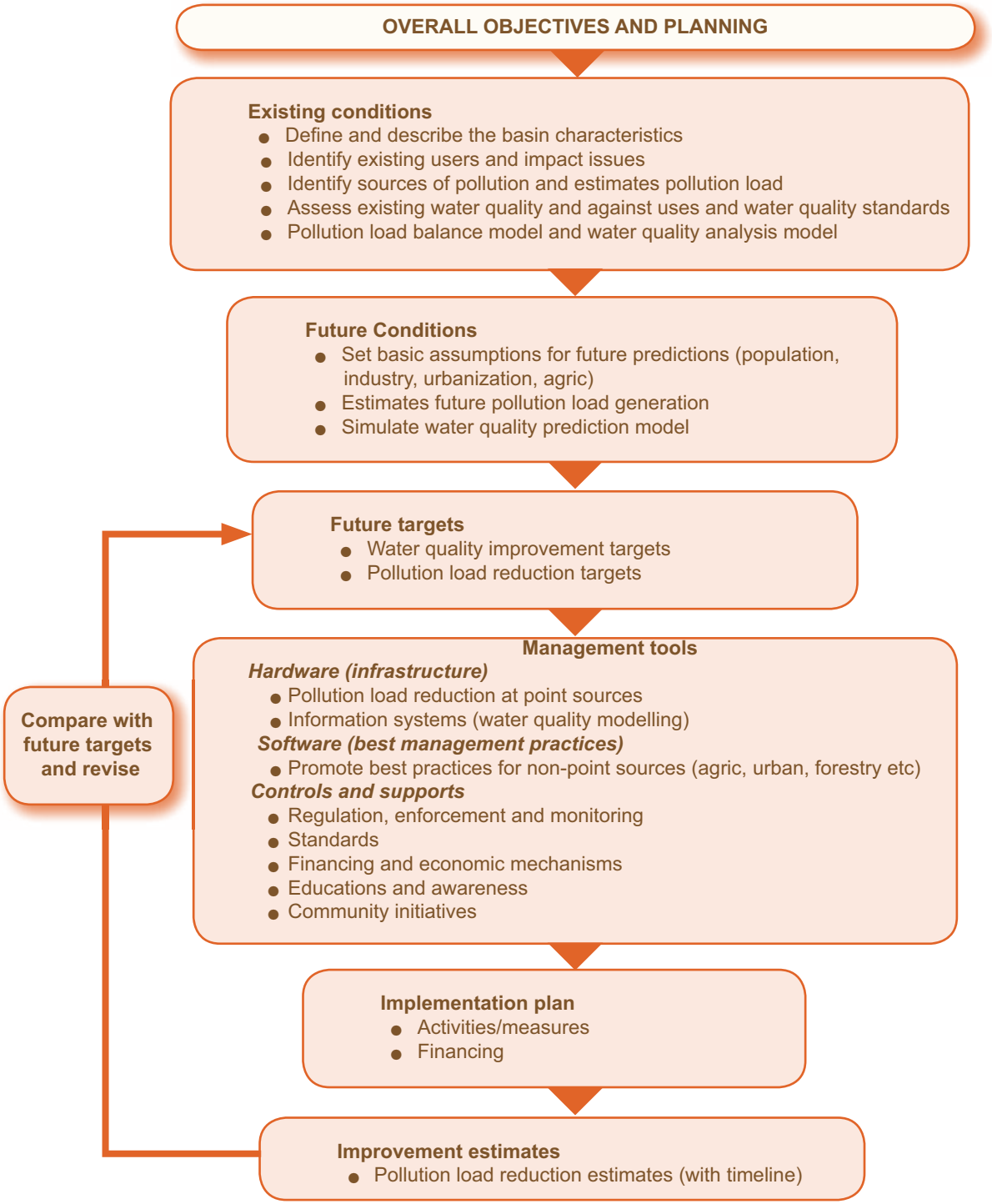
Water management objectives for pollution control need to be realistic and measurable such as those under 2.1 above. The objectives identified also provide a means by which the performance of the responsible organisation will be measured and it is in everyone's interest that they be realistic.

If the present situation is characterised by extremely scarce financial and human resources and major obstacles to economic and social development, it would not be appropriate to define very high standards of water pollution control in the objective, simply because this situation would most likely never occur.

b) Strategy Development

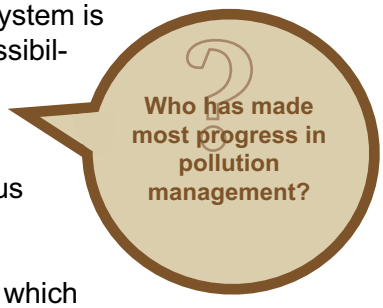
Strategy development involves making important decisions on how to implement the programme. The strategy decision will be influenced by cost, feasibility, human resources, legal and regulatory framework as well as effectiveness.

Figure 6.2: Overview of the process for preparation of a pollution control plan



Documenting the polluters and establishing a permit system for major polluters is one

important step but the successful implementation of the management system is affected by such decisions as monitoring, fees and charges and the possibility of effective action for non-compliance (Box 6.4).



Generally for resource constrained basin organisations it is better to:

- Use the permit conditions to require self monitoring and reporting thus shifting much of the burden to the polluters;
- Use fees and charges to fund the pollution control system;
- Use administrative tools to punish offenders rather than prosecution which can be expensive and not often successful.

Always check strategy decisions against resources and revise the strategy rather than think additional resources will suddenly be made available.

4. Planning and Implementation

From the strategy we derive the action plan, a list of actions proposed for implementation in order to achieve the water management objective. Pollution control will have no significance if the plan is not implemented and phased implementation may be necessary.

The design of phases may consider:

- *Cohesion*. Some actions may cluster together;
- *Conditionality*. Actions to provide basic conditions e.g. creating legislative framework to establish the enabling environment and institutional structures;
- *Dependency*. Actions that must precede others, staff recruitment before staff training can start; and
- *Urgency*. Actions are ranked as high priority.

Key management tools and instruments used for implementing the pollution control programme are briefly listed below. Each tool can be used in a variety of ways according to the circumstances. The manager's task is to decide which tool(s) will most adequately solve the present water pollution problem and to ensure that the selected tool(s) are made available and operational within the appropriate institutions.

Box 6.5: Use of management tools to achieve desired effects

Sweden in the 1970s had a widespread pollution problem because of nutrient enrichment in the water bodies. Consequently, it was required that all water treatment facilities introduce biological treatment stage for removal of nutrients particularly nitrogen and phosphorous. At the same time a tax was introduced for use of fertilizers. 30 years later, there has been an enormous improvement in the water body quality.

a) Regulations and management procedures

Regulations are the supporting rules of the relevant legislation. Only regulations that are enforceable should actually be implemented otherwise they should be amended or abandoned. Management procedures define a process for consistent response in decision making. e.g. procedures to apply for a pollution permit.

b) Water quality standards

Water quality standards may be part of regulations or management procedures defining acceptable minimum standards for discharge to a receiving water body. However it is important that the standards link to the capacity to measure and determine the water quality. This requires access to quality assured laboratory services for both the permit holder and the basin organisation.

c) Economic instruments

Application of economic instruments in water pollution control should offer incentives to reduce polluting behaviour and also raise revenue to help finance pollution control. This can be a simple and effective tool when applied properly.

d) Monitoring systems

Monitoring systems can be simple or complex. Preferably the monitoring burden is shifted to the polluter with periodic supervision by the regulator. Surface and ground water quality should be monitored from fixed stations but supplementary information can be obtained from useful tools such as biological indicators that can even be used by schoolchildren to assess river health.

e) Discharge Permitting

In a majority cases 80% of the pollution problem is contributed by less than 20% of polluters, hence the phased application of the permit system is appropriate by targeting the worst polluters first. Ordinarily, the permit will come with conditions e.g. effluent standard, discharge volumes record keeping and reporting requirement etc.

f) Water quality modelling tools

Modelling tools may be helpful in complex situations and when receiving water quality objectives are the basis for pollution management.

g) Environmental impact assessment

Environmental impact assessments are being used increasingly so as to identify potential impact on water quality arising from proposed projects and provide, information to mitigate potential impacts

5. Lessons

- Water quality is a major water resources management issue.
- A Pollution control strategy is based on current and desired status of water resources quality.
- Major polluters should be known and managed through a permitting system.
- Pollution control measures should match the level of human, technological and financial capacity in the basin.

Box 6.6: HOW ARE YOU DOING?

Measure progress with pollution control in your basin:

- Is the extent and seriousness of surface and ground water pollution known?
- Are polluters licensed according to the regulations?
- Is there compliance with pollution permits/ licenses?

Web References

Water Pollution Control - A Guide to the Use of Water Quality Management Principles. Edited by Richard Helmer and Ivanildo Hespanhol, 1997 available at: http://www.who.int/water_sanitation_health/resourcesquality/wpcbegin.pdf

EXERCISE
Pollution Management

Purpose: To share experience on the implementation of pollution control systems.

Activity: Organise groups (not more than 4) by river basin. 1 hour.

Each group to address the following questions:

- What is the scale and type of the pollution problem in the basin?
- How are the roles and responsibilities for pollution control allocated in your basin?
- Does it work?
- What changes are required to have more effective pollution management?

Report back: 30 minutes.

Facilitator: It is possible that there are minimal criteria for allocation, discuss the implications of this.

Module 7: Monitoring Systems

Learning Objectives

- Appreciate the need for monitoring as a basis for river basin planning and enforcement of water allocation and pollution control.
- Learn the methods and management of monitoring water resources and water use.
- Learn the methods and management of monitoring pollution and water quality.

1. Introduction

Monitoring of water resources, water quality, water use and pollution discharges is essential for effective water resources management. Even if it is not given as a direct regulatory responsibility the river basin organisations thus need to address monitoring as one of their basic functions for conducting water resources management at the basin scale.

This module addresses the two major reasons for monitoring: **planning** and **enforcement** (Section 2) and describes the methodology and management for monitoring surface and groundwater resources (Section 4), water use (Section 5) and water quality and pollution discharge (Section 6).

The link to water resource management functions of basin planning, water allocation and pollution control is therefore obvious. However, also the links to other functions are important to note. Monitoring of compliance and acceptance of produced data is difficult without the involvement of the stakeholders. Similarly, financial management tools such as water tariffs and the polluter-pays-principle are essential to find the economical resources for measurements and to motivate self-monitoring. Information management is also important to disseminate the monitored information. Measurements are never meaningful if the results are gathering dust and are not analysed, presented and used.

Box 7.1 WHAT ARE MY FIRST OBJECTIVES?

My water management objectives for Monitoring in the basin are:

- Develop a reliable knowledge base of water resources availability as a basis for management.
- Ensure that the water allocation system is effective and permits are being complied with.
- Ensure that the pollution control system is effective and permits are being complied with.

2. Why do we Need to Monitor?

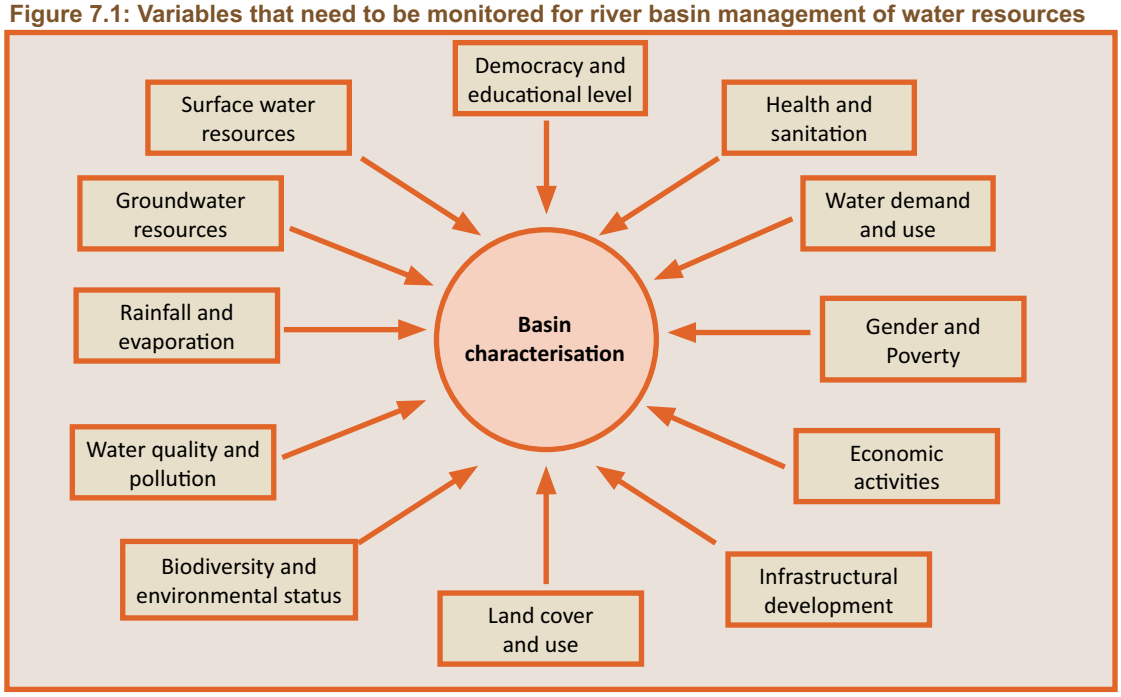
2.1 Monitoring for planning

How should monitoring information be used?

Monitoring of the biophysical environment and the socio-economic situation is fundamental for sound planning and efficient and integrated management of river basin water resources.

Besides general geographical information such as topography, geology and soil, Figure 7.1 illustrates what should be monitored on a continuous or regular basis for IWRM. The monitoring of these variables provides the foundation for the basin characterisations used for basin planning and water allocation (see modules on Basin planning and Water allocation). This basin characterisation is often called a basin monograph and should regularly be updated to ensure that management is made with the latest data and information. The river basin organisation being a central point for the water resources management should be responsible for producing the basin characterisation and thus also monitoring activities in the basin.

Figure 7.1: Variables that need to be monitored for river basin management of water resources

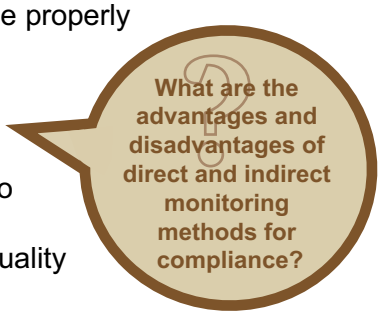


Monitoring is conducted to assess, average values and conditions, spatial variations within the river basin, temporal variation over time, and trends and development directions. Considering the different variables in Figure 7.1 it is obvious that the requirement of details is very different. Assessment of surface water resources will need continuous measurements of river flows, while demography and economical activities may be sufficient to review every fifth or tenth year.

In most cases it is economically impossible for an RBO to have the human skills in-house for conducting all types of monitoring. Normally monitoring of variables such as socio-economic conditions, land cover, biodiversity and environmental status, is made available from other agencies who are stakeholders in the Basin Planning process.

2.2 Monitoring for enforcement

Monitoring of water resources, water use, water quality and environmental status is very important for enforcing water allocation and pollution control decisions. Ensuring that individual water users or polluters stick to the rules is a fundamental part of building trust for a water allocation and pollution control system. This is essential both for the authorities and stakeholders. Monitoring means that review mechanisms have access to actual observed data so that complaints or challenges can be properly investigated.



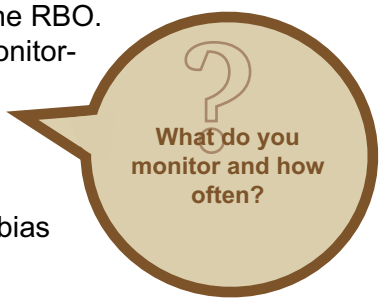
Compliance can basically be monitored in three ways:

1. Direct monitoring – is the measurements of volume of water that is abstracted or mass of pollution effluents that are discharged to the river;
2. Indirect monitoring – is the measurements of river flows, water quality and aquatic ecological status in the downstream river; and
3. Indicative monitoring – is the measurements of variables governing use or pollution, e.g. such as area of irrigated land with a certain crop or amount of applied fertilisers.

Normally a monitoring system based on a combination of the above is applied. A system where all abstractions and pollution discharges are measured both directly and indirectly is, however, extremely costly in terms of financial and human resources. Often the direct monitoring for compliance is therefore applied as self-monitoring where the water users or polluters are required to monitor themselves and report to the regulator.

The responsibility for direct monitoring should, however, preferably still be with the authorising institution. Even if the monitoring is conducted by the user or polluter, the RBO should remain with the right to set minimum requirements on the methods and equipment used for measurements and with the right to make control inspections whenever necessary.

Indirect monitoring for compliance is normally conducted by the RBO. The main reason is that it is possible to combine it with the monitoring for planning purposes. The indirect monitoring is also a powerful tool to efficiently control and follow up the sustainable management of the river basin's water resources and should therefore be the responsibility of the authorities rather than of stakeholders that may have self-interests, which may bias the outcome.



3. Monitoring of Water Resources

The importance of prioritisation

To conduct monitoring of water resources, the most fundamental step for an RBO with limited human and financial resources is to build up a network based on priority gauging stations. **It is better to have a few carefully selected gauging stations that give reliable results than many stations that give uncertain results.**

Box 7.2: Unreliable water resources data

In the Pungwe River in Mozambique (catchment area 31,150 km^2) river runoff data exists from 25 gauging stations. An assessment of the data quality found that:

- 2 stations give reliable data;
- 7 stations give uncertain data that maybe partially used; and
- 16 stations give unreliable data that should not be used for any water resources assessments

Many RBOs make the mistake of choosing too many primary stations or not doing any prioritisation at all. This leads to uncertain or even unreliable records. For river basin planning this is very hazardous since an erroneous record may lead to the wrong decision on water development or water allocation.

The stations measuring river flows should be divided into different categories:

- **Primary gauging stations** – These are stations that aim to give the reliable long-term water resources of the river basin. The requirements of accuracy and consistency of these stations are very high;
- **Secondary gauging stations** – These are stations that support the primary stations but are more focused on compliance. These stations are mostly targeted to identify changes rather than the long-term averages; and
- **Tertiary gauging stations** – These are stations that are temporarily set up for specific studies, such as infrastructural development or environmental investigations.

The primary stations should therefore be chosen based on three criteria:

1) There should be an even coverage over the river basin and some stations should measure natural conditions;
2) The site should enable accurate and consistent measurements; and
3) The station should be easily accessible and possible to maintain within available resources.

Since primary stations should produce reliable long-term data they should preferably be chosen at sites with already existing records. The number of primary stations obviously depends on the scale of the river basin but as a general rule they should not be more than 10.

Box 7.3: No pay no work

Many gauging stations in developing countries fail to produce data just because the observer is not paid.

Secondary stations should be located specifically to target monitoring of large artificial influences. The spatial location should target major users. The purpose of measurements is compliance and the need for long-term data is therefore less. To save resources secondary stations may only be operated during part of the year, e.g. in the dry season to monitor minimum river flow. The number of secondary stations varies with the need to check compliance and with the available resources.

Tertiary flow stations are normally located specifically at the site for future infrastructural development for design purposes or for special studies targeting e.g. environmental issues. These stations are often initiated, funded and operated by a stakeholder.

Monitoring surface water resources

Figure 7.2: Example of a runoff station

River flow is computed from observed water stage readings upstream of a gauging station. The water levels are monitored manually via scales or with an automatic recorder. To be able to calculate river flow an unambiguous relation, called rating curve, between the water level and the river flow is needed. The reliability of the river flow data is directly dependent on how well the rating curve describes the relation between water levels and flow.

Primary gauging stations must therefore be carefully chosen to ensure good conditions for establishing the rating curve and the institutional capacity of the RBO must be enough to ensure regular maintenance of the stations.

Monitoring groundwater resources

Monitoring of groundwater levels is important to assess changes. This could be to register trends due to groundwater abstractions or due to natural causes. The RBO should therefore have primary, secondary and tertiary monitoring stations for groundwater levels. The number of stations for each category depends on how important groundwater is for the water resources of the river basin and how much abstractions are made.

Long-term groundwater yield cannot be estimated directly through continuous monitoring. The hydraulic conductivity and recharge rate of groundwater aquifers are instead assessed through general knowledge about the geology and soil, test drillings, geophysical investigations and test pumping. These assessments of the groundwater availability are essential for deciding major groundwater abstractions and should be part of the RBO functions. Since the main user of groundwater normally is rural water supply the responsibility and funding of these groundwater assessments are in many cases shared with the local government, water utilities and NGOs.

Can you give a good, or a bad, example of groundwater monitoring from your own experience?

Monitoring rainfall and evaporation

Figure 7.3: Pan evaporation and rainfall measurements

To support the water resources assessment it is further important to monitor rainfall and evaporation. Rainfall is relatively simple to measure and data on rainfall and evaporation is normally available from the national meteorological organisation.

Rainfall is essential to understand the climatic variability of the river basin, to provide inputs to hydrological models

for water allocation and for design and operation of rainfed agriculture and rainwater harvesting.

Funding for water resources monitoring

The interest and benefit of monitoring water resources is shared between the national government and the stakeholders of the river basin and should therefore be sourced from them. River basin organisations may have the power to charge an administrative fee to water users that may partly or completely cover the costs of monitoring.

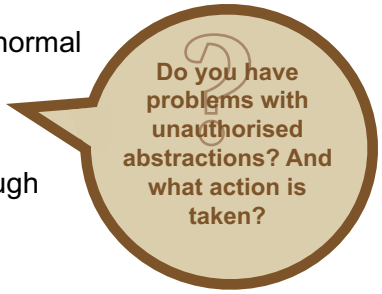
4. Monitoring of Water Use

4.1 Monitoring abstractions

Water is normally abstracted through pumping of surface or groundwater or by gravity from rivers/ streams. Measuring equipment exists to directly measure piped and channel flow but since these measurements are associated with costs the normal way of continuously measuring water use is based on:

- Pump capacity and time of operation;
- Area of irrigated land;
- Time and level of gate opening for channel intakes; or
- Fees generated from sold water.

A combination of self monitoring plus external supervision is the normal monitoring procedure. The monitoring is thus very cost-efficient. The disadvantage with the self-monitoring methods is that the uncertainties may be very large with a tendency to under-report. Control measurements by the RBO or local water user groups may be enough to limit abuse of allocation permits or unauthorised abstractions.



4.2 Funding of water use monitoring

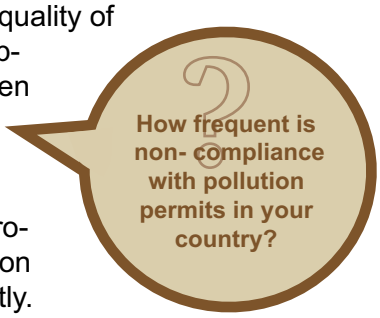
The self-monitoring of water use should be a condition for an approved water permit and the cost should be covered by the water user. The funding of control measurements is normally covered by the RBO but funded from water allocation fees.

5. Monitoring of Pollution and Water Quality

5.1 Pollution

Similar to the monitoring of water resources and use, pollution can be measured directly at the source and indirectly in the downstream river reaches. For any stakeholder given a permit to discharge pollution to the river it should be with a condition to monitor the load to the river.

Ideally a permit for the disposal of waste into a waterbody should state the permitted volume and permitted contaminant levels of the discharge. The permit holder has the responsibility to measure, and report on, the volumes and quality of waste discharged and also the quality of the receiving water upstream and downstream of the discharge point. The RBO is then relieved of much of the monitoring burden and can focus on spot checks to verify that the reports from the permit holder are accurate. The monitoring system should be such that non-compliance with the permit can be identified and appropriate action taken.Avenues for the community to report pollution problems should be clear and complaints responded to promptly. This will engender trust in the system and improve compliance.

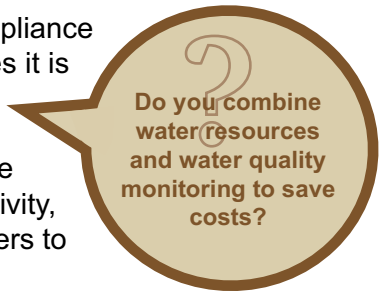


5.2 Water quality

The RBO also needs a water quality network to monitor background load (natural conditions) and accumulated pollution effects along the river reaches. The water quality monitoring network should be designed along the same principles as the one for water resources, with primary, secondary and tertiary stations.

Water quality measurements **demand a lot of resources**. Although continuous measurements should ideally be made it is in practice impossible to implement with normally available institutional resources. The standard method for monitoring water quality is by water sampling and laboratory analysis. For some substances or parameters it may be possible to do in-situ measurements in the field. Both sampling and in-situ measurements are time and resource demanding and therefore it is normally only conducted on a weekly or monthly basis or even less often. To monitor pollutant load also the river runoff is needed. At least the primary water quality stations should therefore be located at river flow gauging stations.

Secondary water quality stations are focussed to monitor compliance with pollution regulations and permits. Since they target changes it is therefore sufficient to only monitor concentrations, which means monitoring can be more cost-efficient and located independent of flow gauging stations. For many substances it may also be possible to use indicator parameters, such as electrical conductivity, pH and dissolved oxygen, which enable the number of parameters to be reduced.



It is essential that the RBO plans and operate the water resources and quality monitoring networks in conjunction. The institutional capacity building for water and quality monitoring should go hand in hand, which will give many opportunities to save costs and improve accuracy.

5.3 Monitoring of environmental status

An alternative to water quality measurements for analysing the effects of pollution is to use biological indicators. This alternative has been promoted during the last decades and is for example recommended by the European Water Framework Directive. The advantage is that it directly monitors the total effects on flora and fauna of the pollution and alteration of flow regimes.

Using biological indicators reflect the results of pollution over a period of time whereas direct assessments of pollutants can only measure what is in the water at that moment. The simplicity of many biological indicator systems means that river health can be monitored regularly by interested community groups or by schools.

Box 7.4: Measuring River Health

In South Africa species inventory cards have been developed for school children to follow up the environmental status of the water resources. Through simple inventory of invertebrates from water sampling the students can classify the status of the water by help of the cards.

5.4 Laboratory analysis

Water quality measurements include another step: laboratory analysis. Analysis of water samples is a complex science by itself and it is usually better, for the purposes

of prosecuting offenders, if the analysis is out-sourced to an independent laboratory which has a quality assurance accreditation.

5.5 Funding of pollution and water quality monitoring

The funding of pollution and water quality monitoring should be a mix between the national government and the stakeholders. Similar to water resources there is a national interest to monitor the status of the natural resources and the primary stations should therefore be covered by governmental funds. The costs for the indirect monitoring of pollution, water quality and biological indicators should however be covered by the polluters through the polluter-pays-principle. The cost for self-monitoring should be covered by the polluter.

A sensitive issue is the payment for laboratory analyses. If the demands are set very high on sampling and laboratory standards the cost may be considerable and the possibility to fund this may be out of hand for many stakeholders. The general recommendation is to reduce the number of samples rather than decreasing the quality of the methodology.

6. Lessons

The major lessons are:

- Monitoring of water resources, water use and pollution is necessary for both planning and compliance purposes;
- Prioritisation must be made to ensure that at least a number of primary stations in the river basin produce reliable data within the available human and financial resources of the RBO;
- Compliance should be monitored both through self-monitoring of abstraction/discharges as well as through spot checks; and
- Emphasis should be given to good sampling and laboratory practices when monitoring water quality and pollution discharge.

And finally: Do not forget that **no monitoring is meaningful if the results are not managed, used and disseminated back to the stakeholders.**

Box 7.5: HOW ARE YOU DOING?

Measure progress with monitoring in your basin:

- Is there compliance with water allocation permits?
- Is there compliance with pollution permits?
- Is the groundwater and surface water monitoring network producing reliable and usable data?
- Are groundwater levels declining?

EXERCISE
Monitoring

Purpose: To share information on the monitoring systems implemented in the basin.

Activity: 1 hour

Select two river basin representatives to provide a 15 minute presentation of their monitoring system. The presentations will be followed by discussion. The presentation should cover:

- Scope of the monitoring programme
- How it is achieved (stakeholders, RBO etc)
- Effectiveness in terms of data quality and completeness

Facilitator: Request the presenters to prepare the day before.

Module 8: Information Management

Learning Objectives

- Appreciate how information management supports effective water management in a river basin.
- Understand the information management process and know some of the tools used in information management.
- Identify important information management outputs and how they are disseminated.

1. Introduction

IWRM, in the context of a river basin, is about management of the limited water resources in a river basin for an optimum outcome among different competing water users. Thus, comprehensive, accurate and timely information is necessary for objective planning, decision-making and for gaining support from competing river basin stakeholders. However, the reality is that most RBO are under-resourced, both in terms of financial and human resources. Thus, there is a need for RBO managers to understand the main IWRM issues in a river basin and prioritise the types of information that they need to collect (separating the essential from the non-essential) to address the identified issues. Deciding on what to report, to whom and how to communicate the report to the relevant stakeholders is the final most important step.

Thus, for effective implementation of IWRM in a river basin there is a need for an information management function to be carried out by an Information Management Unit (IMU) within a relevant RBO.

Box 8.1: WHAT ARE MY FIRST OBJECTIVES?

My water management objective for Information Management in the basin is:

- To ensure that essential information is managed and disseminated to managers and stakeholders so as to support transparent decision-making and to gain commitment and political support for the decisions made.

To implement the above objective the IMU needs to adopt a systematic process to manage the required information, using relevant information management tools, to produce and disseminate the desired outputs for managers and stakeholders. The details are described below under the following 3 topics.

- The information management process
- Some information management tools
- Information management outputs

2. Information Management Process

Figure 8.1 shows the generic information management process steps that can be used to manage and derive any desired information for decision-making and informing stakeholders. An example of the application of the process for the water allocation issue is described below.

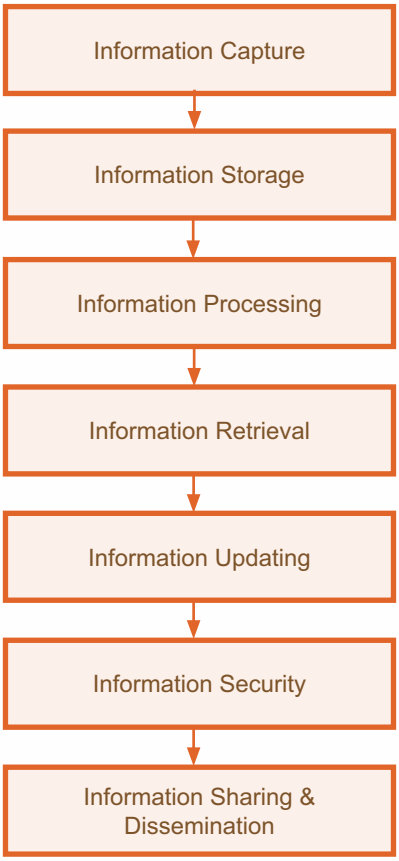
2.1 Information Capture

The first step is to decide "what" and "how" to capture the desired information. The "what" will be defined by the priority information needs of the users, in accordance with the IWRM objectives in a river basin. A list of the required information will then be produced.

For the water allocation issue, information on how much surface and groundwater resources are available in the basin, who are the current consumers of the water resources, how much are they consuming, what are the conflicts between the water users and how the competing users can use the limited water resources in an equitable and efficient way has to be derived.

The required information will most probably be processed information. For example the amount of surface and groundwater resources available will be derived from the processing of the monthly and annual rainfall, stream-flow, and evapo-transpiration in the basin. This will mean that there is a need to identify the raw information (rainfall, stream-flow and evapo-transpiration) required to derive the desired processed information.

Figure 8.1: Information Management Process

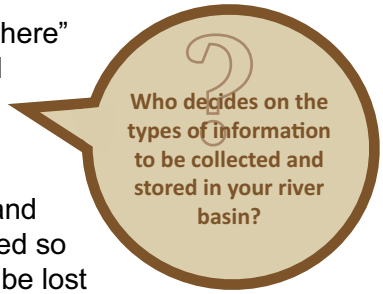


Once the raw information is defined there is a need to define the method to capture each of the raw information. The methods used can be simple or complex, depending on the desired levels of accuracy and timeliness of information, and the technical and resources constraints. For example, the methods and equipment to measure rainfall, streamflow and evaporation can be quite simple or complex, cheap or expensive, manual or automated, depending on the human and financial resources constraints.

Ideally, in defining what information to be captured a scientific approach should be adopted. This is because what ever information that is not collected, especially those related to the physical, hydrological processes in a river basin will be lost forever. However, the reality of resources constraints usually makes it impossible to achieve the aim.

2.2 Information Storage

Once information is captured there is a need to decide on "how" and "where" to store the captured information. The information can be stored in hard copies and stored in paper files in a filing cabinet. It can also be stored in electronic media such as CDs/DVDs and in computer hard-disks. It can also be stored in a computer server for access by network users, both in-house and on the Internet. There is also a need to decide how and where to store the raw rainfall, streamflow and evaporation data collected so that it can be easily accessed by users, and to ensure that they will not be lost due to staff transfers or administrative or technological changes over time.



2.3 Information Processing

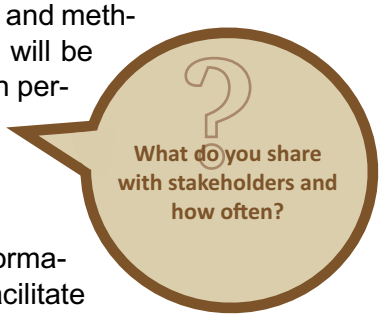
The desired information will normally be processed from raw data or other lower level information. Thus, there is a need to decide on the level of processing and quality control required to produce the desired information from the raw data and lower level information, and also to define the processing methods to be used.

2.4 Information Retrieval

The information that is stored needs to be retrieved subsequently for use. Thus, there is a need to decide on the procedures and methods that will be used to retrieve the stored information.

2.5 Information Updating

The stored information has to be updated on a regular basis to ensure that they are current. Thus, there is a need to decide on the frequency of updating and methods/procedures to be used to update the information. Much of this will be driven by the management systems e.g. monitoring frequency, when permits are allocated etc.



2.6 Information Security

There is a need to decide on the level of security for each type of information so that they can be grouped and stored accordingly. This will facilitate the process of defining access control to the information by approved users. The RBO may decide to provide some processed hydrological information for free to the public, but restrict access to the raw and detailed information for designated persons only.

2.7 Information Sharing and Dissemination

There is a need to decide what information to be shared, what methods to use to disseminate the information and in what form to support decision-making and keep stakeholders informed. The choice of methods will depend on the resources available and the target audience of the information. The methods can range from the simple preparation of regular hardcopy reports and newsletters, to dissemination through the electronic media of CDs and websites. In order to promote transparency the RBO may decide to publish the list of water users and their monthly water consumptions to all users. The RBO will need to decide the methods of transmitting such information to the users and also how to respond to queries on the published information.

2.8 Information Management Plan

The above systematic process to identify the information management requirements, without any human and financial resources constraints, will enable the RBO to define its “ideal” information management plan. However, the reality of human resources and financial constraints will limit an RBO’s ability to collect, analyse, interpret, use and share the information. Thus, the RBO has to prioritise its information collection and processing to derive the necessary information outputs to address the pressing IWRM issues in a river basin. The output from the prioritisation exercise will be an appropriate Information Management Plan that meets the immediate IWRM needs of the basin and which can be implemented by a resource-limited RBO.

One effective method to achieve this prioritisation is to look at the progress or performance indicators for the organisation and make sure that the data is collected for these indicators to be reported on.

The above systematic exercise may also help the RBO defines the information management capacity building needs and also the possible areas where investments in technical improvements and systems can be made.

3. Information Management Tools

The Wikipedia definition of "Information Management" is "The collection and management of **information** from one or more sources and the distribution of that information to one or more audiences. This sometimes involves those who have a stake in, or a right to that information. **Management** means the organization of and control over the structure, processing and delivery of information.

With the advances made in Information and Communication Technologies (ICT) the process of collecting, processing, storing and delivery of the information has changed a lot. To facilitate the organisation and classification of information it will be useful to know what are the generic information types and their characteristics. Also, it will be useful for the IMU to know the possible types of information management tools that may be available to them and how it can work with ICT specialists in developing and customising such tools to support its operations.

3.1 Information Types and Their Characteristics

Table 8.1 below gives a list of the basic information types and their characteristics.

Table 8.1: Information types and their characteristics

Information Type	Characteristics
1. Static Info	Static information does not change with time. They are typically information used to identify an object and those relatively time-invariant characteristics of an object, such as a river name, river length, basin size, etc.
2. Dynamic Info	Dynamic information varies with time, e.g. river flow data, rainfall data, water quality data, etc.
3. Raw data	Raw data are information recorded by a measuring equipment or derive from a survey.
4. Processed Info	Processed information is information that meets a defined need and is processed from raw data.
5. Report-type Info	Report-type information is a combination of text, figures and tables, organised within a set of narrative text.
6. Spatial-type Info	Spatial-type information is information stored in the form of maps and is geo-referenced to a map.

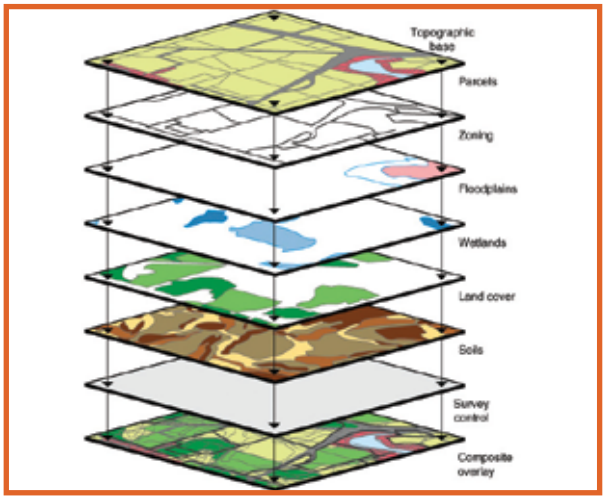
3.2 Examples of Some Information Management Tools

The rapid advances in ICT have enabled a number of new information management tools to be developed and thus assist an RBO in its information management tasks. The new tools have enabled more information to be generated, processed and disseminated compared to the past.

Dedicated data processing systems and databases
Dedicated data processing systems can be developed to process raw data for storage in databases. The systems are normally developed based on the specific information needs of the users and follow a very clear set of information processing procedures.

Geographical Information System (GIS)
A Geographical Information System (GIS) uses the powers of a computer to display and analyse spatial data that are linked to databases. It has been developed specifically to process spatial-type information. Figure 8.2 shows an example of how a GIS is used to overlay different thematic information layers to derive a new map with a new set of geo-referenced objects to solve a specific problem. When a specific database is updated, the associated map will be updated as well. The GIS databases can include a wide variety of information such as geographic, social, political, environmental, and demographic.

Figure 8.2 Example of GIS thematic layers
(Source: http://www3.shastacollege.edu/dscollon/images/GIS_layers.JPG)



"Google Earth" Program
"Google Earth" (http://earth.google.com) is an Internet application program that was developed by Google Inc. that combines the power of the Google Search engine with satellite imagery, maps, terrain and 3D buildings to put the world's geographic information at the fingertips of any Internet user. Most of the satellite imagery used is about one to three years old. Through the use of the free Google Earth program, any Internet user can zoom to any part of the world and have a bird-eye's view of the area of interest. Thus, it will be a useful tool for any RBO information manager.

Web-page type Content Management System (CMS)
The web-page type Content Management System (CMS) uses the Internet standard of presenting linked web-pages to organise and present report-type information. There are many types of CMS available in the market. An example of such a system is the MultiCentrix Information Networking system (http://www.multicentric.com), which facilitates the mapping and publishing of reports in various electronic formats (PDF, HTML, CHM), and also allows the outputs to be uploaded onto a web server for access by any internet user. Report-type information is the most common type of information used by stakeholders in making decisions. Therefore the use of a CMS to store and publish report-type information electronically, either on the Internet or in the form of a CD/DVD, will enable an RBO to disseminate and share information in an effective way.

3.3 Guidelines for the Development of ICT Systems

Due to the numerous reported failures and bad experience of water managers in the application and use of ICT tools and ICT systems to support their operations the following guidelines will assist the IMU in the development of ICT systems:

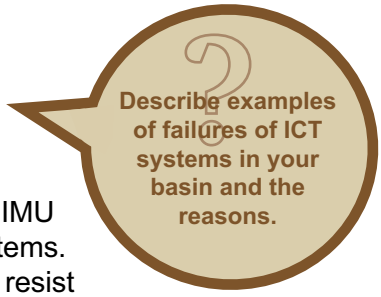
- Develop the Information Management Plan
  The IMU must first develop its Information Management Plan for its river basin, as described in Section 2. By working through the series of steps in the information management process to arrive at the Plan the IMU will gain an in-depth understanding and appreciation of the information management needs of the water managers and stakeholders in a river basin. The IMU will then be able to provide guidance to the ICT specialists on what it needs to support its operations. The Plan will also assist the ICT specialists in advising the IMU on the possible areas where ICT tools may be applied to increase the effectiveness of the IMU.

- Employ a Multi-disciplinary Project Manager
  A frequent cause of failure of the application of ICT tools is due to the lack of technical leadership in the ICT project. The project manager of an ICT project must have a multi-disciplinary background, with knowledge/experience in both water resources management and ICT. This will ensure that the project manager can appreciate and understand the information management needs of the water managers and stakeholders, the constraints they face, and thus communicate them to the ICT specialists.

- Aim for ICT systems that matches existing capacity of IMU
  Another frequent cause of failure of ICT projects is the lack of capacity in the IMU to operate the developed ICT systems. Thus, it is very important to aim for ICT systems that are "simple" enough to be operated by the existing capacity of the IMU. If the ICT systems and tools are supposed to replace some core manual operations or low-level, outdated ICT systems, there is a need to ensure that staff in the IMU are trained to operate the systems.

- Adopt staged development of ICT systems
  The reason why an IMU adopts ICT systems is to increase the efficiency and effectiveness of its information management operations. Thus, there is an inherent drive, especially by ICT specialists, to recommend and sell to an IMU the advantages of developing complex, integrated ICT systems. In view of the guidelines highlighted above the IMU should resist the development of complex, integrated systems.

  The IMU should adopt a staged approach in the development of ICT systems. The computerisation of the information management operations in an IMU should be carried out, independently, for individual functions first. The integration of the individual working ICT systems should only be attempted after the staff responsible for the operations of the individual ICT systems have mastered them.



3.4 Modelling and Decision Support Systems (DSS)

The use of computer simulation models to model the basin hydrological processes, river hydraulics, river-water quality and water allocation process in a river basin is quite common. The models are currently being used to support the work of the individual specialist and water managers. However, ICT tools have been developed to support the

linking and integration of the simulation models with the decision-making process, so as to provide decision-makers with the simulation modelling tools to conduct “what-if” scenarios, while making decisions.

In view of the comments highlighted in Section 3.3 it is advisable that an IMU adopts a cautious approach in the development and use of DSS. A good DSS should only increase the efficiency in delivering the relevant information to a decision-maker. A DSS should never take over the role and responsibility of a decision-maker in making decisions.

4. Information Management Outputs

The effectiveness of the IMU in carrying out its function will be measured by how well it meets the information needs of the water managers and stakeholders in a river basin. Thus, there is a need for the IMU to understand the types of information management outputs that are desired by them. The following is an example of the possible types of information management outputs that can be produced for the water managers and stakeholders, for the water allocation function.

4.1 Example of Outputs for Water Managers

The following are some possible examples of information outputs that water managers may need for the water allocation function:

- Quantity and quality of surface water available for allocation;
- Quantity and quality of groundwater available for allocation;
- List of water users, water permit holders and their conditions;
- Maps showing the quantity and quality of surface water and the water extraction points and amount extracted;
- Maps showing the quantity and quality of groundwater wells and the amount of extraction;
- List of non-compliance by water permit users and actions taken; and
- List of complaints by water users and actions taken.

The IMU may not be responsible for maintaining all the databases to produce the above outputs. However, the IMU needs to co-ordinate with the relevant agencies maintaining the databases to ensure that the required outputs are produced and delivered to the water managers for decision-making.

4.2 Example of Outputs for Stakeholders

All stakeholders should be able to access an annual report of the state of the water resources in the basin. This probably should be an annual report against the basic set of water resources management indicators so that progress can be seen over time. The following are some possible examples of information outputs that the following stakeholders may need for the water allocation function.

- Political Stakeholders
  The political stakeholders will need summarised information and reports at regular intervals, on the status of the water management and water allocation in a river basin. This may take the form of a half-yearly or annual report. Maps of water quality and location of major water users in a basin are useful to all stakeholders.

- Water Users Stakeholders
  The water users stakeholders may need summarised information and reports at regular intervals, on the status of the water allocation in a river basin. This may be a quarterly report in the form of a leaflet.

  They may also need to have access to a system to make complaints and to make queries on the water management and water allocation in the river basin. This may take the form of a complaint or query forms, in hardcopy or electronic forms on the Internet.

- Civil Society Stakeholders
  The civil society stakeholders may wish to know general information on the management of the river basin and the status of management of the river basin. The most common form of disseminating this information is through a web site on the Internet.

5. Lessons

From experience of information management systems and the information presented above the lessons to take away are:

- Good information management is essential for effective water management in a river basin;
- Information management systems should be realistic and work within available resources;
- Information management tools and ICT systems should be adopted in a staged process matching the skills and reliability of the information data base; and
- Information outputs that meet the needs of water managers and stakeholders demonstrate the effectiveness of the information management system.

Box 8.2: How are you doing?

Measure progress in your basin with information management:

- Is water management information available to managers and other stakeholders on time, in the right format and with the desired information?
- Is the information data base in formats compatible with other river basin organisations?

Web References

1. Information Management (http://en.wikipedia.org/wiki/Information_management)
2. What is GIS and how does it work? (http://www.mapcruzin.com/what-is-gis.htm)
3. Google Earth (http://earth.google.com)
4. Web-page CMS (http://www.multicentric.com)

EXERCISE
Information Management

Role Play (1 hour)
An RBO is planning to set up an Information Management Unit (IMU) to address the information management needs of the water managers and key water stakeholders in a river basin. Thus, the IMU is planning to conduct a forum with the water manager and all the key water stakeholders in the basin to gather their views and also explain to them its constraints in meeting their desired information needs. The key water management issue in the basin is conflict among water users for the limited water resources in the basin. There are agricultural and municipal water supply water users in the basin. There is also an environmentally sensitive wetland ecosystem downstream of the river, where most of the water extractions by the two main water users occur. The IMU has been given a limited budget to implement its function. The budget is only adequate for the IMU to meet some of the information needs of the water users.

The Players and their Roles
There shall be 5 groups of players. They are:
(a) IMU Group
(b) Water Manager Group
(c) Agricultural Water User Group
(d) Municipal Water User Group
(e) Environmental NGO Group

The participants shall be divided into the above 5 groups. They shall spend 30 minutes in their respective Individual Group Session before coming together in the 30-minute Plenary Session. In the Plenary Session the IMU Group shall conduct the forum and the Water Manager and Water User Groups shall make their respective requests for the information outputs they need from the IMU Group.

The roles of the 5 Groups are as follows:
(a) IMU Group – You need to identify and prioritise all the information management outputs that the water manager and water user stakeholders may need. Subsequently, you will be required in the Plenary Session to explain why you cannot meet all the information management needs of the stakeholders in the river basin due to your limited budget.
(b) Water Manager Group – You need to identify all the information management outputs that you need the IMU to provide to you to enable you to perform your water management responsibility in the basin.
(c) Agricultural & Municipal Water User Group – You need to identify all the information management outputs that you want from the IMU to enable you to fulfil your business objectives.
(d) Environmental NGO Group – You need to identify all the information management outputs that you want from the IMU to enable you to fulfil your objective of protecting the wetland ecosystem.

Module 9: Economic and Financial Instruments

Learning Objectives

- Understand the difference between financial and economic instruments.
- Appreciate how to apply financial and economic instruments for improved management of water resources at river basin level e.g.
  - ✔ Cost recovery
  - ✔ Behaviour change
  - ✔ Address equity and the poor
  - ✔ Environmental protection

1. Introduction

With improved water resources management and the creation of new management structures increasing attention is being given to the financial viability of water management systems and the use of subsidies and charges to change the way water is being used. This module addresses the use of financial and economic instruments in water resources management and how they can be used to contribute to more sustainable management and development of water resources.

Economic and financial instruments contribute to sustainability of the water management system and the short term

Water Management Objectives may be:

- Water use efficiency is improving through the use of economic and financial instruments; and
- Pollution is being reduced through the use of economic and financial instruments.

Box 9.1: WHAT ARE MY FIRST OBJECTIVES?

My water management objectives for using Economic and Financial Instruments in the basin are:

- Implement economic and financial instruments to improve water use efficiency.
- Apply economic and financial instruments to reduce pollution.

The module will start by explaining financial and economic instruments, we will then look at water as a social and an economic good, before moving to examine how economic and financial instruments can be used to contribute to the principles of IWRM. The final part of the module will address the application of economic and financial instruments in water resources management functions of the RBO.

2. Explaining Financial and Economic Instruments

Economic and financial instruments, defined in very simple terms below, affect behaviour (through the creation of incentives and disincentives related to water management activities and water use) and determine to a large extent the financial viability of water resource management activities and the viability of water management institutions.

Box 9.2: Water fees set in Zimbabwe

The fees for raw water in Zimbabwe are set at national level. This is a disadvantage for the use of economic instruments as it does not allow local level adjustment of tariffs to achieve relevant changes in water behaviour. However the national setting of tariffs achieves other economic goals in that the tariff is a blended price for the whole country making water cheaper in those regions where water development may be more expensive.

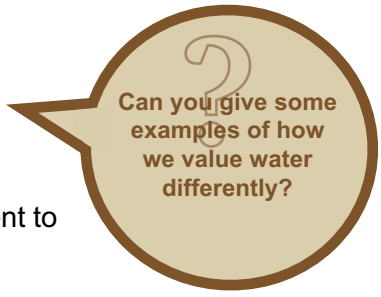
Economic instruments (tariffs, subsidies, cross subsidies and other incentive-based measures such as water trading and effluent charges) are typically used to promote the efficient allocation and use of the water resource. Economic instruments may also be used to achieve the broader objectives of equitable allocation and the sustainable use of the water resource. Economic instruments work best when they complement (and are complemented by) appropriate policy, regulatory, institutional, technical and social instruments. Basically economic instruments are charges levied to encourage people to change their behaviour in a particular direction. They are not charges to recover costs. The income received therefore has flexibility in how it may be used and could for example be used for investment in services for the poor or addressing inequity.

Financial instruments refer to mechanisms that are used to raise money to finance activities (of both an operating and capital nature). Financial instruments are primarily concerned with the income that will result and how this relates to the financial costs of the activities that must be funded.

These distinctions are not as neat as the above definitions imply as both financial and economic objectives may be met in a single instrument, water tariffs being a clear case in point. A commercially-oriented water utility would set tariffs to meet its financial objectives of adequately covering operation, maintenance and capital costs. The utility's performance would be measured by various financial indicators, such as net profit, return on capital, credit worthiness (ability to service loans) etc. By contrast, the economic viewpoint on tariffs is to assess their contribution to a combination of water sector objectives, not just limited to ensuring adequate service delivery to existing water consumers, but also requiring equity improvements (increasing peoples' access to water) and ensuring environmental sustainability. An independent regulator with adequate powers is the best way of ensuring that the financial orientation of a water utility is tempered by the economic or national interest viewpoint.

Value versus charges

Value and charges are two distinct concepts. The ***value of water*** in alternative uses is important for the rational allocation of water as a scarce resource, whether by regulatory or economic means.



Conversely, ***charging for water*** is applying an economic instrument to achieve multiple objectives as follows:

- To support disadvantaged groups;
- Influence behaviour towards conservation and efficient water usage;

- Provide incentives for demand management;
- Ensure cost recovery; and
- Signal consumer willingness to pay for additional investments in water services.

Box 9.3: The use of economic and financial instruments is important for IWRM because:

- As water is becoming scarcer, its economic value is rising;
- Economic and financial instruments can be used for achieving IWRM goals in terms of efficiency, equity and sustainability;
- Without financial viability for water-related projects and decisions, their will not be a sustainable flow of benefits for users; and
- Economic instruments tend to send appropriate signals to producers and consumers about the increasing scarcity of water (something that is less likely when using only non-economic measures).

In general, economic and finance instruments for IWRM are becoming more and more important for taking better decisions that improve water management as well as social goals not only for current but also for future generations.

3. Water as an Economic and Social Good

The Dublin Principles state that water is an economic (and a social) good. Some people find it difficult to accept that water should be paid for citing, for example, that water is a gift from God. We will discuss the difference between economic good and social good and we will also discuss the difference between the value of water and the cost of water. Applying a price to water is not only done because of cost recovery but is equally important as a tool to change behaviour and make sure that water is distributed more fairly

Water has a value as an economic good as well as a social good. Many past failures in IWRM are attributable to ignoring the full value of water. The maximum benefits from water resources cannot be derived if misperceptions about the value of water persist.

When is water an economic good?

Treating water as an economic good is essential for logical decision making on water allocation between different, competing water sectors, especially in an environment of water resource scarcity. It becomes necessary when extending supply is no longer a feasible option. In IWRM, the economic value of alternative water uses helps guide decision makers in the prioritisation of investment. In countries where there is an abundance of water resources, water is less likely to be treated as an economic good since the need to ration water usage is not so urgent. However water has a very important role in economic development which cannot be ignored.

Why is water a social good?

Although water is an economic good, it is also a social good. It is particularly important to view water allocation as a means of meeting social goals of equity, poverty alleviation and safeguarding health. In countries where there is an abundance of water resources, there is more of a tendency to treat water as a social good to fulfil equity, poverty alleviation and health objectives over economic objectives. Environmental security and protection is also part of the consideration of water as a social good.

In most traditions water is respected as an important resource and there are systems to manage water and water shortages at the community level.

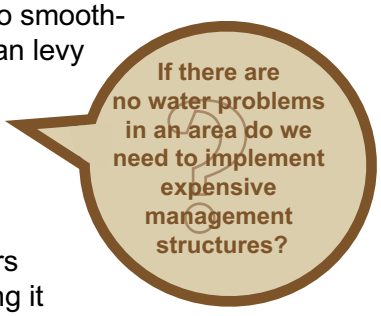
4. Applying Economic and Financial Instruments

4.1 More rational use of water

Economics is about making choices when resources are scarce. This is certainly the case when water is polluted and needs to be consumed, or when investments are necessary to connect more people to drinking water and sanitation systems. It is also the case if there are competing claims: water for human consumption, for agriculture and for industry. In a context of scarcity, competition comes into existence where a price is paid. This may be official or unofficial but there are winners and losers unless this competitive situation is regulated according to some rational and accepted principles.

Water management is characterised by monopolies and vested interests which is why regulatory systems are necessary to correct for these. The application of financial and economic instruments can help to apply the regulations and obtain the desired results of a rational and acceptable allocation of scarce resources.

All kinds of economic instruments have been developed, which help to smoothen the water production and distribution process. If the government can levy a tax, it would have money to spend on water and sanitation. If the utility uses a reasonable tariff, it can invest in new connections; and if the polluters pay the water board or the river basin organisations, they can do something to improve the situation.



The rational use of resources usually requires that consumers, farmers and industrialists contribute to the cost of managing the water, cleaning it and bringing it to their houses, farms or factories.

4.2 The instruments

The best-known economic instruments are taxes, subsidies and the determination of prices, or – once such price is fixed by some authority – the tariff. The fixing of these prices is usually not left to the market, for example, because the price is very important for poor people.

The financial instruments help to take specific investment decisions. One way of improving water efficiency is by investing in and improving infrastructure. This may also lead to more attention to operations and maintenance (O&M) and to a reduction of losses in the system. However, any investment made must be rational and weigh the resources necessary (capital, labour, raw material, etc.) to assure the optimal use of such resources. Tools developed for this purpose are cost benefit analysis, life cycle costing and multi-criteria analysis. The issue becomes even more complicated if the decision implies a decision to invest in one or another sector.

Related principles, which are also used in the water and environmental economics, are cost recovery and the polluter pays. These are based on the objective to recover costs from those who receive the benefit. The water user receives the benefit of access to water and should therefore pay for the costs incurred by the service provider. Similarly

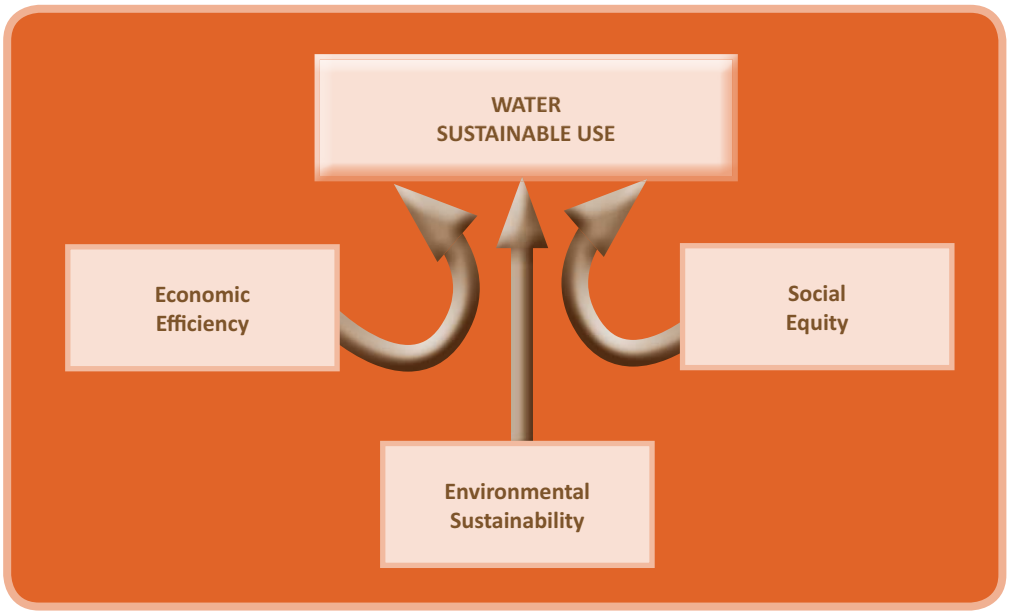
a polluter affects water quality for other users and receives the benefit of being able to dispose of waste. The polluter should pay for the environmental cost and the cost of the management agency in policing the polluter.

5. Water Resource Management Goals

Fundamental to water sector reform and the adoption of IWRM are the goals of Economic Efficiency, Social Equity and Environmental Sustainability. These are the pillars of IWRM and should, at a basic level, form the goals behind the mission of the RBO. How then can the RBO benefit from the use of economic and financial instruments to achieve these water management goals?

Do RBOs really see their work in this way?

Figure 9.1: Water Resource Management goals



5.1 Economic efficiency

Water is vital for economic and social development and is indispensable to sustain and increase urban and rural livelihood activities. Given increasing water scarcity, the choice as to how each drop should be allocated and managed becomes central to maximizing social and economic benefits and ensuring sustainability. In many situations water efficiency can be improved.

Looking at the different types of tariffs that can be charged it should be clear that a fixed tariff will hardly promote any technical efficiency of producers or consumers. Under that system, there is no incentive to save water. Only tariffs with variable components have incentives for improving technical efficiency in water systems. Steeper slopes for tariffs will provide higher incentives for efficiency improvements, and using block tariffs with increasing charges is an even better way of promoting technical efficiency among users. Cost recovery and payment systems are necessary, appropriately adjusted to the recurrent costs, for the maintenance of infrastructure.

What economic instruments have you used to improve efficiency of water use?

The results of increased economic efficiency can be quite marked with:

- More water for allocation;
- Delayed investment in construction of new infrastructure (money saved);

- Reduced pollution;
- Improved economic return from water use in agriculture and industry; and
- Greater economic development

The application of economic instruments to achieve efficient use applies across several of the functions of the RBO.

5.2 Social Equity

Social equity requires that a fair share of water benefits and responsibilities be transmitted to women and men, poor and rich, young and old. This means fair opportunities to access, use and control water resources, as well as equitable acceptance of responsibility for the negative side effects produced so as to avoid placing higher burdens on the poor or disadvantaged members of society. Many countries have issues of equity in relation to water. The most common examples of inequity are:

- Lack of access to clean drinking water, usually for the poor and marginalised groups; and
- Lack of access to water from the formal water allocation process due to race, caste, tribal or gender issues.

Strategies to address this problem are varied and what is the role for the RBO when dealing with water resources?

Water allocation systems can have criteria and methods to address equity. In over-allocated catchments re-allocation may be necessary or may be made possible by strict attention to water efficiency and pulling back unused water allocations.

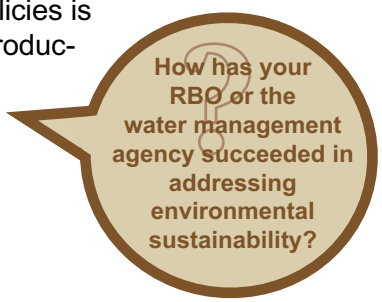
Appropriate priority in the basin development plan, coupled with revenue generation from water can result in investment in infrastructure to address some of the equity issues.

Economic instruments can include those for water efficiency; penalties for exceeding water allocation permits, generating finance for investment from tariffs.

5.3 Environmental sustainability

Environmental sustainability means assuring the capacity of nature to support life. Within the context of IWRM this means a healthy water cycle, adequate water for nature, and less water pollution. Forests and wetlands, among other ecosystems, help regulate water flow and quality.

The relationship between environmental objectives and the functioning of water systems can be very complex. In an institutional context where environmental objectives are given no real expression (either within institutions or among decision makers), the water sector will tend to reflect this situation and is very unlikely to produce positive environmental effects. For example, if the overall effect of economic policies is to favour rapid economic growth with intensive use of water-polluting production processes the water sector will only amplify this, since water will be allocated to the activities favoured by these industrialisation policies.



Economic and financial instruments have a role to play in pollution and allocation but probably the greatest role of the RBO will derive from the basin plan and ensuring adequate linkage and conformity with the environmental plans for the basin. Adequate investment in catchment protection will have major benefits in water availability and quality andreduce the likelihood of future problems.

Box 9.4: Cost recovery and the RBO

In Zimbabwe the river basin organisations and structures are self financed from levies charged. Excess funds are taken by the national water authority and used to fund river basins that are in a deficit situation. In Kenya and Malaysia the funds generated from water management are received into central government and the water management agency is funded from central revenue. It is therefore possible to have a self financing structure but often government is reluctant to create the appropriate structures requiring the appropriate degree of autonomy and accountability.

6. Economic and Financial Instruments and the RBO

How should an RBO be financed and what control should it have over water tariffs? This is not an easy question to answer and whilst situations are different the challenge is whether the choice of financial management systems are adequate to meet the water management objectives – if not, they should be changed.

In a society in which water is considered a scarce resource and water tariffs are set up to reflect the total economic value of water, it will be easier to generate financial resources for water management. In this case, the costs of water management will be incorporated in the water tariff system, and functions related to water management will have financial support. In other circumstances, financing of water management may not be done via water tariffs but mainly via fiscal expenditure, coming from the general taxation system.

This second solution, however, is likely to be less efficient than the other one for water management, due to difficulties for a correct allocation of public expenditures to complex and dynamic water activities, and also due to the fact that water users would not get appropriate signals about the scarcity of water.

Who pays for water resources management in your country? Is it the user of raw water or the general taxpayer?

In general, it seems preferable to have a system in which water users pay for any private benefits from water they get, whereas the public sector mainly finances activities and functions which are related to the provision of public goods in water-related activities.

This is equivalent to having a system with cost-covering water tariffs for residential, industrial, electric and agricultural water use (including payments for water polluting activities), whereas public or tax financing can be oriented to the provision of water management for aesthetic and recreational water values, prevention of water-related disasters and water-related health problems, and for protecting some non-use values (preservation of areas or endangered species). This water management system will likely be more effective in terms of efficiency, equity and sustainability for water management.

The RBO should consider these 'private benefits' and 'public goods' when deciding on tariffs and fees and how the RBO functions should be financed.

6.1 Economic instruments and water management functions

Table 9.1: Examples of financial and economic instruments being applied in water resources management

Function	Financial instruments/purpose	Economic instruments/ purpose
Allocation of the water resources.	Permit charge, Raw water volume charge. Cost recovery admin; cost recovery basin management; cost recovery investment; cost recovery monitoring.	Volume / use charge. Incentives for efficiency, or equity considerations.
Pollution control	Permit charge, pollution charge. Cost recovery admin; cost recovery monitoring; cost recovery environmental clean-up.	Volume and quality related charges. Self monitoring requirement. Penalise for poor quality and high volume discharge.
Monitoring water use, water pollution, compliance, water resources.	% of raw water charges and pollution charges. Cost recovery	Penalties. To ensure compliance.
Basin planning and implementation.	Raw water charges and pollution charges. Cost recovery. Investment.	None
Managing and enabling stakeholder participation.	Raw water charges and pollution charges. Cost recovery.	None
Information management.	Raw water charges and pollution charges. Cost recovery.	None
Financial management.	Raw water charges and pollution charges. Cost recovery.	None

Box 9.5: Key questions to be clear about

- Who Pays?
- Which institution receives the payment?
- What are the financial elements?
- What are the economic elements?

The water resource management functions may (ideally) be in one organisation or in more than one. An important consideration in setting tariffs is a justification of the costs charged and transparency in what constitutes management costs, monitoring costs etc. The costs of running the River Basin Organisation should be carefully analysed and justified on the basis of the activities and effort involved. This justifies what may otherwise be an arbitrary fee. Nevertheless, fee levels are a political issue and income may not meet expenditure. This is acceptable if it is an agreement of government to subsidise the basin for development or other reasons and the government is willing to make up the cost difference. Otherwise with a budget deficit systems will fail and management of the water resources will be limited to those activities of economic priority.

How does your RBO perform against key financial management indicators?

As mentioned earlier often central government may receive the revenue and the RBO may be financed from central taxes. This is not a recipe for efficient management of water resources in the basin and runs contrary to the philoso-

phy of financial and economic instruments being applied to the water users. In such circumstances it is still advisable to maintain an expenditure and income comparison between the RBO and the water resources management income.

A final point is on the poacher (water user) and the gamekeeper (RBO). Often, water resources management functions are being developed within an agency that has other functions such as irrigation, or water supply services. This immediately raises a conflict of interest which may result in a lack of trust or cooperation from other sectors. It is advisable in such circumstances that the water resources management functions are ring fenced and separated from the other functions both financially and from a decision making perspective.

Some principles in tariff setting

The following principles should inform the development of specific tariff policies and practices:

- ✔ Cost-reflective. Tariffs should reflect full economic costs (including opportunity costs, externalities and marginal costs);
- ✔ Cost-recovery. Tariffs should aim to recover the full financial costs;
- ✔ Affordable. Tariffs should be affordable, and should recognise the vital role of water, the special needs of socially deserving cases, and the importance of safe water and sanitation for public health. Subsidies should be targeted; (See below.)
- ✔ Practical. Tariffs should be administratively feasible and cost-effective;
- ✔ Fair. Tariffs should be implemented in a fair manner and not discriminate between consumers in an arbitrary or unfair way; and
- ✔ Effective. Tariffs must be supported by effective implementation mechanisms linked to measurement, revenue collection and credit control.

Box 9.6: Description of some charges in the basin

Catchment management or water resource management charge
The catchment management charge is primarily a financial instrument to finance water resource management activities at the local level. In principle, it covers the costs of river basin or catchment management institutions and is collected by those institutions or by some national parent body.

Abstraction charges
Abstraction charges (for ground and surface water) relate to both the right and cost of abstracting water from its natural environment. Abstraction charges are likely to have a significant influence on water allocations and use and are one of the primary economic instruments in the water sector.

Bulk water tariff
This is the tariff for supplying bulk or wholesale water from one institution to another and is collected by the supplying entity. It is primarily a financial instrument used to recover the cost of the bulk infrastructure and the attendant operation of this infrastructure.

Consumer retail water tariff
This is the tariff experienced by the water user and is collected by the utility supplying water to retail customers. This is the primary economic instrument for influencing water use. This tariff should reflect the full costs of supply plus economic charges to influence water use.

Consumer sanitation charge
This is the tariff charged to the user by the provider of sanitation services. In the case of waterborne sanitation, this tariff should reflect the financial and economic costs of wastewater collection, treatment and discharge back into the river.

Effluent or pollution charges
These charges relate to the allocation of pollution permits (the “right to pollute”) and effluent charges. They should be imposed and collected by the environmental regulatory body and will include penalty charges (economic instruments) to provide an incentive to reduce pollution..

7. Lessons

- Economic tools are an essential water management instrument.
- Cost recovery is both a component of equity and critical to effective water management institutions.
- Good application of financial and economic tools can assist service development.

Box 9.6: How are you doing?

Measure progress in your basin with the application of economic and financial instruments:

- Do charges and fees for water allocation cover costs and favour the poor and efficient water use?
- Are all water use revenues being received?
- Do pollution charges cover costs and give incentive to reduce pollution?
- Are all pollution revenues being received?

Web References

Cap-Net 2008. Economics in sustainable water management. Training manual and facilitators guide available at:
http://cap-net.org/sites/cap-net.org/files/Economics%20of%20water%20FINAL.doc
Rogers, P., Bhatia, R, & Huber, A. Water as a Social and Economic Good: How to put principle into practice available at:
GWP TAC paper 2. http://www.gwpforum.org/gwp/library/TAC2.PDF

Exercise
Economic and Financial Instruments (EFI)

Purpose: Analysing a payment system in a specific basin.

Activity: (45 mins) Work in a group to investigate application of EFI in a specific basin of a participant.

For either water allocation or pollution:

- Who sets the charge?
- Who collects and keeps the funds?
- Are the charges related to real costs
- If there is an economic element how is it applied?
- Is the system effective and sustainable?
- What recommendations would you make to improve the system taking into account goals of sustainable water resource management

Report back: Summarise your analysis of the current system in terms of IWRM principles and recommendations for improvement.

Module 10: Basin Planning for Water Resources

Learning Objectives

- Appreciate river basin planning as a process coordinating water sector issues in order to achieve concurrent environmental, social and economic benefits.
- Identify approaches for planning water resources to bring about the greatest benefit.
- understand basin plans are linked to available and/or potential resources for implementation.

1. Introduction

While river basins are the natural accounting units for water management, political and administrative decisions are often made according to jurisdictional boundaries that do not coincide with river basins. An immediate dilemma for water managers is then how to bring together the different actors and stakeholders to contribute to basin development and management.

The challenge in river basin management is to achieve the ideals of hydrological and ecologic integration in the context of river basin realities. Basin planning provides an opportunity to address water problems and prioritise development in a strategic and integrated manner.

In a nutshell, river basin plan is an action plan for the integrated management of the water and related land resources in the basin. With reference to figure 10.1 the Basin Plan is in the area of strategic planning. It will have details of actions and broad budgets as well as strategic elements. The plan will normally be relevant for several years. It will be brought into an operational plan only when the River Basin Organisation or other agencies take up the plan for actual implementation and incorporate it into their annual work plans accompanied by specified actions and detailed budgets.

Box 10.1: WHAT ARE MY FIRST OBJECTIVES?

My water management objective for Basin Planning is:
To maintain a basin plan that synthesises technical and social priorities for the basin and acts as a basis for action and accountability to stakeholders.

This module addresses basin planning in three steps;
i) Preparing for basin planning;
ii) Basin planning process; and
iii) Implementing basin plan.

2. Preparing for Basin Planning

2.1. Why basin planning?

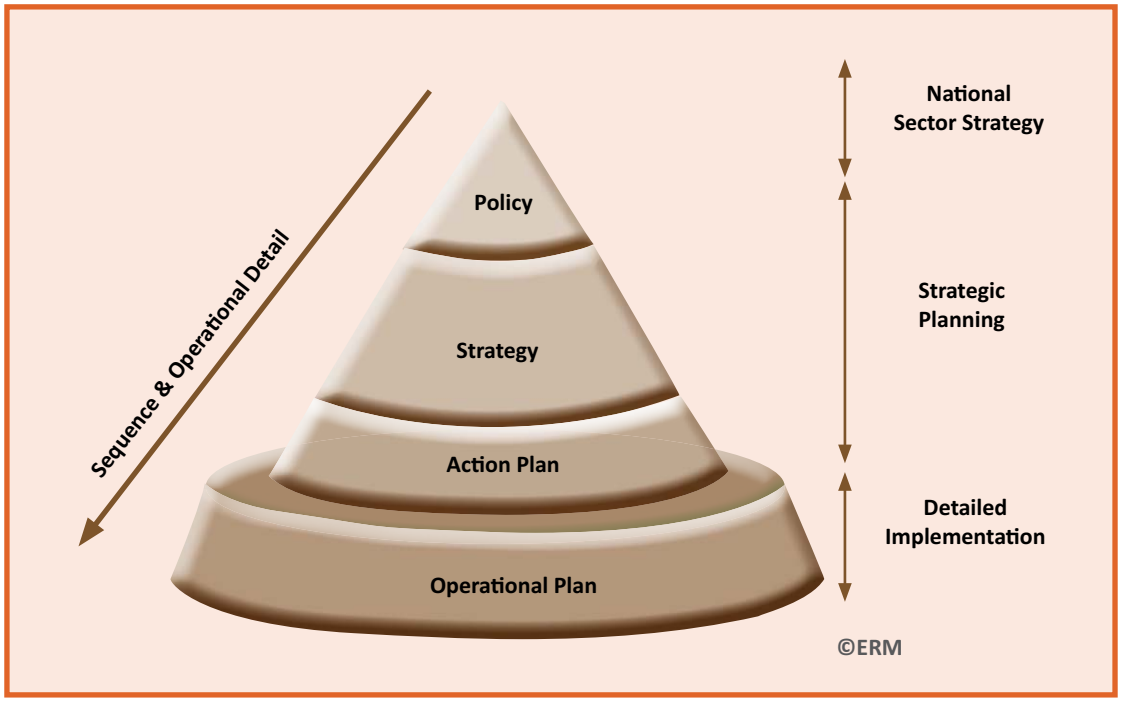
The most powerful reason for planning at the basin level is to address priority water problems affecting society and to stimulate growth and development. Basin plans for water resources are therefore set within the realities of water availability, within the geographical and political context and will take into account all activities and developments requiring water or influencing the water resources, which include ecological requirements, water supply and sanitation, irrigation, land use and forestry, fisheries, hydropower and industrial use.

This approach appreciates the shared opportunities and impacts for water resources within the basin and the need for transparent negotiation, cooperation and concerted actions for sustainability. Often the planning process leads to recognition that water problems are symptomatic of a deeper failure of the water management systems. The role of water in development and as a key factor in poverty reduction and sustainable development also drives river basin planning for water resources.

2.2 Planning context

The basin planning process should promote enhanced dialogue, negotiation, and participation mechanisms, resulting in transparent decision making. Water resources management is a process characterized by management of competing and conflicting interests and viewpoints. To seek the solutions to the causes of water problems rather than the symptoms there is need to build a shared view for the underlying causes, generate commitment for the planning process and eventually a commitment for implementation.

Figure 10.1: The Planning Hierarchy (World Bank)



- Basin planning process can contribute to strengthening good governance.
  Engaging with stakeholders in the development of the basin plan builds interest from stakeholders in the outcomes and also how the water resources are being managed in the basin. In parallel with the planning process many countries are implementing IWRM principles and reforming water resources management.

  This principle, especially those of decentralised management and involving stakeholders, introduces both greater transparency into water resources management and has the potential to improve overall water governance.

- Leadership of the planning process rests with government, its agencies and authorities at basin level.
  Practically, for a basin plan to be implemented it has to belong to the RBO or responsible government agency at the basin level, and as such they must be available to lead the process.

- Basin planning cross-sectoral process.
  The basin planning take into account development options within the water sector itself but also scenarios for development in other sectors that may have an impact on the water resources (e.g. mining, industry, irrigation). Likewise, the consequences of water management decisions in other economic sectors (e.g. tourism or health, agriculture) should be an integral part of the analyses made during the planning process.

- Plans should also take account of potential hazard and the vulnerability of people and ecosystems to extreme events.
  It is important that the planning process includes analysis of risks (flood management, climatic variability, as well as economic, political and other risks) and addresses necessary and adequate measures to reduce or manage risks.

- Planning should link to indicators of performance or targets.
  A plan is only as good as the extent to which it is implemented. The basin plan is the foundation for the work plans of the RBO and provides a guide for water users and other stakeholders within and outside the basin.

2.3 Co-ordinating and decision-making across the hierarchy of scales

Usually the RBO will not exercise autonomous authority, or at least will have reporting responsibility to national or state level authority. Some river basins are large and complex and require subsidiary level organisation at the sub-catchment or other appropriate planning units. Therefore river basin planning requires integration across several planning scales. Possible levels of coordination include national government, administrative regions, basin level sector and local level organisation. In some cases the RBO will involve coordination of decision at a trans-national level.

Challenges also arise in trying to ensure coordination across the many planning initiatives both within government departments but also at national level such as Poverty reduction strategies, environmental action plans, the Millennium Development Goals and National Development Plans.

At the river basin level the authority responsible for management of water resources is the primary and appropriate level for analysis, planning and setting out how water resources management goals will be achieved.

2.4 What is the expected outcome?

The outcome of the process will be a Basin Plan, endorsed by government and implemented by the river basin through its annual work plans. Another outcome will be stakeholders committed to the vision of water development in the basin. A third outcome should be improved water resources management – although we have to remember that many plans are not implemented or not implemented very well!

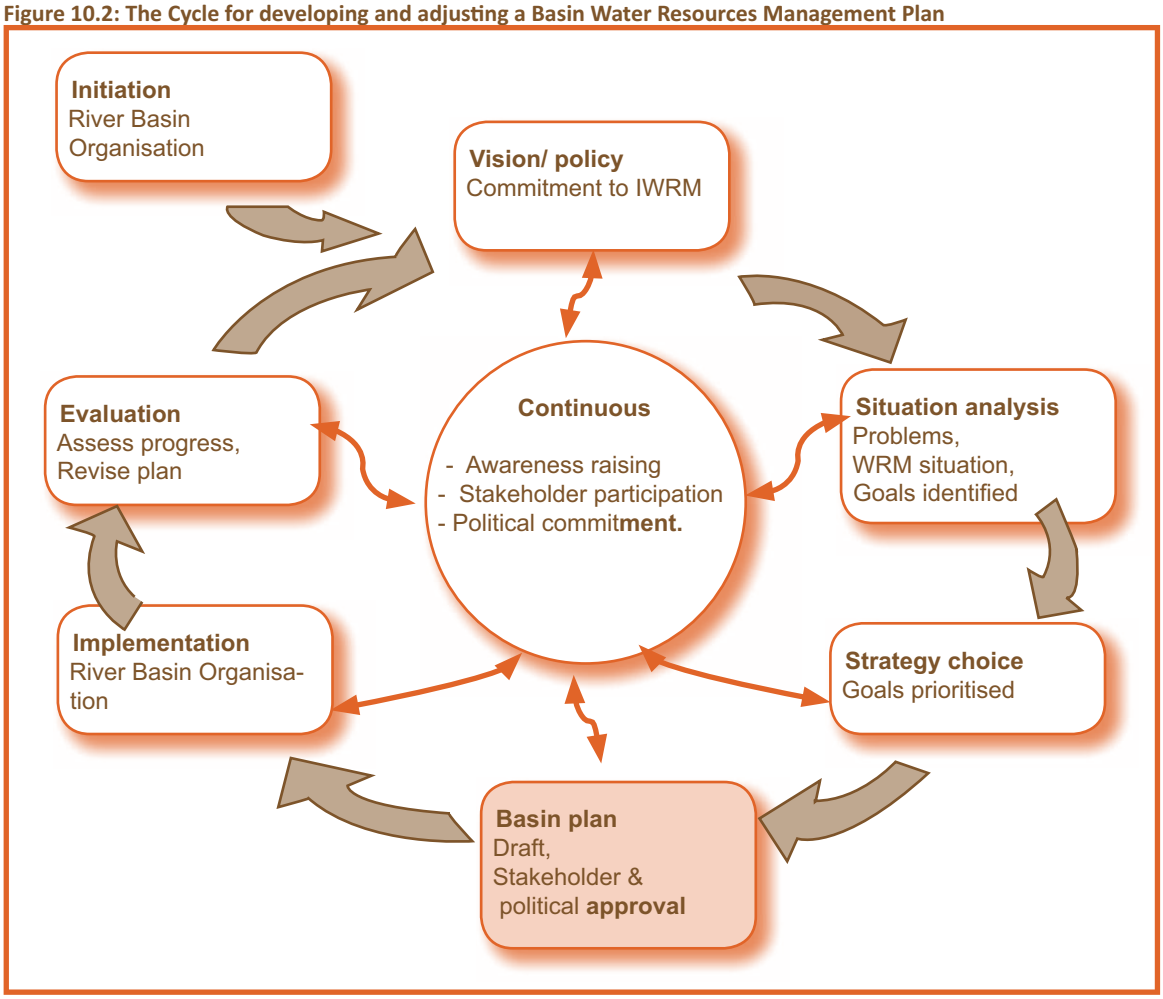
3. Basin Planning Process

Planning is a process most effective when viewed as a continuous cycle. The planning cycle is a logical sequence of phases driven and supported by continuous management support and consultation events shown here in Figure 10.2.

3.1 Getting started

The initial stage of the planning process targets raising the interest and awareness of the government agencies and stakeholders on the basin plan and/or translate this to commitment for planning. The task is to bring an understanding between the sectors that a plan is needed to improved the management and development of water resources

Figure 10.2: The Cycle for developing and adjusting a Basin Water Resources Management Plan



Who initiates the planning process?
The process may be initiated external to the basin e.g. a requirement of the national water law, or from within the basin. Practically though, for a basin plan to be implemented it has to belong to the RBO or responsible government agency at the basin level who must be available to lead the process

A multi-sectoral approach should be recognised as essential considering that many actions proposed in the plans will be accomplished by other agencies than the water management agency. For example erosion control may involve the departments of forestry or agriculture, monitoring pollution may be a responsibility of the environmental agency etc. The success of the water management plan requires the support of other sector players from the onset.

Conclusive step for this phase will be the setting up of a team to develop the plan and agreeing on the process to be followed.

3.2 Stakeholder Mobilisation

Mobilisation of stakeholders and political commitment all throughout the process is an important part of basin planning. On the part of the stakeholders this gives room for participation and influencing the process outcome. In the category of stakeholders here we should also mention the very important group of government agencies who have water interests and whose own plans impact on water management.

Ensuring political commitment is to consciously bring on board the power structures and decision making organs at the basin because of the obvious political implications. Political support is necessary for the adoption and implementation of the plan and it is advisable to build this commitment throughout the planning process and not leave it until the end.

These groups together contribute throughout the planning process and the drafting of the plan.

3.3 Water resources management vision and policy

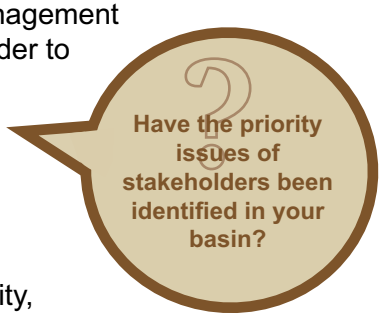
A vision captures the shared dreams, aspirations and common view about the state, use and management of water resources in the basin in the long term. It is a statement of the long term goal.

A water policy for the basin should be framed from the national water policy if there is one. Preferably a short document with clear statements, the policy embodies basic principles that will guide any actions and decisions on water in the basin. The policy statement would cover such issues as environment, equitable access to water, maintaining a gender balance, sharing the benefits of water, amongst others.

3.4 Basin characterisation – pressures, risks and impacts

The basin plan is anchored in reality by starting from an understanding of the existing situation. Many elements can be considered in the situation analysis (Fig 7.1) requiring technical and non-technical data from many sources. One key challenge is to get the balance between the analytical tasks and the stakeholder inputs. Consultation with stakeholders and various government entities is vital to understand problems in the basin, competing needs and goals in relation to the water resource management. Some guidance to identify priorities for action is given in Box 10.1.

To identify the strengths and weaknesses in the water resource management in the basin, and point other aspects that should be addressed in order to improve the situation and reach the vision.



The outcomes of the situation analysis are:

- Description of the situation in terms of items in Fig. 7.1;
- Priority water management problems to be addressed; and
- Description of medium term goals for water management in relation to the situation analysis in specific areas such as water quality, economic areas, and other stakeholder issues.

3.5 Implementation strategy

Box 10.2: Criteria for prioritising WRM problems

- It is a barrier to solving other problems.
- Has an impact on a large number of people.
- Is a major equity issue.
- Will improve development and reduce poverty.
- Will significantly improve efficiency.
- Will positively impact on environment.
- Will improve water resource availability.

Adapted from Cap-Net IWRM plans, Training Manual (200?)

High level water resources strategy documents may be available at central level and will have an important role in guiding basin plans. However from an operational point of view it is also necessary to consider strategies within the basin on how to address basin specific problems.

The strategy is a transforming link between the problems and the desired goals for sustainable water resources management. A Water strategy elaborates how the water vision will be achieved.

It should go beyond the actions needed to solve current problems or achieve short term objectives and establish a clear long term framework to achieve sustainable management and development of water resources.

Water management and development goals for the basin may be achieved in many different ways. The strategy choice defines which of these ways is best (cheaper, more effective, equitable, acceptable to stakeholders) taking into account the various points mentioned and also the guiding water policy.

The basin strategy then addresses the question - what should be changed in the way water is managed and what are the implications of the proposed changes? An array of possible solution arises and they are analysed considering the requirements, the advantages and disadvantages involved and their feasibility. The basin plan will compile the necessary action areas, time frame and budgets to implement the strategy and achieve the goal. As the basin plan has a relatively long time frame (it may be valid for 5 to 10 years) these action plans are necessarily only indicative and will be implemented through more detailed operational plans of the river basin organisation (Fig 10.1).

The point is to avoid being too ambitious, consider the reality of political, social and institutional capacity problems that must be resolved for effective implementation. Avoid a strategy that looks great on paper but may never translate into action on the ground. In particular the resource limitations should never be ignored.

Some important things when making strategic decisions:

- Understand the problems affecting water resources management;
- In negotiating the strategy there will be winners and losers – ensure the trade-offs are informed and as transparent as possible;
- The reality in the basin and constraints must always be recognised. Political, institutional structure at the basin, financial and other resource realities should never be ignored;
- If a strategy is to be successful it must have support across government and stakeholders;
- Dominance by some stakeholder groups, excessive control by government or influence of external agencies deny chances for balanced participation; and
- As much as possible work with the existing structures rather than create new ones.

3.6 Preparation of basin plan and adoption

The planning process leads eventually to the drafting of the basin plan. Basin plans detail what has to be done, by whom, when and using what resources. The plans will also prioritise action based on significance of water use/need and impacts within the basin. The result at this stage is production of a river basin plan.

Several drafts may be written, not only to achieve feasible and realistic activities and budget, but to get decision makers and stakeholders to agree to the various trade offs and decisions made. How to engage with government and public participation in the basin has been discussed in the stakeholder module. However, decisions have to be made on how to relay the information to stakeholders and incorporate their views as the draft develops. Equally important a close liaison will need to be maintained with basin level sectors that are affected or interested. The importance of maintaining this commitment cannot be overemphasized.

Who writes the plan?

Who does the actual writing of the basin plans? is it the staff of the RBO managing water or a team, or a consultant? If so how are they selected? The important thing is that whoever will undertake this task should be aware of the required outputs at all stages of the process. Consultants are often not sufficiently in touch with the realities of the basin and may produce a plan that is too idealistic. Remember the RBO is expected to implement the plan.

A key part of any plan is the resources required for implementation. The total financial requirements need to be assessed and a strategy on how the resources can be mobilized developed. Basin plans need proper investment planning and sound estimate of the revenues. The principles of cost recovery have been widely accepted in principle but poorly applied in practice. If the financial aspects of the plan are based on principle and not practice, then problems will arise. An RBO that is developing a business plan and financing strategy based on cost recovery and has the requisite autonomy may be better able to implement the basin plan than others.

Box 10.3: Sample Basin Plan Content

1. **Background**
   - Rationale, vision for basin water resources management
   - Progress for integrated water resources management
   - Basin plan objectives
   - Plan preparation and process constraints
   - Structure of the plan
   - Link basin plan to national planning processes and/or plans

2. **Basin characterisation**
   Overview of the baseline conditions in the basin and draws out the key features of the catchment that have a bearing on the management of the water resources.

   Overview on the most urgent issues and prioritisation of the areas of intervention are included:
   - Legal and institutional environment for WRM in the basin;
   - Land use patterns and impacts;
   - Hydrological and physical characteristics;
   - Water uses and who are the users, how much they use and for what purposes;
   - Conflicts and pressures on water resources;
   - Water availability present and future/ water balances;
   - Socio-economic context, stakeholders;
   - Description of floods and droughts, the frequency of events;
   - Conservation measures, risk and vulnerability analysis;
   - Issues raised by stakeholders during the participation process; and
   - Information management

3. **Strategies**
   A description of how to achieve the vision, goals, aims and objectives, either with direct reference to the water resources strategy or incorporating the relevant issues into the plan itself

4. **Planning Intervention**
   Describes the activities over time to resolve problems and achieve strategic goal identified that may relate to RBO activities or those of other organisation within the basin.

   - *Water Allocation and Water Use Management*
   - *Water Resource Protection*
   - *Catchment Conservation Strategy*
   - *Institutional Development Support*
   - *Water Infrastructure Development*
   - *Monitoring and Information Management*
   - *Financing and Implementation*

5. **Resource plan**
   Financial requirements requirement and mobilisation strategy

Funding for basin plan implementation may come from government sources, donors, private sector and revenues from user charges. Ultimately the RBO should strive to recover cost associated with water resources management by levying charges for water abstraction and pollution commensurate to the level of use or pollution discharge.

Adoption: Finally, the plan needs to be accepted by the stakeholders and approved at the appropriate level. If participation process was good and political commitment maintained then approval should not be problematic.

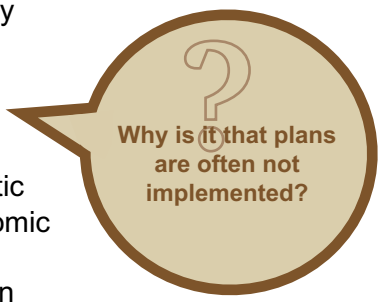
4. Implementation of the Basin Plan

Development of the basin plan for water resources is not an end in itself. Plans derive meaning only if they are implemented and reviewed on a regular basis.

A communication strategy for the plan and the planning process should be established as part of activities by the planning team. The final IWRM plan should be widely publicized and easily accessible.

Some reasons why plans may not be implemented include:

- Lack of political commitment to the process. Usually due to the drive coming from external sources or a lack of engagement of key decision makers in initiating the process;
- Unrealistic planning with resource requirements beyond the reach of the RBO;
- Unacceptable plans. Plans rejected by one or more influential groups due to inadequate consultation or unrealistic expectations of compromise and especially where the economic benefits or power relations may be affected; and
- Out of date. The planning period should be clear and the plan reviewed at specific intervals to ensure that it is in line with current trends.



5. Lessons

- The logical unit for analysis and planning for water resources is the basin level.
- Basin planning should engendered support of government and stakeholder from the onset to ensure success in implementation.
- Basin plan should form basis for RBO work plans.
- Basin plan should be updated regularly to capture changing situation in the basin.

Box 10.4 HOW ARE YOU DOING?

Measure progress with planning in your basin:

- Was the Basin Plan prepared with participation of basin stakeholders and does it reflect their priorities?
- Are water management activities driven by the Basin Plan?

Web References

Cap-Net, GWP, 2005. Integrated Water Resources Management Plans. Training Manual and Operational Guide available at: http://www.cap-net.org/sites/cap-net.org/files/English%20version.doc

Water for Life and Livelihoods – Consultation on a Strategy for River Basin Planning, January 2005 available at: www.scilly.gov.uk/Council%20of%20the%20Isles%20of%20Scilly/generalpurposeswaterforlife13.6.06.pdf

EXERCISE
Basin Planning

Purpose: To strengthen understanding about the planning process and how the plan will be used.

Activity: (1 hr) Use cards, one idea per card and stick cards on the wall where they can be re-arranged and grouped as necessary. Facilitated card session to address three issues

- Process to develop the Basin plan
- Sample content/ structure of the plan
- How the plan will be used.

Facilitator: Deal with one question at a time, group and organise the cards. Provide opportunity for comments and questions to the results.

ANNEXURE 1: Sample Course Programme

Day	Day 1: Monday	Day 2: Tuesday	Day 3: Wednesday	Day 4: Thursday	Day 5: Friday
	Welcome and introductions	Results previous day	Results previous day	Results previous day	Results previous day
	Objectives, agenda and expectations	Stakeholders	Water allocation	Exercise:	Environmen-tal and other objectives of the RBO
	break	break	break	break	break
	Introduction to IWRM	Exercise	Exercise:	Monitoring	Exercise: Benchmarking
	Water Management functions.	Basin planning	Pollution control	Exercise:	Course evaluation
	Lunch	Lunch	Lunch	Lunch	Lunch
	Water Re-source Management Indicators	Exercise	Field Trip	Economic and Financial instruments	Closing
	Exercise.	Information management	.	Exercise:	
	break	break	break	break	
	Plenary feed-back	Exercise			
	Dinner		Free		

Structure of presentations

Presentations should combine presentation by the facilitator plus discussion and contribution from the participants. The experience of the participants is critical to maximise benefit of the training and can be included by various means such as:

- focused questions to the participants;
- case studies from the floor; and
- various participatory activities.

At least 50% of the course time should be exercises, group work or other methods to draw out experience from participants. Facilitators should choose their own method but avoid long lectures.

Acronyms

AguaJaring,	South East Asia Capacity Building Network for IWRM
Cap-Net	International Network for Capacity Building in IWRM
CMS	Content Management System
DSS	Decision Support Systems
GIS	Geographical Information System
ICT	Information and Communication Technologies
IMU	Information Management Unit
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
Lanka CapNet	Sri Lankan Capacity Building Network for IWRM
LA-WETnet	Latin America Water, Education and Training network
MDGs	Millennium Development Goals
NGO	Non Government Organisation
Nile IWRM-Net	Nile basin Capacity building network for IWRM
RBO	River Basin Organisation
SWMA	Selangor Waters Management Authority
ZINWA	Zimbabwe National Water Authority

International Network for Capacity Building in Integrated Water Resources Management

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