Local Government and Integrated Water Resources Management (IWRM)

Part III

Engaging in IWRM – Practical Steps and Tools for Local Government

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Imprint

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Part III: Engaging in IWRM – Practical Steps and Tools for Local Governments

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Part III

Engaging in IWRM – Practical Steps and Tools for Local Governments

The set of materials entitled "Local Government and Integrated Water Resources Management (IWRM)" aims to assist Local Governments with active participation in IWRM. The information provided addresses both the theory and practice of developing and implementing a process through which the IWRM principles of social equity, economic efficiency and environmental sustainability can be applied.

The materials are primarily targeted at Local Government officials, but are considered equally useful for individuals and organisations that work with Local Governments in the management of water resources.

The IWRM set of materials consists of the following four parts:

Part I: Reaping the Benefits – How Local Governments Gain from IWRM

Part II: Understanding the Context – The Role of Local Government in IWRM

Part III: Engaging in IWRM – Practical Steps and Tools for Local Governments

Part IV: Making Water Work for Local Governments – Ten Top Tips for Integration in Water Management

The materials are an output of LoGo Water[1], a research project aimed at improving the capacity of Local Governments to implement IWRM, thus contributing to the achievement of water-related Millennium Development Goals (MDGs).

The complete set is available to download from www.iclei-europe.org/logowater.

[1] LoGo Water: Towards effective involvement of Local Government in Integrated Water Resources Management (IWRM) in river basins of the Southern African Development Community (SADC) region, EC Contract 003717

March 2008

ICLEI Local Governments for Sustainability

List of contents

Introduction

This document is Part III of the 'Local Government and Integrated Water Resources Management (IWRM)' set of materials. It provides guidance on how to embark on an IWRM process at the local level by proposing a number of practical steps and tools. The document consists of three main parts. The first describes opportunities to apply IWRM principles within Local Government mandates (Sections 1 and 2), the second focuses on the development of a local IWRM action plan (Sections 3 and 4) and the third is a collection of tools and methodologies to assist the user in IWRM (Section 5 and Annexes).

The document is primarily targeted at Local Governments from the Southern African Development Community (SADC) region interested in participating in IWRM, but is also of use to any individual or organisation working with Local Governments on issues of water management. It suggests ways in which IWRM principles can be translated into practical applications at Local Government level and is intended to be used once a commitment to IWRM is in place, backed up by political support and stakeholder participation.

Developing and engaging in an IWRM process can be a daunting task, especially at the local level where capacities may be limited. However, the application of IWRM principles does not necessarily require substantial resources, as it can start with a few small steps carried out in selected Local Government mandates. The extent of IWRM can vary and may target just the local community or, ideally, also look beyond Local Government boundaries through collaboration with neighbouring administrations and higher levels of government on water resources issues in what is described as a 'twin-track' approach.

Overall this guidance document aims to provide Local Governments that are committed to IWRM with advice and the necessary means to start putting IWRM into practice, as well as assisting them in identifying the best approach for their specific circumstances.

1. Integrated Water Resources Management and its principles

Integrated Water Resources Management (IWRM) is a holistic approach to water resources management that is widely promoted throughout the world to help better understand, protect and develop water resources in a coordinated fashion, thus contributing to sustainable development. The Global Water Partnership defines IWRM as:

> *"a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems"*[1] .

IWRM is based on the three principles of social equity, economic efficiency and ecological sustainability. These principles form a method of analysing and subsequently managing water resources in a way that leads to a coordinated outcome. The interaction between the principles is shown in Figure 1.1.

Social equity – refers to the consequences of decisions and actions faced by different water users. The focus is particularly on ensuring equity in access to, and use of, water resources and the derived benefits for all users, particularly the disadvantaged.

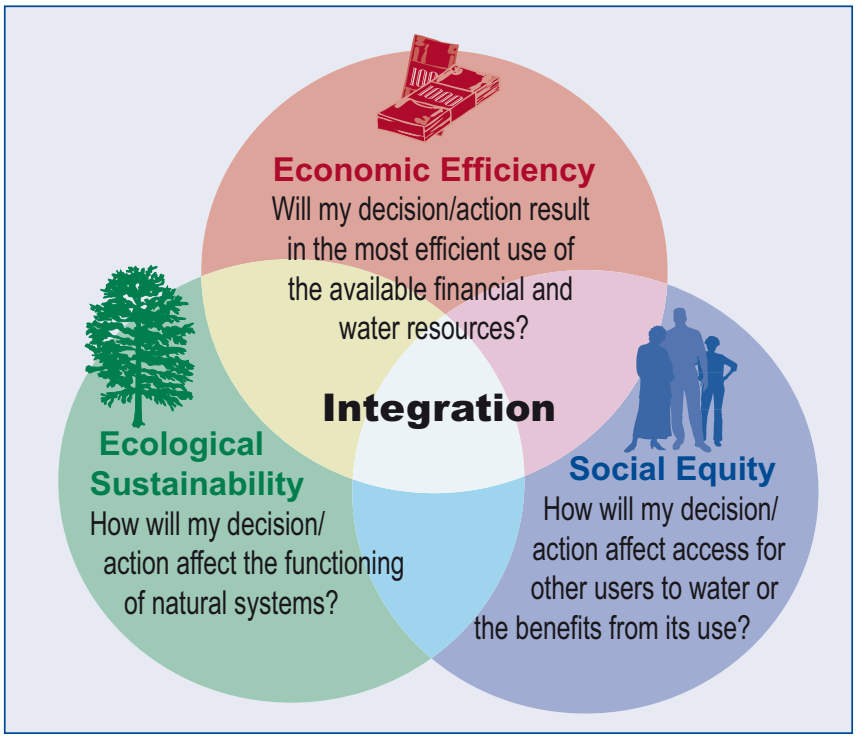

Figure 1.1 – The IWRM principles and how they interact

Economic efficiency – refers to the need to make the most economic use of water resources to attain the highest value returns, thus achieving the greatest benefit for the greatest number of people. This value is not only a price issue, but should also include current and future social and environmental costs and benefits.

Ecological sustainability – refers to the recognition of the environment as a user in itself and calls for maintaining the services that ecosystems provide. As such, water resources should not be depleted beyond the limits of replenishment by natural processes or human intervention.

For more information on IWRM and the principles, please see Part II of the IWRM set of materials entitled 'Understanding the Context – The Role of Local Government in IWRM'.

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[1] Integrated Water Resources Management, TAC Background Paper #4, Global Water Partnership Technical Advisory Committee, Stockholm: 2000, p. 22

2. Options for Local Government engagement in IWRM

The way in which water resources – such as groundwater, lakes, streams, rivers, etc. – are managed has a direct impact on Local Government duties and mandates. A poor status of water resources can reduce the effectiveness and quality of many services that Local Government provides and is held accountable for.

Likewise, a large number of actions by Local Governments impact on water resources and can affect downstream, and sometimes also upstream, users in the catchment. This can cause conflicts with other communities' needs and interests.

Local Governments can play a large role in making IWRM more effective. As the following sections show, there are numerous opportunities for Local Government to engage in water resources management, thus ensuring that the needs of both water users and the natural aquatic environment are better addressed both locally and, ultimately, elsewhere in the catchment.

Selecting the right approach

Once a commitment has been made to engage in IWRM, Local Governments must select an approach that is most appropriate for the local circumstances and capacities. Sections 2.1 and 2.2 of this guidance identify two options that Local Governments may consider when engaging in IWRM. These are:

a) **IWRM at local level** – At the local level, Local Governments can contribute to IWRM by taking into consideration the status of water resources when performing their regular mandates. The IWRM principles help to direct the respective decision-making and planning processes in each mandate. Whether to initiate IWRM in only one or two mandates or to roll it out across all relevant departments will depend on local conditions. The chosen approach could of course be anywhere within this range and would not necessarily remain static, but would rather be expected to cover an increasing number of mandates over time.

b) **IWRM beyond Local Government boundaries** – Integration is best achieved through cooperation. What is important at local level is also key beyond local boundaries. Local Governments can create synergies by coordinating their IWRM activities with neighbouring Local Governments and other Local Governments in the basin ('horizontal collaboration'). If the institutional framework allows, opportunities may arise to voice local interests at higher levels of government or the newly established river basin institutions ('vertical collaboration').

Bringing the two options together – actions within and outside local boundaries – is referred to here as a 'twin-track' approach. Such a combination is likely to yield the best results. However, this may not always be feasible or the most appropriate path towards IWRM for all Local Governments. Each Local Government will have to identify the entry point to IWRM that is most suitable for the conditions and challenges of its own local area.

The decision on whether or not 'IWRM beyond local boundaries', and hence a 'twin track' approach, is possible will depend on the opportunities for Local Government to consult with catchment and national level water resources management agencies and authorities.

Figure 2.1 shows the two options of the 'twin-track' approach.

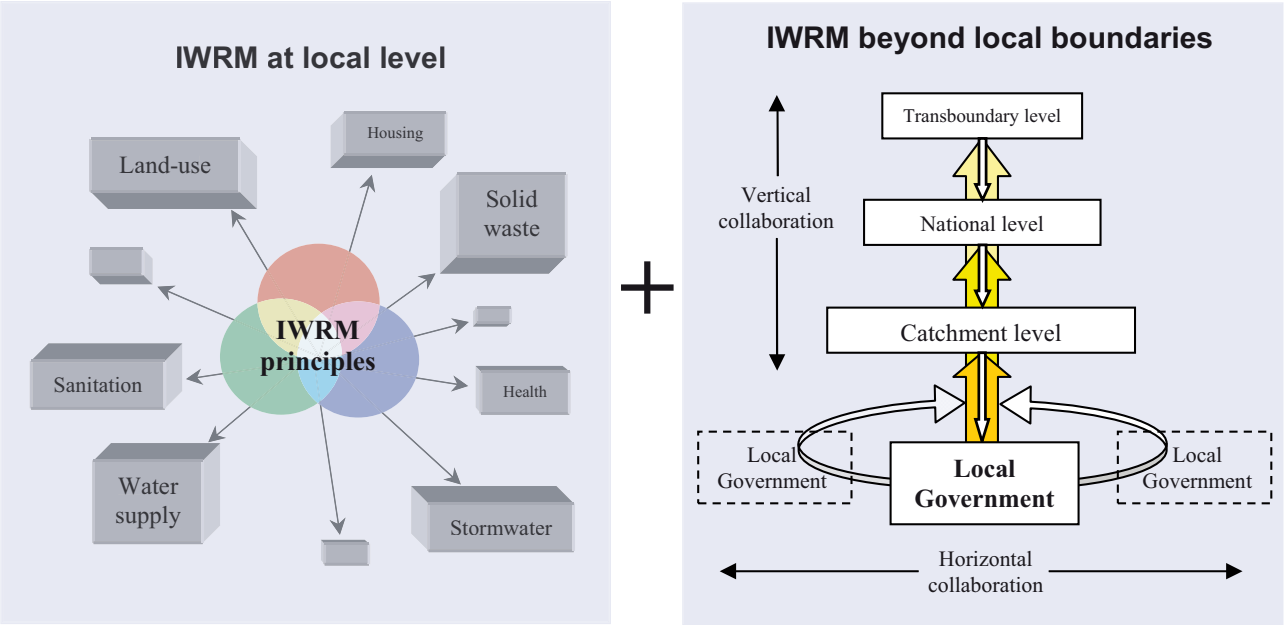


Figure 2.1– The 'twin-track' approach to IWRM

2.1 IWRM at local level – applying the principles to Local Government mandates

As has already been briefly discussed, IWRM principles can be applied at the local level to a greater or lesser extent across a range of Local Government mandates. This could be a basic approach that implements simple IWRM actions into the day-to-day operations of just one or two local mandates. At the other end of the scale, it could include the application of IWRM measures into all relevant mandates thereby achieving a more integrated approach. In many cases, Local Governments might decide to start with a few selected mandates and then look for opportunities to expand as their IWRM process develops.

Many Local Government mandates are closely linked with water resources. This connection is a mutual relationship with the delivery of certain mandates impacting upon water resources and, vice versa, water resources impacting upon certain mandates. Some mandates have an obvious link with water resources, such as water supply and stormwater management. Others are less obvious due to an indirect relationship, such as land-use planning. Figure 2.2 lists the relevant mandates, distinguishing between those that are directly and indirectly related to water resources.

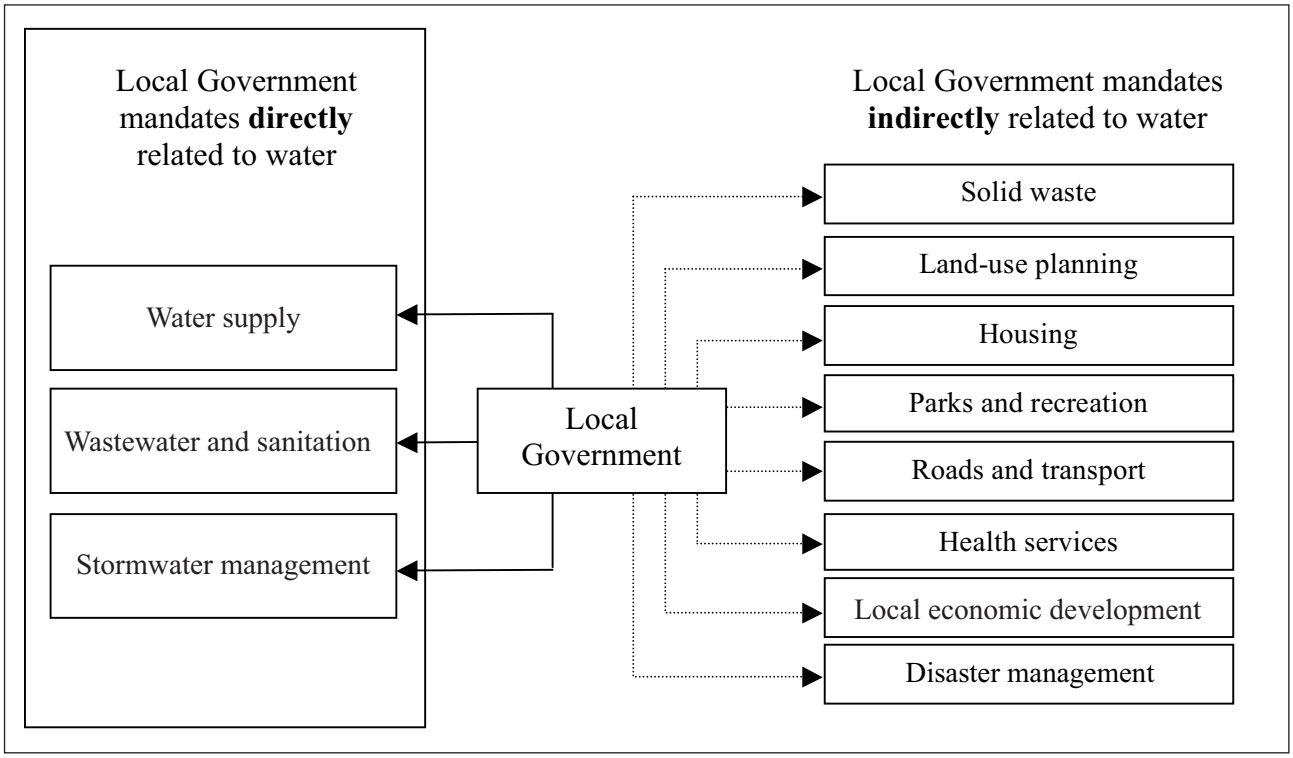


Figure 2.2 Local Government mandates that are directly and indirectly related to water resources

The choice of mandates to which a Local Government initially applies IWRM principles will depend on a range of factors and specific conditions in the local area. When deciding which mandates to target, Local Government should consider, for example, where actions are going to have the greatest immediate impact, which areas have been prioritised for improvement and where the biggest tangible benefits will be gained through the lowest investment.

Figure 2.3 shows how IWRM can start small and increase in size to become mainstreamed over time.

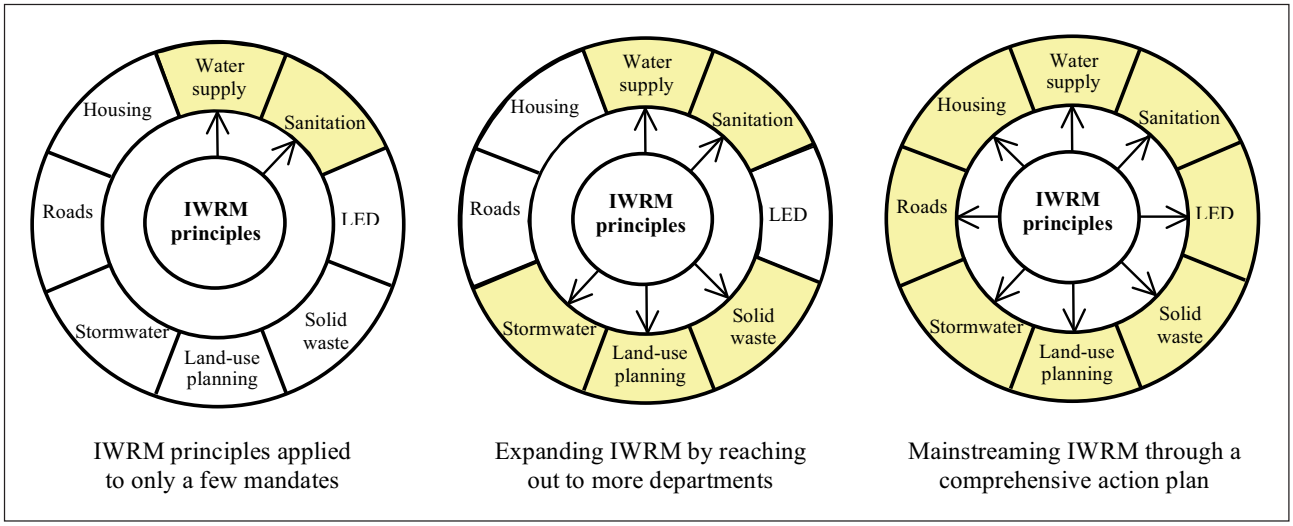


Figure 2.3 Expanding IWRM to a full-scale approach

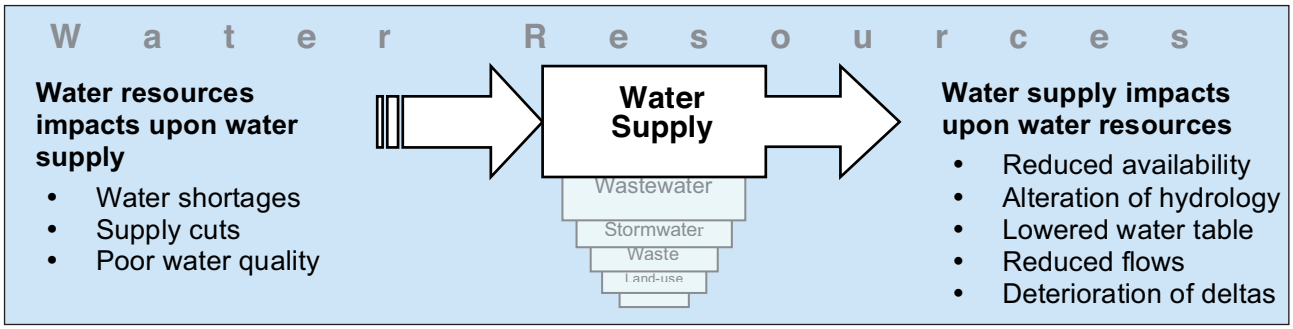
The application of IWRM principles across Local Government mandates can be comprised of many small moves to engage in water resources management. Even when limited in scope and applied to only two or three mandates, initial actions can nevertheless make inroads in the enhancement of social equity, economic efficiency and environmental sustainability.

Focussing on only a few mandates is particularly suitable for smaller administrations that have limited financial and human resources. It may also be the most appropriate starting point for administrations that are implementing IWRM measures for the first time. Although small advances towards IWRM may seem insignificant to begin with, they will always be better than doing nothing at all. Starting in this way can lead to the roll-out of numerous other initiatives, the sum of which will ultimately begin to have a sizeable impact within the local community and encourage the development of a more comprehensive implementation of IWRM.

Sections 2.1.1 to 2.1.11 draw attention to specific linkages between the Local Government mandates listed in Figure 2.2 and water resources. These describe how water resources impact on each mandate and simultaneously how each mandate can impact upon water resources. The descriptions are followed by checklist questions related to the mandate and examples of local measures that could be considered when the questions identify issues that need to be addressed. The listed measures should not be viewed as rigid instructions of what to do, as this will vary depending on local conditions and circumstances, but rather a selection from a range of options that can help tackle the problem at hand.

2.1.1 Water supply

Water supply is one of the most important mandates of every Local Government, as the provision of this basic service has such a crucial impact on standards of living. A safe and reliable water supply can help achieve improvements in livelihoods, health and school attendance thereby contributing to poverty eradication.



Water resources → Mandate

Water supply depends directly on the state of water resources and the access to a reliable source. In areas where water is scarce either on a permanent basis or as the result of drought, the local population is at risk from **supply cuts** and **water shortages**. Under such circumstances standards of living may suffer due to a lack of water for drinking, washing, sanitation and garden plots, which can impact on health and productivity. Access to scarce resources may also be restricted to domestic users due to competing demands by larger, more profitable users such as agriculture, industry and mining.

The **quality of the water** source can have a large impact on water supply. Poor water quality can be naturally occurring or linked to human activity in the catchment. Algal blooms, turbidity, salinization, and water contaminated by pathogens and carcinogens, such as cryptosporidium and arsenic, can restrict the supply of water from a source where treatment technologies are not available to remove the problem.

Mandate → Water resources

Local water supply abstractions from both surface and groundwater sources **reduces the availability of water resources for other local uses, the environment, and downstream users**. This is especially the case around big cities where a huge domestic demand upon resources may be created.

The abstraction of water for domestic use and the development of water supply infrastructure can **alter the local hydrology** with implications for users downstream and the environment. Unsustainable abstractions from groundwater **lower the water table** and may cause **springs** and the **streams** and **wetlands** they feed to **dry up**. Over-abstraction from rivers can have similar consequences through **reduced flows**. On a larger scale, the construction of dams for water supply to, for example, large cities, flood valleys, alter river flow patterns and trap sediment causing the **deterioration of river deltas**.

Checklist

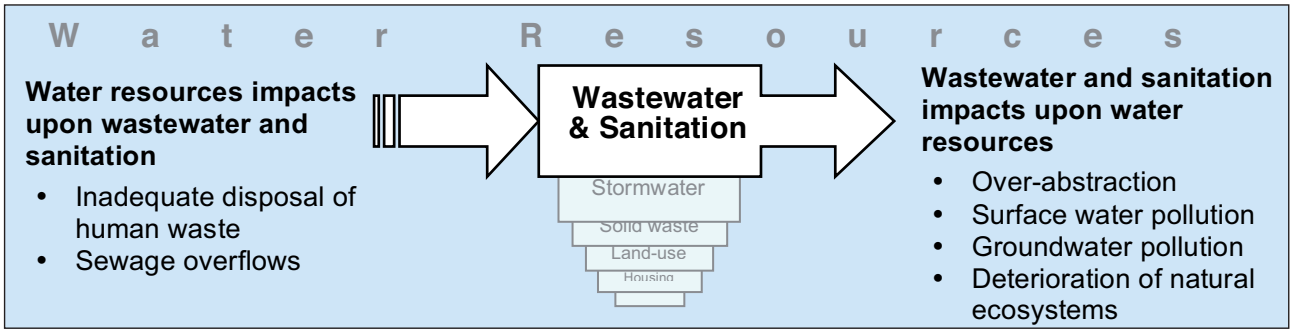
Checklist question	Yes/No ☑		Possible measures if answer is no*
Are there sufficient local water resources to provide a reliable water supply?	Yes ☐	No ☐ →	• Investing in water efficiency measures such as water demand management options, rainwater harvesting, greywater reuse and repairing leaking infrastructure. • Implementing options to obtain bulk transfers or develop new resources if water demand management is unlikely to provide enough savings to close the supply-demand gap. (*Note:* the impacts on users elsewhere in the catchment and the environment should be carefully considered before such options are developed.)
Are the local water sources of adequate quality following the available treatment, so as not to cause potential health issues for users?	Yes ☐	No ☐ →	• Assessing the reasons and sources of poor water quality and developing mitigation options to deal with these including stricter enforcement of water discharge regulations, protection of springs and watercourses, and groundwater management protection plans. • Improving water treatment techniques.
Have the downstream and ecological impacts of existing and planned water supply schemes been assessed and shown to be negligible?	Yes ☐	No ☐ →	• Carrying out water ecology assessments and hydrological and hydrogeological modelling. • Conducting environmental impact assessments.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.2 Wastewater and sanitation

How are wastewater treatment and sanitation linked with water resources?

Sanitation facilities and wastewater treatment have several linkages with the water cycle. These differ according to the type of sanitation technology used and the wastewater collection, transportation and treatment facilities available.



Water resources → Mandate

Sanitation systems that use flush toilets require water to operate. If, due to local water scarcity, a reliable water supply is not in place to flush the toilets, the system no longer works and the **disposal of human waste** can become a **problem** resulting in public health issues.

Many wastewater drainage systems are combined with stormwater drainage. Large increases in stormwater during heavy rainfall can cause the **system to overflow** and exceed the capacity of wastewater treatment works. The flooding that can result is likely to pose a health risk to the local population.

Mandate → Water resources

Although volumes are small compared to other water uses, flush toilets can still require a significant amount of the local treated water supply. This may result in **over-abstraction** from the local water resources raising questions on whether scarce fresh water supplies should be used to dispose of human waste at all.

Flush toilets also require the collection, transportation and disposal of the resulting wastewater. This may have large impacts on downstream users as, if not managed properly, leaking infrastructure, poor collection methods and insufficient treatment can cause **pollution in watercourses** that receive the discharge. The **natural environment** may also **suffer** as a result.

In many rural and peri-urban areas, people rely on dry latrines (VIP latrines, urine diversion toilets, etc.) which do not require water to flush and are therefore not associated with the issues of water supply and wastewater management. However, especially when built close to wells or in areas with a high water table, these may cause **groundwater pollution**. When designed properly, such contamination should be relatively easy to manage and pose only a minimum level of risk.

Checklist

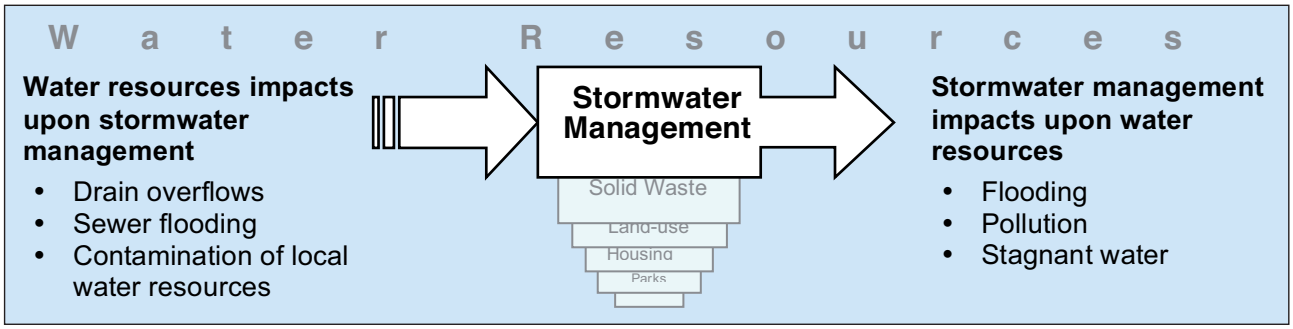
Checklist question	Yes/No ☑		Possible measures if answer is no*
Is there a reliable supply of water to operate flush toilets in the local community?	Yes ☐	No ☐ →	• Replacing flush toilets with pit latrines where this does not cause unacceptable social and/or environmental impacts. • Using collected rainwater or greywater for the flushing of toilets.
Is the wastewater collection and transportation system capable of handling high flows resulting from stormwater influx during heavy rainfall?	Yes ☐	No ☐ →	• Separating stormwater drainage from the wastewater system. • Increasing the capacity of the sewerage network and wastewater treatment plants to facilitate high flows during storm events without incidents of flooding.
Are the wastewater collection and transportation system and treatment works of sufficient design and quality to prevent pollution of the local area through raw sewage leakage and discharges of poorly treated effluent?	Yes ☐	No ☐ →	• Investigating improved wastewater treatment options such as reed beds and wetlands. • Upgrading treatment works and wastewater pipe networks to ensure that sufficient quality standards are met. • Maintaining pipe networks and treatment works and carrying out of regular checks to detect leaks and system failure. • Ensuring that where manual collection and transportation occurs, the operation of the tasks poses minimum threat to human health and the local environment.
Are dry latrines constructed following the recommended guidelines for each type including minimum pit depth, avoiding areas with high water tables and/or impermeable soils, located at least ten metres from the nearest water source, and emptied or filled in at the correct intervals?	Yes ☐	No ☐ →	• Relocating dry latrines from areas unsuitable for their use. • Constructing or reconstructing dry latrines following the recommendations specified for the chosen design.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.3 Stormwater management

How is stormwater management linked with water resources?

The management of stormwater is closely related to water resources through the influence that stormwater infrastructure has on the local hydrology and drainage during heavy rainfall events. Stormwater is also a source of fresh water itself and, if managed efficiently, can be collected and utilised for increasing local supplies.



Water resources → Mandate

Stormwater infrastructure not designed with sufficient capacity may **overflow** during extreme rainfall events. In systems where there is no separation of stormwater from wastewater, such overflows cause **sewer flooding** and the risk of **untreated wastewater contaminating the local area**.

Mandate → Water resources

Stormwater systems are often designed to rapidly remove high surface flows from an area, thereby reducing interception and ground infiltration rates. This can have a number of consequences for water resources.

The increased volume of runoff can cause **flooding** both along the drains themselves and in the bodies of final disposal. The physical impact of higher flow can also cause riverbank erosion and sedimentation of river and streambeds. Drainage systems that intercept and detain stormwater can help to mitigate these issues.

Stormwater systems tend to drain developed areas that often contain pollutants such as car oils and agricultural pesticide. If source mitigation measures to treat runoff do not exist there is a high possibility that these will be carried into the local watercourses and cause **pollution**.

A lack of adequate stormwater drainage can have a number of impacts. Poorly designed and maintained drainage systems can cause pools of **stagnant water** providing breeding sites for vectors of diseases, such as malaria. Blocked drainage channels and systems not designed to cope with high flows can also cause localised and upstream flooding as high flows are backed up.

Well designed stormwater drainage systems where runoff is collected and stored for future use can also have a positive impact on the natural water environment by reducing demands from freshwater sources.

Checklist

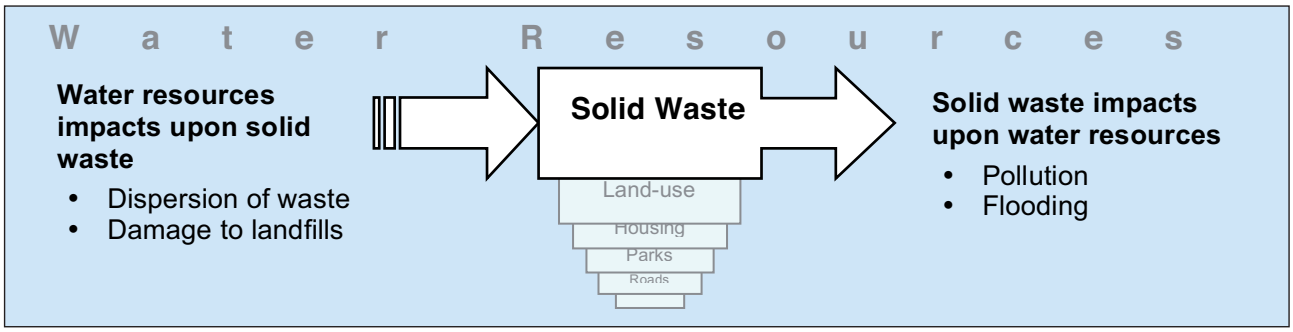
Checklist question	Yes/No ☑		Possible measures if answer is no*
Is stormwater drainage separated from the domestic sewage system and/or designed with sufficient capacity to accommodate extreme rainfall events?	Yes ☐	No ☐ →	• Drainage systems that separate stormwater from domestic wastewater. • Increasing the capacity of drainage systems that combine stormwater with wastewater to ensure that overflows and flooding do not result from extreme rainfall events.
Are managed stormwater flows controlled to the extent that they are not the cause of increased flood risk, and do not result in riverbank erosion and the sedimentation of watercourses?	Yes ☐	No ☐ →	• Stormwater drainage systems that intercept and retain stormwater rather than discharging it rapidly into watercourses.
Are measures in place to prevent stormwater runoff from carrying pollution into local water bodies?	Yes ☐	No ☐ →	• Drainage techniques that include treatment facilities, such as filters, interceptors and detention basins.
Is the stormwater management infrastructure of sufficient design and quality to drain the local area without pools of stagnant water forming after heavy rainfall?	Yes ☐	No ☐ →	• Stormwater drainage that is capable of coping efficiently with high rainfall. • Maintaining existing stormwater drainage systems to ensure that these are not getting blocked or falling into disrepair.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.4 Solid waste

How is solid waste linked with water resources?

Solid waste can have an effect on water resources through the contamination of water bodies and the blocking of drainage channels.



Water resources → Mandate

The construction of landfill sites on areas prone to flooding can render the site vulnerable during periods of high rainfall and storm events. Without mitigation measures in place, such events can cause the **dispersion of waste** requiring expensive clean-up operations. **Flooding also causes risk to landfill sites** that are not sufficiently protected, which can make costly rehabilitation measures necessary.

Mandate → Water resources

Poor disposal of solid waste may lead to the **pollution** of water resources through direct contamination of water bodies and the leaching of harmful substances from landfill and hazardous waste sites into groundwater. Solid waste pollution of water resources can happen at different points: the point of origin, when not adequately collected, during transport, or at the point of final disposal. The problem may indirectly impact on local industries, such as fishing if, for example, mercury appears in water supplies.

Uncollected or poorly collected solid waste blocks man-made and natural drainage channels potentially causing localised **flooding**.

Checklist

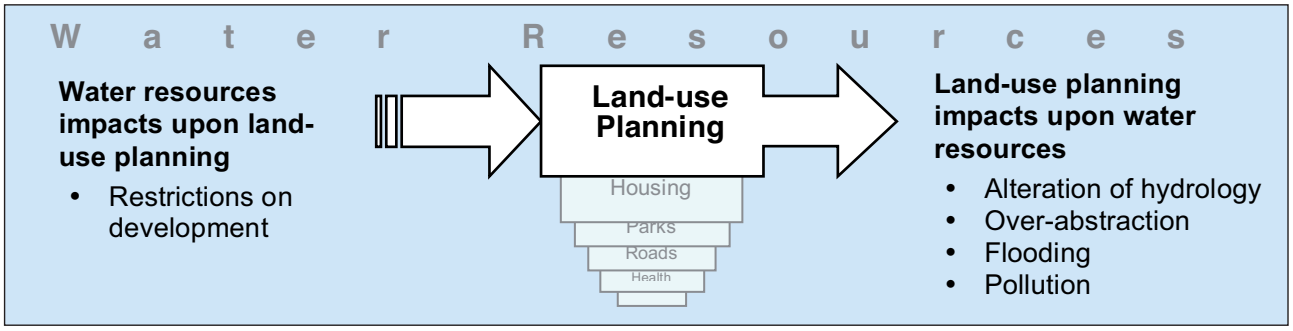
Checklist question	Yes/No ☑		Possible measures if answer is no*
Are waste disposal sites located away from areas vulnerable to flooding?	Yes ☐	No ☐ →	• Carrying out a flood risk assessment of the site. • Considering the relocation of the site if it is shown to be at risk from flooding. • Constructing flood defences.
Are waste disposal sites chosen and constructed with the necessary features to avoid leaching of harmful substances into the ground?	Yes ☐	No ☐ →	• Carrying out an environmental impact assessment. • Constructing landfill sites on low permeability surfaces and areas with a deep water table. • Lining landfill sites with compacted clay mineral and synthetic materials to reduce leachate.
Is it confirmed that there is no risk of water bodies being contaminated through runoff and leaching during the collection, transportation and storage of solid waste management?	Yes ☐	No ☐ →	• Assessing waste collection, transportation and storage methods. • Containing contaminated water and liquids through efficient collection and transportation methods and engineered on-site drainage and storage.
Are drainage channels and watercourses clear from uncollected and poorly stored solid waste?	Yes ☐	No ☐ →	• Ensuring that the strategy for solid waste collection includes the clearing of drainage channels and watercourses to reduce the risk of flooding. • Maintaining drainage channels and natural watercourses to prevent solid waste from collecting in them. • Developing and enforcing by-laws that penalise the dumping of solid waste in drainage channels and watercourses. • Raising awareness and educating private households and local businesses about the damage caused by dumping solid waste in drainage channels and natural watercourses.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.5 Land-use planning

How is land-use planning linked with water resources?

Certain types of land-use development can cause significant changes to water resources through alterations in the local hydrology, demand for more water from local sources and increased pollution.



Water resources → Mandate

For types of land use, such as agriculture, industry and housing, a reliable water supply may be an essential requirement. Areas that already suffer from water scarcity may not be able to supply enough water to meet the demand associated with the planned land-use thereby **restricting development**.

Land situated on flood plains may experience regular flooding. Development of this land without sufficient flood protection measures can result in costly damage when flood events occur and can make it hard to obtain insurance for property and infrastructure.

Mandate → Water resources

Changes in land use result in **changes in the local hydrology**. This is especially the case where hard surfaces replace permeable ones as run-off and infiltration patterns are altered causing erosion and increased sedimentation of stream and riverbeds. This can also occur with soft surfaces as, for example, forestry plantations may retain runoff, thereby reducing flows to watercourses and aquifers (although it should also be noted that afforestation in certain locations can reduce soil erosion and the risk of flooding as the trees attenuate runoff).

The water demand of land uses, such as irrigated agriculture and certain industries can be high and reduce the water availability for other users in the local area and downstream. Under such circumstances the natural environment should also be considered a user and this might suffer as **over-abstraction** occurs to meet the increased demand.

The conversion of natural vegetation to hard surfaces can increase **flood risk** both locally and downstream. Less water infiltrates the ground during heavy rainfall causing runoff to enter watercourses more rapidly and in greater volumes, which can result in significant increases in peak flows.

Certain types of land-use can have implications for the quality of water resources through the discharge of **pollutants** into local water bodies. This is especially the case with agriculture, mining and many forms of heavy industry.

Checklist

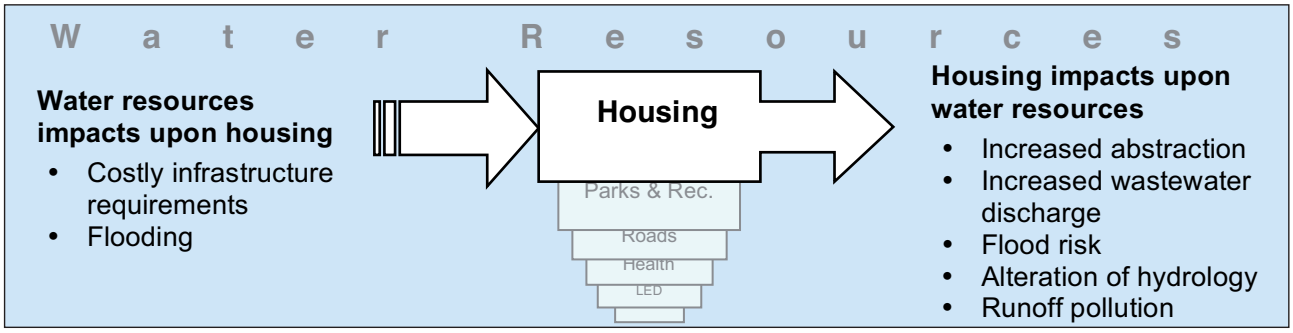
Checklist question	Yes/No ☑		Possible measures if answer is no*
Are sufficient resources available to meet the water needs of the planned land use?	Yes ☐	No ☐ →	• Reconsidering the use of the land. • Investigating alternative sources of water to supply the planned land use such as rainwater harvesting, onsite storage and wastewater re-use.
Have flood risk assessments shown that the land marked out for development is not at risk from flood events that may have implications on the land infrastructure and use?	Yes ☐	No ☐ →	• Reconsidering using the land for a purpose that will not be negatively affected by flooding. • Constructing flood defences. *(Note:* care must be taken to ensure that the construction of defences does not move the problem from one area to another.)
Will the local hydrology, and runoff and infiltration in particular, remain unaffected by the projected changes in land use?	Yes ☐	No ☐ →	• Constructing sustainable drainage systems directed at recreating natural runoff and infiltration characteristics.
Is the water required for the planned land use available without having a negative impact upon the supply to other groups in the community as well as local water ecosystems?	Yes ☐	No ☐ →	• Carrying out a water resources supply-demand balance assessment to examine existing local demands and whether surplus resource is available. • Carrying out an environmental impact assessment based on hydrological modelling. • Constructing rainwater harvesting systems and water reuse schemes to supplement new demand.
Can it be proven that runoff from land development will not increase the risk of flooding in the local area?	Yes ☐	No ☐ →	• Carrying out a flood risk assessment • Constructing sustainable drainage systems directed at recreating natural runoff and infiltration characteristics if flood risk is likely to be increased.
Is there sufficient evidence that the planned land-use development will not pose a pollution risk for local water resources due to pollutants in runoff or wastewater discharges?	Yes ☐	No ☐ →	• Constructing pollution mitigation measures such as onsite treatment methods.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.6 Housing

How is housing linked with water resources?

Housing development will have a large influence on water resources due to the associated increase in population and change to the natural landscape. The consequences can vary depending on, for example, whether the development is planned housing or informal constructions.



Water resources → Mandate

New housing developments require access to a reliable water supply. Constructing new developments in areas of water scarcity can result in the inhabitants suffering from water supply shortages and increase the **need for costly infrastructure**, such as water transfer schemes.

Building housing projects near rivers without carrying out a sufficient flood risk assessment can expose the new developments to regular flooding. The economic costs of **flooding** can be substantial and homeowners may have difficulties insuring their properties against flood damage.

Mandate → Water resources

Supplying water to new housing developments can negatively impact on other users within either the local community or up and downstream of the catchment as less water is available for use. The environment can also suffer as the result of **increased abstraction** from natural sources.

New developments cause an **increase in the volume of wastewater**. Inadequate treatment and disposal of the effluent can pollute local ground and surface water sources leading to health problems. This can especially be an issue in informal settlements.

Converting the natural environment to an urban landscape often requires the replacement of vegetated surfaces with hard ones. This can create a **higher risk of flooding** as increased runoff due to lack of vegetation to intercept flows and reduced ground infiltration rates result in larger volumes of drainage being discharged rapidly into local watercourses. Increased runoff also erodes riverbanks and deposits high levels of sediment into rivers and lakes **altering the local hydrology**.

Pollution can also occur as much of the increased runoff will come from roads and parking areas on which vehicle oils will often be present.

Checklist

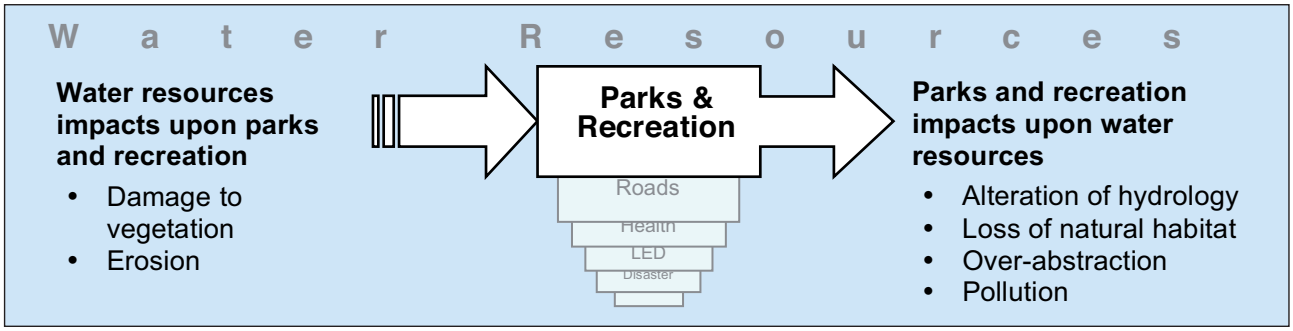
Checklist question	Yes/No ☑		Possible measures if answer is no*
Are there sufficient local water supplies to provide the needs of a new housing development?	Yes ☐	No ☐ →	• Reconsidering the location of the housing development. • Implementing rainwater harvesting and water demand management measures elsewhere in the local area to free up resources for new housing. • Assessing whether feasible options exist to transfer water from other areas where water surpluses exist.
Are the proposed sites for new housing developments situated on areas that evidence suggests have a low risk of future flooding?	Yes ☐	No ☐ →	• Carrying out a flood risk assessment. • Reconsidering the location of the housing development where a flood risk assessment has shown the site to be at risk from flooding.
Has it been shown that a reliable water supply can be provided to new housing developments without having a negative impact upon the supply to other groups in the community?	Yes ☐	No ☐ →	• Carrying out a water resources supply-demand balance assessment to examine existing demands locally and whether surplus resource is available. • Constructing rainwater-harvesting systems to supplement new household demand.
Is there adequate wastewater collection systems and treatment infrastructure in place to cope with the sewage generated by housing developments?	Yes ☐	No ☐ →	• Reconsidering the location of the housing development. • Investing in expanded wastewater collection and treatment infrastructure.
Can it be confirmed that runoff from housing developments due to the paving of naturally vegetated areas is not increasing flood risk, riverbank erosion and the sedimentation of water courses in the local area?	Yes ☐	No ☐ →	• Constructing sustainable drainage systems directed at storing and infiltrating runoff with the objective of maintaining a site's natural drainage characteristics.
Can it be confirmed that runoff from housing developments is not causing pollution in local surface and groundwater?	Yes ☐	No ☐ →	• Constructing drainage techniques that include onsite treatment, such as filters, interceptors and detention ponds to reduce pollution entering local water bodies.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.7 Parks and recreation

How are parks and recreation linked with water resources?

The construction and management of parks and areas of recreation is often closely related to water resources through alterations in vegetation, water course manipulation and irrigation requirements.



Water resources → Mandate

Depending on the choice of landscape and vegetation, parks and areas of recreation can suffer damage from lack of rainfall and droughts. Periods of low rainfall can cause **damage to vegetation** as non-drought resistant plant species die and lawns and playing fields dry out.

Poorly designed drainage facilities within parks and recreation areas can result in **flooding** and erosion during heavy rainfall events. Standing water prevents the use of parks and sports fields and can destroy certain plant species. A lack of storage basins or efficient drainage channels can lead to **gullies** being formed and **soil erosion**.

Mandate → Water resources

The construction of parks and areas of recreation may involve the removal of native vegetation and the introduction of alternative plant species. Such changes can impact on the balance of the **river ecosystem** resulting in **loss of natural habitat**. These alterations can cause increased run-off that erodes riverbanks, transfers high quantities of silt onto river and streambeds and increases the risk of flooding.

Parks and areas of recreation often require irrigation to maintain lawns, playing fields and foreign plant species. Inefficient irrigation techniques, such as spray irrigation (associated with high evaporation losses) can be a wasteful use of scarce water resources leading to **over-abstraction** that leaves less for the environment and other local uses.

The presence of graveyards in close proximity to surface and groundwater sources can cause **pollution**, thereby increasing health risks for those that use the sources for water supply.

Checklist

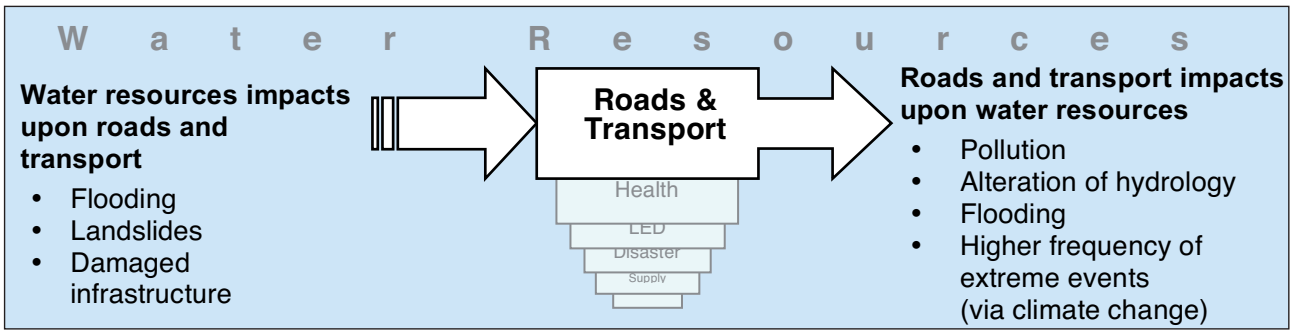
Checklist question	Yes/No ☑		Possible measures if answer is no*
Are parks and recreation areas designed to cope with the local climatic conditions and prolonged periods of low rainfall without the need for extensive irrigation?	Yes ☐	No ☐ →	• Selecting plant species that are compatible with the local climate and are resistant to drought.
Are parks and recreation areas designed to cope with heavy rainfall?	Yes ☐	No ☐ →	• Designing drainage systems that allow attenuation of high rainfall to take place through retention basins and infiltration. • Constructing drainage channels that are efficient in managing stormwater flows without causing significant erosion. *(Note:* care must be taken to ensure that stormwater flows are not directed to areas vulnerable to flooding.)
Is it known what effects the alteration of existing habitats to construct parks and areas of recreation will have on the local water ecosystems?	Yes ☐	No ☐ →	• Carrying out an Environmental Impact Assessment. • Carrying out hydrological modelling.
Is the additional water required for irrigating planned parks, gardens and sports facilities available without restricting other users in the catchment, including the environment, from accessing and maintaining the supplies they need?	Yes ☐	No ☐ →	• Developing onsite storage facilities to collect rainwater and run-off during wet periods for use during the dry season. • Designing parks and gardens based on local vegetation and drought resistant species to reduce the need for irrigation. • Using recycled or raw water of sufficient quality for the irrigation of sports fields.
Does the proposed irrigation regime make the most efficient use of the available water?	Yes ☐	No ☐ →	• Using water efficient irrigation technologies, such as trickle irrigation, rather than for example spray irrigation which can cause significant losses through evaporation. • Carrying out irrigation in the early morning or late afternoon and when winds are low to reduce evaporation rates which are higher during the hottest part of the day and when winds are strong.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.8 Roads and transport

How are roads and transport linked with water resources?

Local transport networks, such as roads, railways and bridges can have potential affects on, and be affected by, water resources. These should be considered during the development of local private and public transport plans and before the construction of infrastructure projects.



Water resources → Mandate

Roads and transport infrastructure constructed near watercourses can be badly affected during incidents of **flooding** due to the effects of inundation and **landslides**. Such events can put the **infrastructure out of use** for long periods, as well as causing costly **damage to roads and railways**.

Mandate → Water resources

Runoff from roads can often contain oils from vehicles and litter which is then transferred to watercourses causing **pollution**. River courses and traffic routes are the "arteries of development" – how they are located in relation to each other is important to minimise the impact of pollution.

Roads cause increased surface runoff as water flow is concentrated and channelled off the road into watercourses. This alters streams and rivers as increased runoff rates erode the riverbanks and carry high sediment loads especially where roads are dirt based. **Flooding** can also result as impermeable road surfaces increase peak flows during storm events.

Bridges that are not properly designed to accommodate high flows can form a barrier during floods. This can increase the impacts of localised **flooding** as water backs up behind the bridge and flow is redirected.

From a more global perspective, the construction of roads leads to increased car use which, when added to an already dense road network and an increasing volume of traffic, has long-term pollution and climate change implications. This can **increase the frequency of floods and droughts**.

Checklist

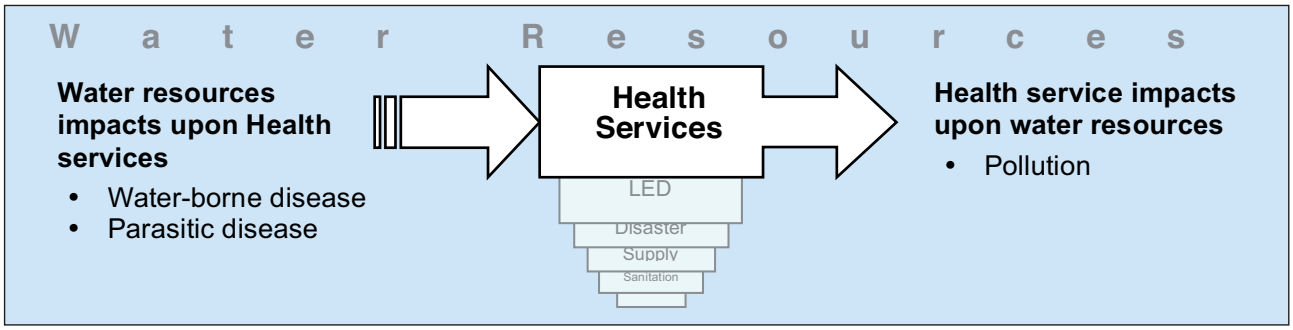
Checklist question	Yes/No ☑		Possible measures if answer is no*
Has the flood risk to transportation infrastructure been examined and measures taken to mitigate flooding of local transport infrastructure?	Yes ☐	No ☐ →	• Carrying out a flood risk assessment prior to the construction of new infrastructure on flood plains. • Constructing embankment walls, culverts, diversion channels, etc., to improve road drainage. *(Note:* care must be taken in mitigation selection to avoid moving the problem from one area to another.)
Have measures been taken to reduce pollution in run-off waters from transportation related sources?	Yes ☐	No ☐ →	• Monitoring of waste oil disposal from car repair shops and gas stations. • Developing on-site drainage systems that capture pollutants at the source through interceptor structures designed to remove oil and grease as well as solid materials.
Is the planning and design of roads sensitive to the location of water resources, especially wetlands, and avoids disturbing hydrological regimes?	Yes ☐	No ☐ →	• Locating roads away from water sensitive areas. • Designing roads with impermeable surfaces and drainage systems that retain run-off and reduce peak flows during storm events. • Carrying out an Environmental Impact Assessment.
Has the planning and design of roads and bridges considered possible increases in flood risk that may result?	Yes ☐	No ☐ →	• Carrying out flood risk assessments. • Designing roads with impermeable surfaces and drainage systems that retain run-off and reduce peak flows during storm events.
Have alternative measures such as improved public transportation been considered to reduce traffic congestion rather than building a larger road network?	Yes ☐	No ☐ →	• Increasing investment in public transport services. • Introducing road tolls and congestion charges.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.9 Health services

How are health services linked with water resources?

The health of the local population is closely related to safe and secure water supplies and adequate sanitation, as well as the effectiveness of drainage systems.



Water resources → Mandate

The negative impacts of water resources on health are often the result of mismanagement of water resources rather than the resources themselves. The main causes of water related diseases tend to be poor water quality and stagnant pools of water, both of which can be avoided through effective water resources management in mandates such as wastewater treatment and stormwater management.

More specifically, **water borne diseases**, such as cholera and diarrhoea, can be the direct result of a lack of access to water supply and sanitation services as they are transmitted through drinking water contaminated by human waste.

Poor drainage infrastructure can result in pools of stagnant water that become breeding grounds for vectors of **parasitic diseases**, such as malaria. Water supply options, including reservoirs and smaller embankments can also have health impacts as, along with the malaria threat, additional problems such as bilharzia and intestinal worms that were not present previously can become an issue.

Poor health caused by an inadequate supply of water and sanitation and poor drainage can have significant social and economic impacts throughout the local community. Healthcare expenditure by Local Government is likely to increase at the expense of funds for other mandates and projects. In addition poor health in the local community reduces the able workforce and limits school attendance, thus creating a long-term impact on the local economy.

Mandate → Water resources

The impact of health services on water resources can be significant. Solving these problems may however be the responsibility of other Local Government mandates such as wastewater treatment and solid waste. Health services should, nevertheless, be aware of the issues and work together with other Local Government departments to reduce the impacts.

The uncontrolled discharge of hospital wastewater without specific pre-treatment can cause significant **pollution** to local water resources. Contaminants such as pathogenic micro-organisms, heavy metals, disinfectants, detergents, solvents and pharmaceuticals can exist in concentrations that are damaging for the environment and pose potential toxic or infectious risks for humans.

The disposal of solid waste from hospitals and clinics must also be carefully controlled as inadequate incineration and disposal can contaminate local water supplies.

Checklist

Checklist question	Yes/No ☑		Possible measures if answer is no*
Can it be shown that wastewater and sanitation services are adequate and drainage infrastructure is sufficiently efficient so as not to cause incidents of water-borne and parasitic disease among the local population?	Yes ☐	No ☐ →	• Contact those responsible in the relevant departments to discuss the issues and raise awareness of the need for improvements.
Have the potential health impacts of new water supply options such as embankments and reservoirs been considered and discussed with the relevant departments?	Yes ☐	No ☐ →	• Raise awareness of the health issues that may result from the establishment of artificial water bodies.
Is the local population aware of the health implications of poor sanitation practices and the use of contaminated water for drinking and food preparation?	Yes ☐	No ☐ →	• Conduct public health awareness campaigns throughout the local community. • Provide water related health education in local schools.
Are wastewater discharges from hospitals and clinics adequately collected and transported and are the local wastewater treatment works capable of coping with the levels of contamination?	Yes ☐	No ☐ →	• In consultation with the wastewater services department, consider safe methods for collection and transportation of wastewater discharges from hospitals and clinics and whether there is a need for on-site pre-treatment of the effluent.

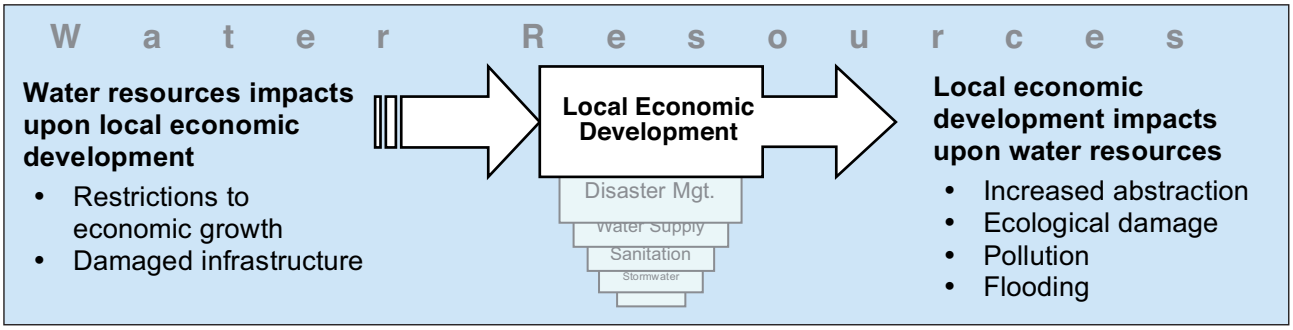
* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.10 Local economic development

How is local economic development linked with water resources?

The local economy is based on a range of different industrial, agricultural and trade businesses that are all water users in various ways. Water is, therefore, a key factor of production and can be regarded as indispensable for promoting local development and ultimately helping to eradicate poverty.

Balancing the different interests at stake in economic development is an especially difficult role for Local Governments. In most situations, not all water users can be satisfied equally and priorities will have to be set for water allocation and the issuing of licenses. Less powerful groups of society often lose out. However, the water resource itself is often the biggest loser since the economic value of ecosystem services tends to be hugely underestimated, if understood at all.



Water resources → Mandate

Water scarcity restricts local economic development as the lack of secure water supplies can **hamper industrial and agricultural growth.** Many industries such as metal processing and paper mills require large volumes of water to operate and agricultural profits are often based on water-intensive crops, for example, cotton and wheat.

Flood events can have devastating effects on the local economy as the local damage can result in substantial reconstruction costs. In addition, **damaged industrial, agricultural and transportation infrastructure** may remain out of use for significant periods following floods. This makes it difficult for the economy to pick up again once the floodwaters have receded.

Mandate → Water resources

The use of water for economic development has to be in balance with the overall water available for use and quality of water at the local level. **Increased abstractions** to meet new demand can cause restrictions in water availability for local users and users downstream as well as creating **ecological damage** by removing an unsustainable amount of water from the environment. Further impacts include **pollution** as industrial and agricultural wastewater is discharged into local water bodies. Increased **flood risk** is also a concern associated with the development of land for economic purposes.

Checklist

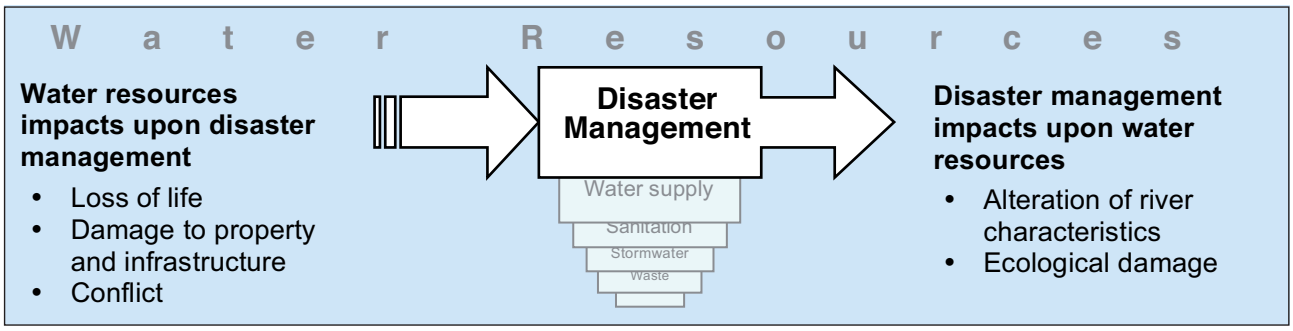
Checklist question	Yes/No ☑		Possible measures if answer is no*
Are there sufficient water resources to supply expansions in industrial and agricultural development without significantly upsetting the balance with other local users, users downstream, or the environment?	Yes ☐	No ☐ →	• Implementing industrial water demand management measures such as wastewater reuse. • Stimulate water-sensitive productive activities. • Encouraging the cultivation of non-water intensive crops and water efficient irrigation techniques. • Developing water transfer schemes or new sources of supplies if these are available without having an impact on downstream users or the environment.
Are the existing and planned locations for industrial infrastructure and land developed for agriculture on sites that are unlikely to be at risk from flooding?	Yes ☐	No ☐ →	• Relocating industrial and agricultural infrastructure to areas less at risk from floods. • Improving flood defences and attempting to mitigate upstream causes of floods.
Is there evidence that existing and planned economic activity does not cause unacceptable levels of pollution in surface and groundwater resources both locally and downstream?	Yes ☐	No ☐ →	• Encouraging the installation of onsite water treatment facilities such as sand filters and detention basins to intercept pollutants at the source before wastewater is discharged to the local water bodies. • Regulating wastewater discharges from economic activity to ensure that quality standards are maintained, and penalising companies and individuals that fail to comply.
Can it be shown that changes in the natural drainage characteristics brought about by the development of land for economic purposes will not cause an increased risk of flooding locally or elsewhere in the catchment?	Yes ☐	No ☐ →	• Constructing sustainable drainage systems on industrial and agricultural sites that are directed at recreating natural runoff and infiltration characteristics.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.1.11 Disaster management

How is disaster management linked with water resources?

Some of the most common natural disasters in southern Africa, namely floods and drought, are closely linked to water resources. By preparing for such disasters, Local Government can help to reduce the impact and costs when they occur.



Water resources → Mandate

Large scale flooding is often the result of heavy rainfall. Floodwaters may rise gradually during periods of prolonged precipitation or may occur rapidly as the result of intensive rainfall brought on by events such as cyclones. However, other circumstances such as upstream snow melt and the release of water from dams may also cause flooding. The effects of flooding can be devastating on local communities due to potential **loss of life** and **damage to property and infrastructure**.

Drought tends to inflict areas following the failure of rains during the wet season or accumulated periods of unusually hot and dry weather. However, over-exploitation of water resources can also cause man-made droughts through aquifer depletion and the emptying of lakes. The impacts of drought can be severe. These may involve violent **conflict** between users, migration of people and famine.

Mandate → Water resources

Flood protection measures can significantly **alter river characteristics**. Most rivers flood naturally and building defences to prevent this changes the hydrology and can shift the problem downstream with magnified effects.

Reactive measures to deal with droughts can **damage aquatic ecosystems** and the flora and fauna that depend on them, as alternative sources of water are sought to replace the reduced availability from regular supply points. Transferring water from elsewhere may provide a temporary solution to local shortages but can cause long lasting damage to the ecology of its source. Taking proactive measures to manage droughts can go a long way in reducing these impacts.

Checklist

Checklist question	Yes/No ☑		Possible measures if answer is no*
Are areas prone to natural flooding free from housing and infrastructure allowing space for rivers to rise without causing damage to property and services?	Yes ☐	No ☐ →	• Carrying out a flood risk assessment. • Relocating housing developments and infrastructure away from flood plains. • Developing a flood warning system that provides early notice of potential flood events through the monitoring of water levels and weather patterns, and establishing good communications network with which to raise the alarm. • Constructing flood defences. *(Note:* care must be taken to ensure that the construction of defences does not simply shift the problem further downstream.)
Have drought plans been created to ensure that measures are in place to mitigate the impacts of long periods of below average rainfall?	Yes ☐	No ☐ →	• Creating drought plans that include an early warning system based on the monitoring of water levels, weather patterns and historical records. • Drafting different steps to be taken depending on set drought indicators being triggered. These could range from proactive water efficiency and non-essential use restrictions to emergency measures such as the tankering of water.
Is enough known about the characteristics of water sources such as aquifers and lakes to ensure that abstraction regimes are sustainable for long-term use?	Yes ☐	No ☐ →	• Carrying out hydrological and hydrogeological modelling. • Monitoring ground and surface water sources to determine when levels are low and abstractions need to be reduced.

* Note that these are only a selection from a range of measures that may be appropriate depending on specific conditions and circumstances

2.2 IWRM beyond Local Government boundaries

The local level actions, as discussed in Section 2.1, are a crucial part of IWRM. Local Governments can, however, go further and reach out beyond local boundaries thereby adopting a 'twin track' approach to IWRM.

Reaching out beyond local boundaries is possible in two directions:

- **horizontal** – coordination and collaboration between different Local Governments
- **vertical** – collaboration with higher levels of authority such as catchment agencies, National Government and transboundary institutions

Ideally vertical collaboration is conducted from a base of horizontal coordination between several Local Governments. This ensures that common interests and issues are communicated vertically and stand a better chance of influencing higher level legislation and policy. Figure 2.4 displays this process.

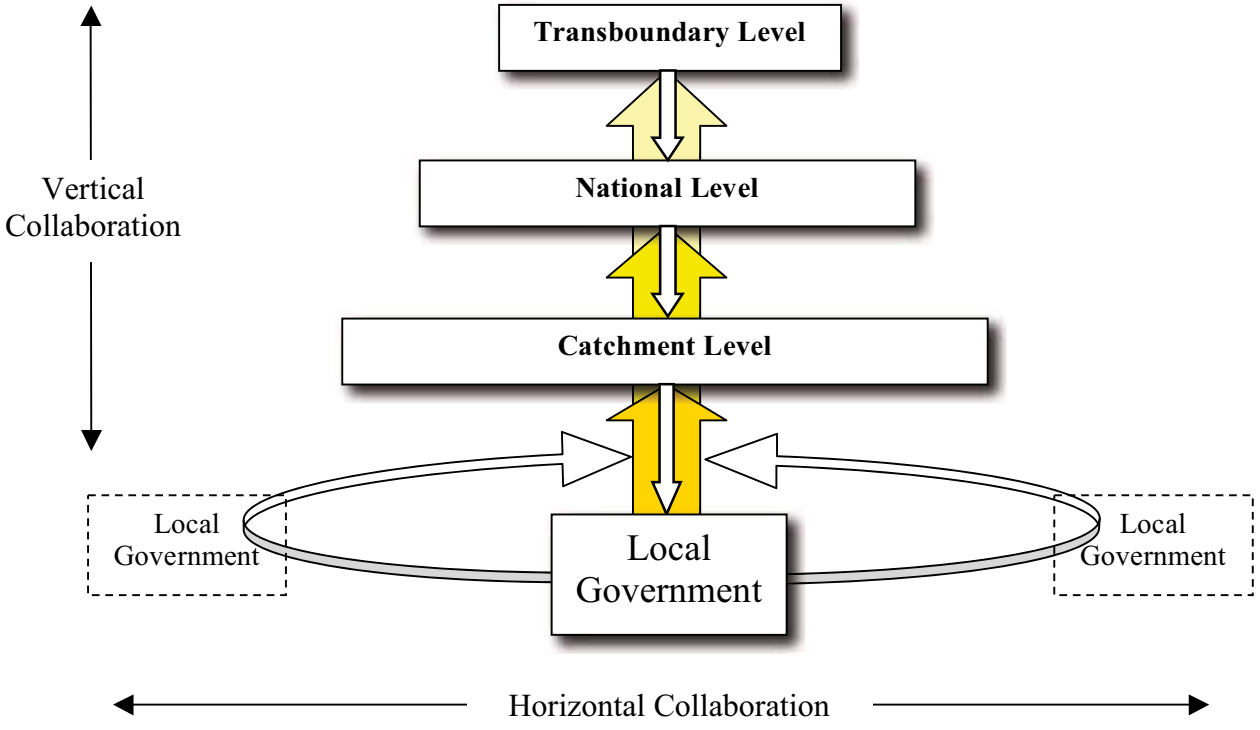


Figure 2.4 IWRM beyond local boundaries

2.2.1 Horizontal collaboration: forging links with other Local Governments

IWRM measures are more effective if Local Governments in the same region organise their activities in a coordinated manner. Benefits for water resources, and consequently the population, economy and ecology of the local area, are likely to grow when increased numbers of Local Governments within the catchment apply the principles of IWRM in a synchronised approach.

Collaboration should not be limited to dialogue simply between Local Governments themselves, but rather should include other water users in the catchment who also have a stake in the management of local water resources. Such a participatory approach takes advantage of the wide range of knowledge that exists on water resources outside of Local Government and enables issues and needs to be identified that are not only in the interest of a select few.

Collaboration also has the potential to rationally defuse conflicts that may arise from competition over access to and use of water resources. Working together is the most effective way of negotiating economic trade-offs and reaching a consensus over issues at stake.

In some countries in the SADC region, city and town councils have shown themselves to be more advanced than National Government and have become forerunners in certain IWRM activities. In these situations, the Local Government is in a good position to accelerate progress by actively sharing their experiences of IWRM with others beyond local boundaries.

2.2.2 Vertical collaboration: engaging in sub-national, national and transboundary IWRM institutions

Water resources legislation, regulation and policy are usually developed at the international, national and river basin or catchment level of government. Depending on the degree of decentralisation, Local Governments possess the power to develop their own bylaws and policies, which they can make use of when engaging in IWRM at the local level. However, these must comply with the frameworks that are in place at higher levels. Before embarking on IWRM, Local Government must therefore have a good understanding of these frameworks to ensure that its own activities do not contravene them.

In some countries, national or catchment level authorities have made specific arrangements to ensure that Local Government can get involved in IWRM. An example of this exists in South Africa where Local Government is allocated seats in the Catchment Management Agencies (CMAs). In such cases, it is important that Local Governments take advantage of the situation by attending meetings and raising the relevant issues that they would like to see addressed.

Local Government is less likely to have the opportunity for direct involvement with institutions at the national and transboundary levels. However, their interests may be indirectly represented at the national level by Local Government associations and catchment authorities and thus in turn, National Governments may have the opportunity to raise local issues at the transboundary level.

3. Introducing a local IWRM process

A local IWRM process is a structured approach to planning, implementing, monitoring and evaluating IWRM at the local level. Such an IWRM process is comprehensive in nature and tries to identify and observe the linkages between water resources and Local Government mandates in a holistic way.

The process starts with a baseline review of a variety of aspects of the water resources themselves, the surrounding legal and institutional frameworks and the water users in the area. Building on this information, a multi-stakeholder platform is established to develop the overarching vision in which the plan will be embedded. The vision is translated into more specific objectives, indicators and targets following strategic choices made by the Local Government in coordination with the stakeholders. Using this strategy as a foundation, projects are developed to achieve the objectives and targets through which the overall vision becomes reality.

Before starting the planning process, two key requirements should be addressed and realised:

- **Political support** – It is important that the decision to develop a local IWRM action plan has full political backing in order to ensure that a developed strategy goes beyond the planning stage and is successfully implemented. Support from local politicians will help raise awareness and secure budget allocation, which reduces the risk of the plan failing to develop beyond a well-intentioned paper.
- **Internal coordination** – As the local IWRM action plan will concern many Local Government responsibilities, it is essential that there is a good communication network between Local Government departments. This is necessary to ensure that all needs and interests are taken into consideration in the development stage and that all departments are aware of their role in the implementation and monitoring of the plan itself.

These requirements are described further in Sections 3.1 and 3.2.

The planning process can be laid out as a series of steps that highlight the different development stages of the local IWRM action plan. Figure 3.1 shows these steps and gives a brief description of what they involve. Whereas the diagram illustrates an obvious starting point, a process such as the one described in this section is unlikely to have a defined ending. This is because the management of water resources is ongoing and should be constantly monitored, evaluated and improved.

Section 4 provides more detail of each of the steps of the planning process while Section 5 lists and summarises a number of tools that can be used to assist with the development of the different stages.

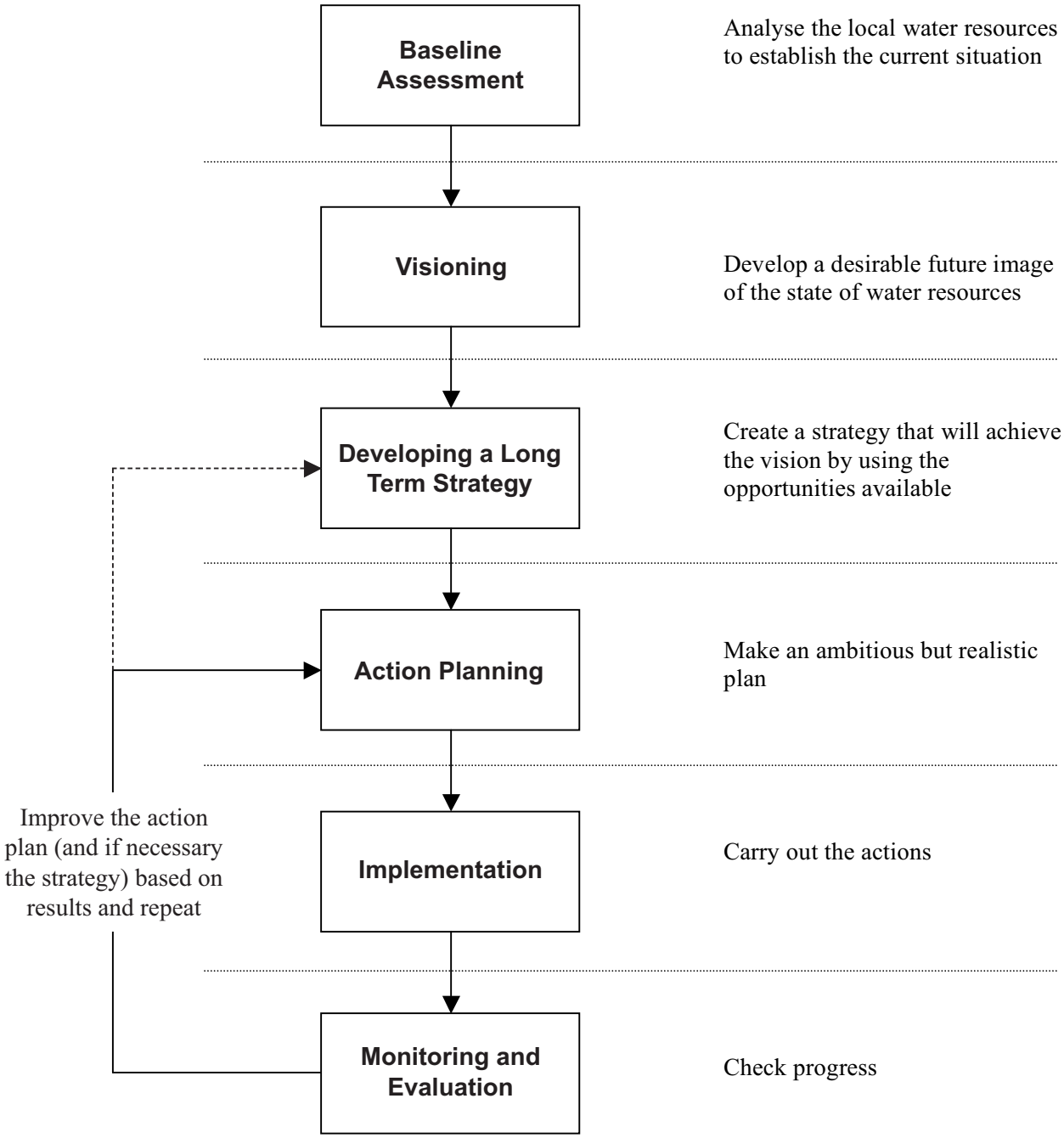


Figure 3.1 Steps of the local IWRM process

3.1 Ensuring political commitment

Before embarking on the development of a local IWRM action plan it is crucial that the local political leadership supports the legitimacy of the IWRM process, provides motivation and creates a binding framework for planning and implementation. Political approval is extremely important for launching an over-arching process that covers all relevant Local Government departments – rather than isolated projects on individual issues – and for putting participatory planning on the political agenda.

Political approval is also essential when the first major step of the IWRM process is achieved, that is, when the water action plan has been finalised and is ready to be implemented.

Making the case for IWRM at local level

To establish the support and commitment of the local council it is necessary to convince the politicians of the economic, social and environmental benefits to be gained through IWRM. Equally, they need to become aware of the added value of involving stakeholders to achieve IWRM goals more effectively.

In order to get politicians on board someone has to make the first step and bring IWRM into the local debate. It might be, for example, an individual or maybe a small group of colleagues within the Local Government itself that launches and drives the discussion. Such people often distinguish themselves through their strong ability for visionary and strategic thinking, their dedication to make Local Government truly serve their communities and their readiness for innovation. In other cases, the initiative for localising IWRM may come from outside the Local Government, for example from a community-based organisation or a farmers cooperative.

The significance of political commitment

Political commitment and support for embarking upon IWRM, as well as maintaining the momentum once the process is underway, should be gained through approval by the local community's elected political representation, the local council. This formal endorsement is significant as it helps to create the following:

- **Legitimacy** – Through council approval, the administration receives formal backing to become active in IWRM. It is also the prerequisite for the allocation of a budget to the process.
- **Motivation** – Official support expressed through a decision of the council is a motivating signal for staff and stakeholders who contribute their time and effort.
- **Binding nature** – By granting approval to the administration and stakeholders, the council also binds itself to acknowledge the output and results of the plan, as developed through a participatory approach involving stakeholders. This guarantees that the process is being taken seriously and will produce concrete effects. It will also ensure that Local Government remains accountable to stakeholders.

Political commitment by the local council is a key factor of success for a comprehensive IWRM process.

The need for cooperation with stakeholders

Council approval of the IWRM process should acknowledge the important role of stakeholders. It needs to be stressed that a participatory approach does not mean undermining the powers of the elected body. Rather local politics benefits from direct cooperation with stakeholders by obtaining support from the local community, gaining access to additional sources of information, experiences and capacities and sharing responsibility for the planning and implementation of programmes and actions.

3.2 Establishing internal coordination

To successfully put a local IWRM action plan into place, it is important that an efficient coordination process exists within the Local Government. An integrated approach to managing water resources at the local level demands that different Local Government departments are linked and work together to share responsibilities. This is likely to require a coordinating unit that oversees the entire process. The cooperation of senior staff in each department will also be needed to ensure that allotted actions are effectively performed.

Understanding IWRM across Local Government departments

For some Local Government departments it may not be obvious why IWRM is relevant for the fulfilment of their mandate. Staff has to be aware of how actions within their own area of responsibility can influence water resources in order to adjust the performance of their mandates. This is particularly the case for departments where the link between the mandate and water resources is not immediately obvious, such as roads and transport management, or land-use planning.

The need for a coordination unit

A cross-departmental unit should be set up to oversee the IWRM process and its management as well as to coordinate internal communication and activity. The unit is ideally made up of representatives from the relevant departments who provide input to the process and act as a communication link between the departments. Members of the unit should also have sufficient seniority to implement agreed change within the various departments. In smaller administrations, it might be sufficient to assign the role of coordination to a single senior member of staff.

The coordination unit could exist in a number of possible forms. These include:

- **Option A** – A separate, higher level office to which all departments report
- **Option B** – A new office at the same level as the other departments
- **Option C** – A unit within an already existing department
- **Option D** – Regular roundtable meetings of representatives of all departments that are involved in the process

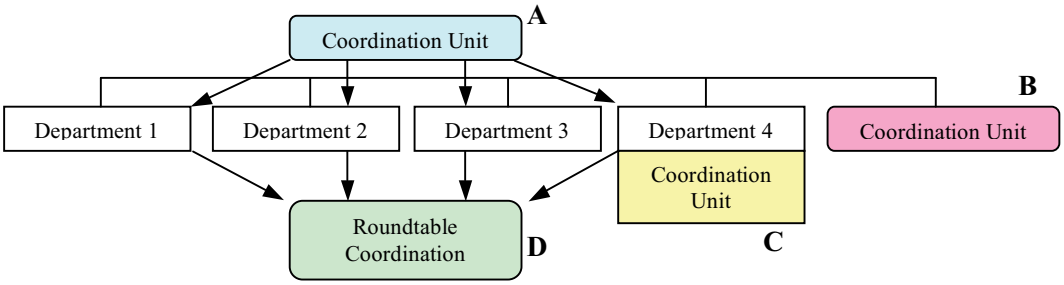


Figure 3.2 Options for locating the internal coordination unit of an IWRM process

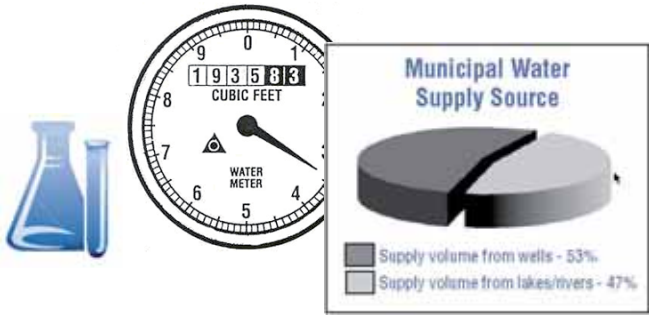
Good communication

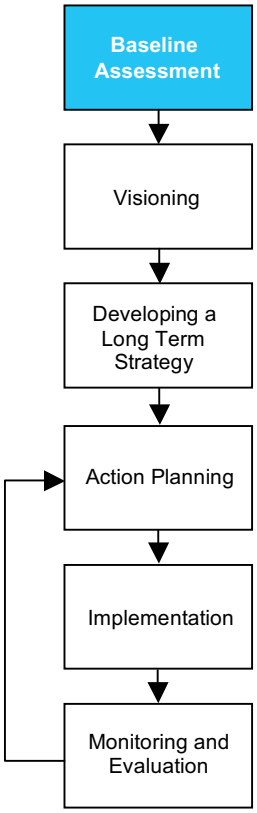
The coordination unit should also ensure effective internal distribution of information through formal or informal mechanisms. Informal methods include email distribution lists, notice boards and personal communication. More formal approaches could consist of announcements during cross-departmental meetings, official written communication to heads of departments and presentations of IWRM progress and issues.

4. Steps of a local IWRM process

The local IWRM process is a structured approach to comprehensive water resources management. The process consists of a number of steps through which the planning, implementation, monitoring and evaluation of IWRM at the local level takes place. The following sections provide details of each of these steps.

4.1 Baseline assessment





What it is and why it is necessary

The baseline assessment collects information to establish a comprehensive knowledge base that outlines the current water management status of the local area. This includes not only the physical state of local water resources and infrastructure, but also relevant legislation, existing policies and current management activities. It is also the stage where stakeholders are identified for inclusion in the IWRM process and in which a deeper understanding of the underlying causes of existing problems is established.

Information for the baseline assessment can be obtained from a wide variety of sources and should roughly focus on the following categories:

- the local water resources situation, including the assessment of the quantity and quality of the local surface and groundwater sources, rainfall rates, average and peak demands, as well as the condition of water infrastructure;
- water legislation, such as water acts and licensing practice;
- key stakeholders, such as individuals and representatives of groups who will be invited to participate in the development of the local IWRM action plan; and
- water management activities and institutions, such as completed and ongoing projects and the existence and roles of institutions at, for example, river basin level that impact on local water resources.

The role of Local Government

In carrying out the baseline assessment, Local Government should:

- identify the sources and contacts required to gather the necessary information;
- oversee, coordinate and, where possible, participate in the collection of information;

- provide facilities and resources for an efficient system to store information and enable access for interested members of the general public; and
- establish a list of stakeholders and a platform through which they can participate.

It is not necessary for a Local Government to do the baseline assessment single-handedly. Various organisations, such as universities, research institutions and private consultants can assist with many of the tasks, including data collection and information analysis.

Key tasks

Key tasks	Description
Compilation of a list of information sources	The drafting of a list of institutions, organisations and any other sources that might provide useful information for carrying out a baseline assessment.
Collection of secondary information	Collection of information that is already available from the archives and data stores of all Local Government departments as well as from identified external institutions and organisations. This should provide a good understanding of the current water resources situation both physically, in terms of quality, quantity and patterns of demand, and legally, with regard to legislation and policy.
Collection of primary information	Collection of information through, for example, investigations to fill information gaps on the local infrastructure and water environment, and discussions with the local community to highlight existing concerns, such as health problems, that might be related to local water resources.
Storage of information	Ensuring that information is properly documented and stored in a systematic and structured way. Ideally this should be done in an electronic database. However, it is also possible with a well-organised and maintained paper filing system.
Providing access to information	Providing other government departments with easy access to the compiled information and, externally, allowing civil society to benefit from the growing amount of knowledge.
Stakeholder identification	Identification of stakeholders at an early stage of proceedings in preparation for their involvement in the development of a local IWRM action plan.
Media and public relations work	Announcement of the intention to carry out a baseline assessment in order to raise public awareness of the reasons for the collection of information and encourage people to get involved.

Useful tools and methodologies

See the following tools in Section 5.1 and Annex A:

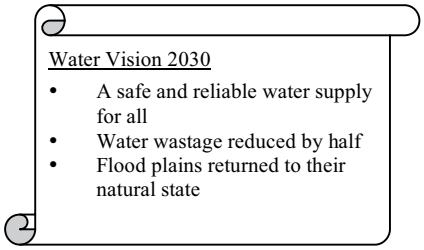
- **A1** IWRM checklist for Local Governments
- **A2** Stakeholder analysis
- **A3** Problem tree analysis
- **A4** SWOT analysis
- **A5** Water Poverty Index (WPI)
- **A7** Press release
- **A13** Worksheet for Participatory Monitoring and Evaluation (PME)

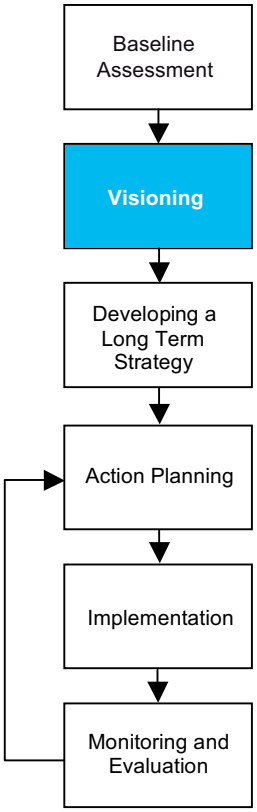
See also the papers on Water Resources Assessments (B1) and Aquatic ecosystem assessment and evaluation (B2) in Annex B.

Pitfalls and success factors

- **Getting stuck in data collection** – Collecting an endless mass of data is time consuming and often unnecessary. The basic situation and trends often become sufficiently clear without the need to achieve '100% information coverage'.
- **Meeting resistance from sources of information** – Resistance to the provision of information can come from within or outside the local administration and is typical where people are unaware of the reasons behind the collection of information. Involving 'owners of knowledge' actively in the IWRM process can help to overcome resistance.
- **Poor quality information** – The collection of information is in vain if it is not accurate enough for use. All collected data should be validated and a wide range of sources used when gathering information.
- **Preventing access to gathered information** – Once the information has been collected it should not be "hidden". Everyone should have access including institutions and other government departments as well as the general public.
- **Water users are experts** – The local community is a valuable source of information and their knowledge should be fully utilised. Water users are as important as water specialists or consultants when it comes to providing information about water resources.

4.2 Visioning





What it is and why it is necessary

A vision is an agreed long-term projection of what the local water resources situation will ideally be in 20 to 30 years' time. The vision provides the overall goal that the local IWRM action plan strategy will aim to achieve.

More specifically, visioning is important for:

- building a consensus with stakeholders on the future of local water resources;
- giving the IWRM process direction; and
- creating ownership among the public for the IWRM process.

The role of Local Government

When developing a vision Local Government should:

- ensure that identified stakeholders are part of the visioning process;
- coordinate the organisation of workshops in which the vision can be discussed and agreed with the relevant stakeholders; and
- hire an independent facilitator to help guarantee that the workshops are conducted professionally, that all participants have an equal chance to contribute and that the final outcome – the actual vision – is a consensus balancing the different needs and interests of local water users and other relevant stakeholders.

Key tasks

Key tasks	Description
Organising workshops	The organisation of workshops should be the responsibility of the Local Government who should ensure that previously identified stakeholders are invited. An independent facilitator should be appointed to conduct the workshops to demonstrate that all interests will be given an equal hearing. Efforts should be made to create an informal atmosphere in a bright and comfortable setting. Materials such as flipcharts and pens should be provided. The appointment of a high-ranking official to open the first session can help to emphasise the importance of the visioning process to the participants.
Creating the vision	The workshop facilitator should gather ideas from participants and these will be structured, evaluated and prioritised according to theme. No ideas are bad ideas and themes are likely to be varied. Points of conflict should not be avoided, but rather discussed and, if possible, resolved. At the end of the workshops the agreed vision should be written down in a short, well written document. This will be the reference document that should be kept in mind as the local IWRM action planning process develops. The IWRM coordination unit will have the responsibility of gaining approval of the vision from the city council.
Media and public relations work	The finalised vision should be actively disseminated throughout the local community. This can be done through libraries, schools and public institutions. The local media should also be approached with the aim of gaining coverage in the local press and on local radio and TV.

Useful tools and methodologies

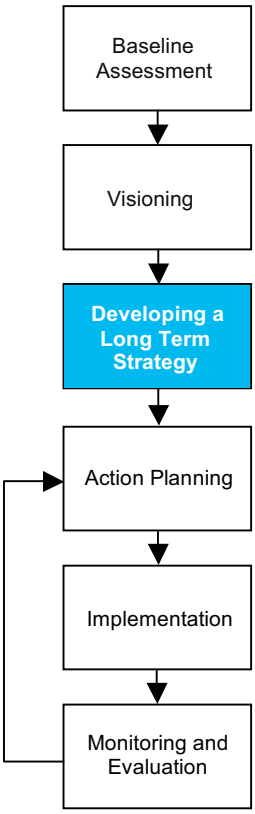
See the following tools in Section 5.1 and Annex A:

- **A6** Visioning
- **A7** Press release

Pitfalls and success factors

- **Allowing individuals to dominate the visionary exercise** – The facilitator must ensure that all participants have the chance to speak and that all views are treated equally. A well-facilitated and relaxed workshop will help all participants feel at ease and give people confidence to speak.
- **Conflicting interests grind the process to a halt** – Conflicts between stakeholders are likely to occur and will often be difficult to resolve with both sides having valid claims or views. It is important that these do not cause stakeholders to withdraw from the process due to a refusal to work with other members of the group. The facilitator should therefore ensure that efforts are made to reach compromises and establish trust between stakeholders.
- **Not all groups of society are represented** – Representatives of all members of society should participate in the development of the vision. Provisions need to be made to ensure that disadvantaged groups such as the elderly, disabled or very poor are not prevented from participating. Gender equality must also be guaranteed.
- **A shared vision gives people a sense of achievement** – Whilst it may be hard to achieve consensus, the creation of an agreed vision, developed in an environment of cooperation, will generate an optimistic atmosphere amongst the group.
- **Raise the profile of the vision** – The involvement of a high-ranking official, such as the local mayor, for the opening or closing of the workshops, highlights the importance of the visioning exercise among the participants and the local community as a whole.
- **The vision becomes a point of reference** – Consensus creates a reference point that transcends political differences and short-term electoral politics. The achievements of future actions carried out within the local IWRM action plan can be assessed using the vision as a reference.

4.3 Strategy development



What it is and why it is necessary

The long-term strategy brings together the issues and priorities for local water resources management, as identified in the baseline assessment and visioning exercise. These are used to define the strategic objectives. The completed strategy provides a framework for planning future actions, which are chosen with the aim of achieving the strategic objectives and ultimately the overall water resources vision.

The objectives are specified through targets and indicators.

- **Targets** differ from objectives in being a specific measurable commitment. They define in numeric terms which level of improvement is to be achieved and by when in order to ultimately satisfy the objective (for example, leakage from pipes reduced by 50% by the end of year X to achieve overall objective of less wastage from the water supply network). Several targets might be related to the achievement of one objective.
- **Indicators** provide evidence on progress towards the targets. They have to be measurable and relevant for achieving the objective, such as using the number of reported leaks to determine whether progress towards the reduction of wastage in the supply network has been made.

The strategy may also consider action beyond the immediate local level (see 'twin-track' approach in Section 2.2), such as the collaboration with neighbouring Local Governments or those located further afield in the catchment. Furthermore it may define whether a Local Government wants to engage itself in the activities of the nearest catchment agency or similar institution to advocate for the community's interests on a broader scale.

The development of the strategy is necessary in order to:

- define a consistent approach to the local IWRM action plan;
- help maintain the overall direction of local policies and prevent these policies from being affected by short-term political interests or changes in elected representatives and staff;
- direct and focus actions and projects to be carried out as part of the local IWRM action plan; and
- identify cases where it is necessary to reach outside Local Government boundaries to gain the support and capacity necessary to achieve certain objectives.

The role of Local Government

When developing a long-term strategy Local Government should:

- oversee the establishment and coordination of a steering group to develop the draft strategy;
- draw up 'Terms of Reference' for the steering group; and
- take responsibility for finalising the strategy.

Key tasks

Key tasks	Description
Coordinate the establishment of a steering group	Senior staff from relevant Local Government departments (for example water services, land-use planning, waste management, etc.) should be nominated to make up a steering group tasked with developing the draft strategy. A process for organising meetings and chairing the group should be decided upon. The steering group should agree on and sign 'Terms of Reference' for meeting and developing the strategy which must be clear from the start to ensure that the process is transparent.
Development of objectives	Strategic objectives are defined using the results of the baseline assessment and visioning exercise. The objectives form the basis of the strategy and it is with the aim of achieving these that projects within the IWRM planning process are selected and implemented.
Development of targets	The objectives need to be translated into more specific targets. Targets define commitments to meet the objectives within an agreed timeframe. Targets may be proposed by the steering group and negotiated with stakeholders, who play a key role in checking they correspond consistently with the vision and strategy documents.
Development of indicators	Indicators allow progress towards the targets to be assessed. These should be developed by the steering group together with the targets as the two are closely related. Indicators should be measurable in a way that provides clear evidence that progress is being made, for example through the use of statistical data, questionnaire results, economic analysis, etc.
Development of a draft strategy by the Local Government steering group	The steering group is responsible for drawing up a draft of the strategy. This should include the issues and priorities, identified in the baseline assessment and vision, and how these have been used to develop objectives, targets and indicators for local water resources.
Consultation with stakeholders	The draft strategy should be subject to a period of consultation with the previously identified stakeholders. Workshops or other activities should be arranged where comments and suggestions can be aired and a consensus on the strategy content reached.
Finalisation of the strategy and confirmed political commitment	Following the consultation period, the steering group must take into account the feedback and finalise what should be a truly integrated and representative strategy for the local community. To ensure political commitment, the local council must adopt the strategy as a binding document for IWRM over a defined period of time. The strategy should also be recognised outside local boundaries by, for example, catchment authorities, so that support is provided throughout the development of the local IWRM action plan. Changes to the strategy should only be made in consultation with the stakeholders and with local council agreement.

Media and public relations work	Once the strategy document has been finalised, it should be published and sent to all key IWRM stakeholders. A public information campaign, including use of the local media, should take place to raise awareness and commitment to the new strategy among the local community.

Useful tools and methodologies

See the following tools in Section 5.1 and Annex A:

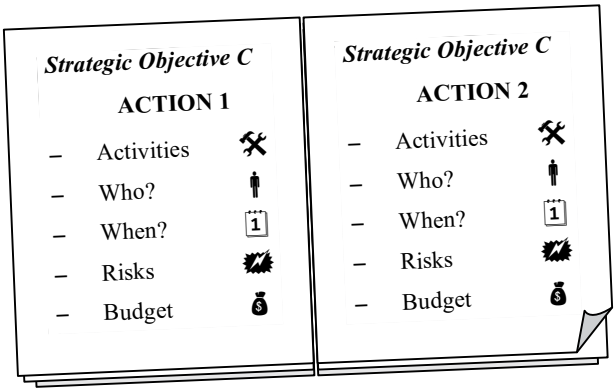
- **A5** Water Poverty Index (WPI)
- **A7** Press release
- **A8** Scenario building

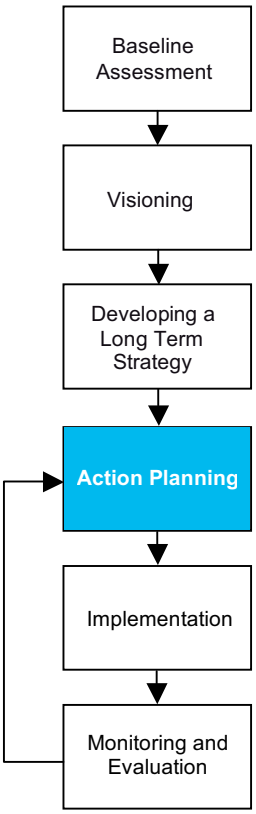
See also the paper on Water Demand Managements (B3) in Annex B.

Pitfalls and success factors

- **Uncooperative colleagues** – Poor communication within a Local Government may mean that key staff in the relevant departments are unwilling to spend valuable time participating in a steering group for an IWRM process they know little about. If they are to be convinced of the need to commit to the process, each department must be made aware of the importance of IWRM and how it is linked to their area of interest.
- **Lack of political support** – Without political support from higher levels, strategies will remain well-intentioned plans that are unlikely to ever come to fruition. Financial backing and technical know-how are examples of higher level assistance that will be necessary to turn a strategy from paper into action. Long-term political support is therefore essential.
- **Awareness raising** – Raising the public profile of a long-term strategy will help society understand the issues at stake and the reasons for proposed changes. Such awareness can alter behaviour and increases the likelihood that society will accept and support the strategy.

4.4 Action planning





What it is and why it is necessary

An action plan contains the projects and measures (referred to as actions) chosen to achieve the objectives and targets set out in the long-term strategy. These could range from education programmes aimed at highlighting the importance of hygienic sanitation, to specific engineering projects, such as the construction of improved drainage channels.

The actions identified for inclusion in the plan should be carefully considered, not only to ensure that they are indeed appropriate for achieving the strategic targets and objectives, but also to determine whether implementation is feasible within a realistic timeframe and with the financial resources available. Potential obstacles and risks to the implementation of an action should also be assessed when deciding whether or not it is worth pursuing.

The development of an action plan for IWRM is necessary to:

- initiate practical measures for changing the status-quo;
- ensure that all actions are coherent and suitable for realising the objectives set in the strategy; and
- make stakeholders role in implementation transparent.

The role of Local Government

When developing an action plan Local Government should:

- act as the overall coordinator;
- ensure relevant stakeholders have become sufficiently involved in the process;
- take responsibility for sign-off; and
- accept accountability for the contents of the plan.

Key tasks

Key tasks	Description
Collection and selection of project ideas	Workshops can be held to collect ideas on how the targets will be achieved. Criteria for suitable projects should be agreed and a number of suggested projects selected. These should be checked against the IWRM principles and the local IWRM action plan strategy. If necessary, ways should be considered on how proposed projects can be adapted to better suit local needs.
Budget planning	Realistic long-term planning of finances is key to the implementation of an action plan. A professional and transparent approach to budget planning will help convince investors, development banks and national or international donors to make financial resources available.
Establishing partnerships and the pooling of local resources	Budget constraints can be overcome through partnerships. Potential partners can be, for example, businesses, universities and NGOs. They can be encouraged to contribute with their capacities by creating win-win situations (for example protection of biodiversity boosts tourism).
Development of the action plan	Members of the steering group should meet and bring together the vision, strategy, and pre-selected projects, which are used to create a draft action plan. Some projects should be identified for earlier or later implementation, depending on priorities. When complete, this draft action plan should be distributed to stakeholders for final comments – once feedback has been received, the action plan can be finalised.
Media and public relations work	As with the vision and strategy, the community must be made aware that an action plan has been produced. This is of particular importance, as the action plan will include targets that are likely to have an impact on the lives of the local population. A communication strategy can be used to raise awareness of the positive benefits for the community, as well as explaining that there are necessary trade-offs, such as the introduction of water pricing, which will not please everybody. This will help to further strengthen local ownership of the plan and encourage public participation in the implementation of projects. To raise the profile of the final plan, a launch event involving local media can be arranged to ensure a dynamic kick-off. Publishing the document professionally and in simple language encourages citizens to take an interest. Distribution should also be widespread so as to reach as large an audience as possible.

Useful tools and methodologies

See the following tools in Section 5.1 and Annex A:

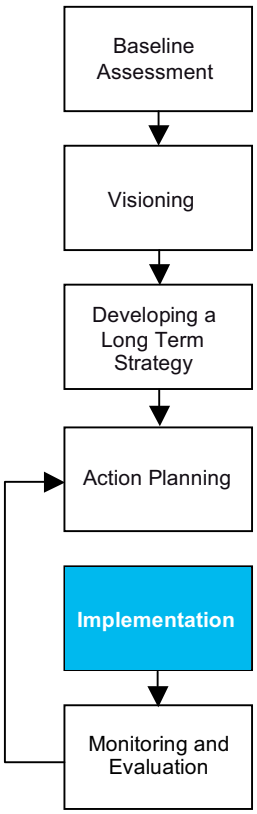
- **A7** Press release
- **A9** Participatory Rural Appraisal (PRA)
- **A10** Logical Framework
- **A11** Template for structure of action plan
- **A12** Template for proposal concept note

See also the papers on Water Demand Management (B3) and flood risk prevention (B4) in Annex B.

Pitfalls and success factors

- **Plan not adopted by the local council** – Failure to gain political support can be due to many reasons, such as unrealistic budget planning, disregard of agreements with stakeholders, or lack of involvement of local politicians during the process. The momentum of the action plan process can be severely damaged, if not completely interrupted, by these factors resulting in disappointment and loss of motivation.
- **Raising false expectations** – The publication of the action plan will raise expectations of real improvements. This means all projects must be properly assessed before they are announced. Proposing unfeasible projects with no clear financing will seriously damage the credibility of the action plan as a whole.
- **The action plan can build trust in the process and motivate involvement in implementation** – The local population will appreciate that earlier problem assessment, visioning and strategy development is turned into practical plans. This may encourage more people to take part in implementation.

4.5 Implementation



What it is and why it is necessary

Implementation simply means carrying out the projects identified in the action plan. Expectations among stakeholders and the general public are likely to be high following the participatory approach to the development of the preceding stages of the planning process. It is therefore important that actions are visible and demonstrate tangible results early to build confidence in the process.

Implementation is necessary to:

- put the action plan into operation; and
- achieve tangible change and improvements.

The role of Local Government

When implementing an action plan, Local Government should:

- take on a central coordination role to ensure that the implementation process evolves as agreed and the deadlines are met;
- provide support where necessary to enable the successful implementation of projects;
- manage the budget and funding;
- ensure that the necessary partnerships for implementation are established; and
- carry out the implementation of projects where appropriate.

Key tasks

Key tasks	Description
Coordination	The different projects in the action plan need to be effectively coordinated. Central coordination through one point in the administration can assist project implementation and provide a channel through which progress is reported back to the Council.
Development of work plans	Projects should be carefully planned, including a breakdown of work into smaller units, allocation of responsibilities, timing of all steps and their outcomes, equipment and materials needed, etc. Failure to do so can limit progress and waste resources.
Project management	Each project should have a manager who is responsible for implementation and reports back to the overall coordinator.
Team management	A project manager needs to have a good understanding of the abilities within the project team and should arrange for specific training if needed. This is especially the case if innovative procedures or technologies are to be implemented.
Media and public relations work	The public should be informed about successes, but also be made aware of things that don't work as expected. A transparent approach to the presentation of results will increase the credibility of the Local Government and of the strategy as a whole.

Useful tools and methodologies

See the following tool in Section 5.1 and Annex A:

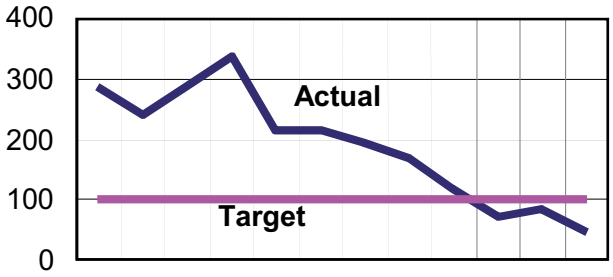
- **A7** Press release

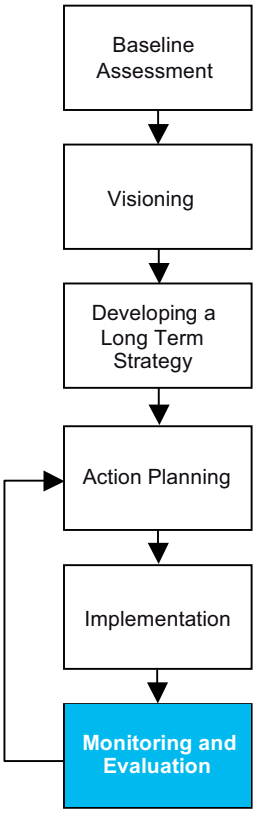
See also all papers in Annex B.

Pitfalls and success factors

- **Corruption** – Evidence of corrupt practices in procurement will undermine the entire process and waste precious resources. A transparent and well-audited process is essential.
- **Unrealistic budgets** – Poor financial planning can lead to budget constraints in the midst of operations. A contingency plan should always be in place so that key projects are not threatened if this occurs.
- **Become a role model** – Success stories and experiences can be shared with specialists from other cities and towns, especially from within the same river basin. The local benefits, as well as the advantages that may have been gained elsewhere in the catchment should be highlighted to encourage others to adopt similar approaches, which in turn may improve water resources management in the local area.
- **Maintain ownership** – By continuing to take responsibility for the strategy, Local Government can optimise its potential and maintain public participation in a positive fashion.

4.6 Monitoring and evaluation





What it is and why it is necessary

Monitoring is necessary for determining whether or not the implemented projects are achieving their intended targets. Monitoring can be done in a number of ways, for example through the measurement of a variety of data, collection of specific information from the local community and comparisons made with conditions prior to action implementation. Monitoring should take place on a regular basis and be in line with the time scales set out in the action plan.

The results of monitoring must be evaluated, with the participation of stakeholders, through analysis and interpretation using data from the baseline assessment as a reference point where appropriate.

Monitoring and evaluation of action implementation is necessary to:

- ensure that agreed objectives and targets are being achieved;
- identify shortcomings;
- decide about a revised course of action if measures are not effective; and
- maintain accountability.

The role of Local Government

As part of the monitoring and evaluation stage, Local Government should:

- carry out aspects of monitoring and evaluation in-house where appropriate and feasible;
- coordinate monitoring activities to ensure that the responsibilities for collecting relevant information are clearly outlined;
- use evaluated results to report progress (and failures) both internally, to senior levels of the administration and the Council, as well as externally, to sponsors, stakeholders and the public; and
- take responsibility for proposing and implementing necessary changes to the action plan and implementation process.

Key tasks

Key tasks	Description
Establishing mechanisms	A transparent system for monitoring and evaluation should be established. This should identify the assignment of responsibilities to specific departments and individuals, the ways and means of collecting and storing data, intervals for evaluation and reporting, and rules for internal and external communication.
Carrying out monitoring activities	Data and information should be collected in a systematic way, with particular reference to the indicators and targets specified in the action plan.
Evaluation of findings	Data and information should be assessed against the indicators and targets specified in the action plan. The analysis should, if necessary, specify corrective – and possibly new – measures for improving performance and is ideally carried out with the involvement of the intended beneficiaries. The approach must be flexible – if it is clear things are going wrong, timely adjustments to activities should be made to avoid wasting resources.
Taking decisions on corrective actions	Proposing changes and corrective actions to the Council for formal adoption and funding.
Reporting	The evaluation results should be reported and presented to the Council and stakeholder group. Successes should be highlighted and areas where targets were not met explained.
Media and public relations work	The evaluation results should be announced to the general public to keep them informed about progress. This can be done through the release of press reports, the use of special events to launch reports, the presentation of good practice awards and other creative commitments to raise the profile of completed projects.

Useful tools and methodologies

See the following tools in Section 5.1 and Annex A:

- **A5** Water Poverty Index (WPI)
- **A7** Press release
- **A12** Template for proposal concept note
- **A13** Worksheet for Participatory Monitoring and Evaluation

See also the paper on aquatic ecosystem assessment and evaluation (B2) in Annex B.

Pitfalls and success factors

- **'Hidden' problems** – Those responsible for implementation of certain projects may not want the administration or public to learn about failures or mistakes due to a fear of disciplinary action. Evaluation should be conducted in a fair and constructive way.
- **Lack of transparency** – Problems encountered should be openly discussed to let people know what changes are necessary to make improvements. This will create credibility and trust, whereas a lack of transparency excludes the general public and creates scope for corrupt practices.
- **Involving beneficiaries in evaluation** – This increases the reliability of evaluation and provides the opportunity to receive useful feedback and ideas for corrective actions.
- **Flexibility** – Activities should be stopped or adapted when evaluation makes it clear that they are not contributing to the intended improvements.
- **Reward commitment** – Participation by the public should be acknowledged and incentives for commitment offered. Competitions for children are one way of doing this. People should have a feeling of satisfaction when working and contributing to the improvement of life in the community.

5. Tools and further guidance

There are a large number of tools, methodologies and other sources of information available to assist with the local IWRM process. This section provides summaries of some of these to give an idea of what is on offer and how they can be used.

Section 5.1 includes summaries of some useful tools and methodologies that are appropriate for different stages of the planning process. The actual tools that are addressed are also provided in Annex A.

Section 5.2 gives a brief summary of four guidance papers that focus on key areas of water management, how these are relevant for Local Government and references to additional sources of information on the topic. The papers discussed are provided in Annex B.

5.1 Tools and methodologies

There are a large number of tools and methodologies that can help to develop and implement a comprehensive local IWRM action plan. Summaries of the ones listed below follow in this section. More detailed descriptions of the tools and methodologies themselves are provided in Annex A.

A1 IWRM checklist for Local Governments

A2 Stakeholder analysis

A3 Problem tree analysis

A4 SWOT analysis

A5 Water Poverty Index (WPI)

A6 Visioning

A7 Press release

A8 Scenario building

A9 Participatory Rural Appraisal (PRA)

A10 Logical framework

A11 Template for structure of action plan

A12 Template for proposal concept note

A13 Worksheet for Participatory Monitoring and Evaluation (PME)

5.1.1 Tool A1: IWRM checklist for Local Governments

WHAT

The IWRM checklist is a template with which to assess a Local Government's current position in water resources management, the legislative and institutional frameworks that are in place, and the management instruments and institutional capacity available at the local level. While providing a core set of questions, further issues might also arise during its use that need to be examined or clarified. These questions can easily be incorporated into the given list.

The tool is made up of two parts. Part 1 is an overview section in which yes/no questions are answered. Part 2 contains questions requiring the user to provide more detailed answers.

WHY and WHEN

The IWRM checklist is designed for gathering information that can be used to gain a comprehensive overview of the current water resources management situation at the local level and how this is influenced by existing policy, legislation and support from higher levels of government.

The IWRM checklist is best used as part of a baseline assessment. The actual process of completing it can help make Local Government more aware of gaps in their understanding of framework conditions, institutional capacities and management instruments in place at the local level. In some cases, different people working with it might also answer certain questions in conflicting ways, so that further questions arise and additional research will be needed to consolidate all information in an appropriate way. By doing this, the IWRM checklist helps to create a complete and commonly shared understanding of framework conditions and the status quo of water resources management policies and activities.

HOW

The tool is a list of questions that the users answer by ticking boxes or writing down brief sentences. Analysis of the answers should then be carried out and a summary compiled highlighting key issues that have emerged when discussing the questions.

WHO

The tool is aimed at Local Governments, although the involvement of other stakeholders – for example representatives from a Catchment Management Agency for input to the legal and policy issues – can prove very valuable. Those in charge should have access to a wide range of information concerning the roles and responsibilities of local actors in water resources management as well as the frameworks within which these need to operate and the management instruments and capacity available to assist them. Within a Local Government, it might be the team of the coordinating unit or the steering group for the IWRM planning process that takes responsibility for the checklist since it will be necessary to get information from different departments.

More detailed information on the IWRM checklist is provided in Annex A1.

5.1.2 Tool A2: Stakeholder analysis

WHAT

The stakeholder analysis ranges from a simple first mapping of who the stakeholders are to deeper analyses of different types of relations between stakeholders. It takes place in a workshop setting using different types of matrices and diagrams in which stakeholders are identified and their importance and influence established.

WHY and WHEN

IWRM, by definition, requires the involvement of all relevant stakeholders. In order to involve them, it is necessary to know who they are, and what their stake in water management is.

The stakeholder analysis needs to be done as one of the first activities in any IWRM process. The exercise may be repeated, expanded and deepened as the process unfolds and new stakeholders join in.

HOW

The analysis, in its simplest form, is done in a workshop or meeting setting that already involves some of the stakeholders. During the workshop, participants are asked to list all the relevant stakeholders they can think of, and their possible stakes.

In the second step, the relative importance and influence of the different stakeholders are defined. After this first basic analysis, further detailed analyses can be done on relationships between stakeholders in subsequent workshops, when all stakeholders are present.

WHO

Workshops are ideally facilitated by a person with prior experience in stakeholder analyses, especially when going into the further detailed analyses.

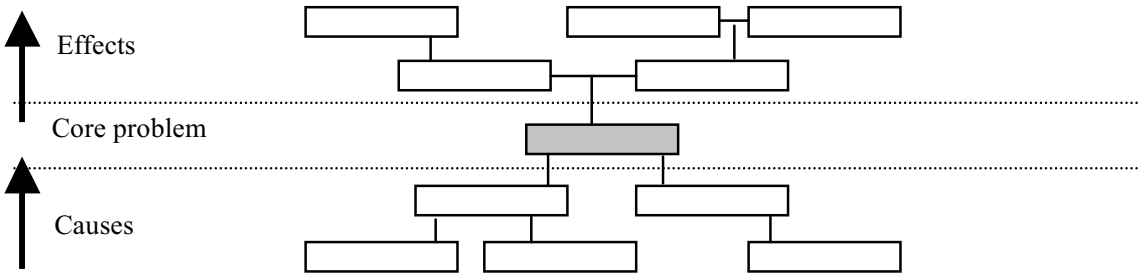
There are various rounds to a stakeholder analysis, with various people involved. The first stage of identifying stakeholders involves the local government itself and possibly others who are leading the IWRM process. Subsequent workshops in which the full analysis is carried out will then involve all identified stakeholders, which are likely to increase as the process develops.

More detailed information on the stakeholder analysis is provided in Annex A2.

5.1.3 Tool A3: Problem tree analysis

WHAT

A problem-tree is a visualisation of the main causes underlying a problem and effects of these. When completed the problem tree contains the core problem(s) as the central focus with identified causes listed below and effects listed above.



WHY and WHEN

Water resources issues are highly complex in nature and are often the result of a range of closely linked factors, within and outside the direct domain of water management. A problem tree analysis attempts to separate immediate causes from root causes, as well as from their effects, by making the chain of causes and effects more transparent. By doing this it may help to identify areas in which more information collection is needed to better understand the causes and effects of some the of problems.

A problem tree analysis is ideally done at the beginning of a process that addresses water resources management issues, as it is a tool to further define the problem.

HOW

A problem tree analysis is carried out in a stakeholder workshop setting. Participants take part in brainstorming sessions in which all water related problems in the local area are identified. From this collection, core problems are separated from causes and effects. Adding the causes and effects of the core problems in a logical horizontal and vertical sequence then develops the problem tree.

With large groups the problem tree development may be done in stages, i.e. first in separate sessions with different groups, and then in full plenary with all stakeholders. Ideally, the exercise is guided by an expert facilitator, without a direct stake in the issue at hand.

WHO

Different stakeholders may have different perceptions on the same water situation, or see different angles to the same problem. Ideally the problem tree is developed with input from all identified primary stakeholders including Local Government representatives.

More detailed information on the problem tree analysis is provided in Annex A3.

5.1.4 Tool A4: SWOT Analysis

WHAT

SWOT stands for Strengths – Weaknesses – Opportunities – Threats. The SWOT analysis was originally developed as a planning tool for companies when devising new marketing strategies, considering the introduction of new products and starting new business ventures. However, it is now widely used for a variety of planning purposes in many different fields including the public sector.

A SWOT analysis is based on a simple matrix with two columns and two rows that link internal strengths and weaknesses with external threats and opportunities.

WHY and WHEN

The SWOT analysis helps to identify external and internal factors that are expected to enable or hinder the achievement of future objectives. The analysis can be adapted to fit a large range of purposes. In the case of Local Governments engaging in IWRM, it is particularly useful before setting out on the IWRM process. Here, it can help to increase the understanding of the institution's own readiness and capacity to manage an IWRM process and to identify potential needs that will assist preparation.

A SWOT analysis can also help to invest human and financial resources in a more targeted way.

HOW

The matrix is filled out and evaluated in a facilitated group process. A previously completed IWRM checklist (see Tool A1) can help stimulate the discussions.

WHO

Depending on the chosen purpose of the analysis, a group of people from different Local Government departments needs to be brought together. The invited individuals should have worked with the Local Government for a minimum time period, have a thorough understanding of the issues to be analysed, be open-minded, creative and able to think in strategic terms. The more diverse the participants are the better as this will help to collect as many different perspectives as possible. Senior and junior staff should both be encouraged to attend so as to mix experience with fresh ideas.

If the analysis explores an issue beyond the institutional boundaries of the Local Government, a larger group of knowledgeable individuals from a wider spectrum of backgrounds should be invited. However, because of the workshop format of the event, the number should ideally not exceed 25 to 30 people.

More detailed information on the SWOT analysis is provided in Annex A4.

5.1.5 Tool A5: The Water Poverty Index (WPI)

WHAT

The Water Poverty Index (WPI) is a composite index, ideally calculated on the basis of existing data. It goes beyond standard approaches to hydrological water resources assessment, by addressing the issue from a holistic and integrated perspective. The WPI is made up of 5 key components which are:

- **Resources** – how much water do we have?
- **Access** – who has access to this for domestic and other uses?
- **Capacity** – what is the potential for water to be well managed?
- **Use** – what is water used for, where is the greatest economic return from water use?
- **Environment** – what is the environmental impact of water management decisions?

WHY and WHEN

The WPI provides a sound and consistent basis for the evaluation of water resources by assessing how they are used, the pressure they are under and where attention is most needed for improved water provision. This can be particularly important in the context of IWRM, since it is possible to apply the tool at various locations within a basin in order to compare different levels of need that may exist in different places.

Within a local IWRM action plan, the WPI is particularly recommended when analysing current water provision and use during the baseline assessment, although it can also be applied for monitoring and evaluation purposes as the plan progresses.

Furthermore, the WPI can help identify links between how water is managed and how it can benefit people, highlight particular difficulties and define the impact of projects. The results are also useful for drawing attention to issues within the local area, with the aim of lobbying for political attention.

HOW

By combining indicators of the five key components, a measure of the links between water and human welfare, and the effectiveness of water management actions is provided. It is a relatively simple methodology that can be applied at various spatial scales. No specialist software is needed, and it can be based on existing data, or on data collected through surveys. The results can be displayed in various ways, making it easy to understand for a wide range of stakeholders.

WHO

The WPI needs a specialist team of, for example, water managers and planners, within the Local Government who are in charge of collecting the required information and of calculating it according to a prescribed set of formula. For the collection of information it will be necessary to also consult selected stakeholders within the community.

More detailed information on the Water Poverty Index is provided in Annex A5.

5.1.6 Tool A6: Visioning

WHAT

In the area of water resources management, visioning refers to the development of a desirable future image of the state of water resources, people's access to these resources and the role of water in society, culture, and economic development.

A visioning process is a moderated group exercise aimed at achieving a consensus on such a vision.

WHY and WHEN

The vision provides the overall long-term direction and guiding framework for all further planning, implementation, monitoring and evaluation. A commonly agreed vision can broaden ownership of the foreseen IWRM process and should be used as a key message to the general public, thereby increasing awareness and readiness for engagement and the contribution of resources.

A visioning process should take place immediately after the baseline review. It can be argued that it may even be the very first step in a management cycle, i.e. it should be organised before the baseline review. This will have to be decided locally. In either case, an indispensable pre-requisite is the completion of a stakeholder analysis.

HOW

A visioning process is usually carried out in a workshop setting over the duration of one or two days. It is advisable to choose the venue with care, so that a relaxed and creative atmosphere can be established.

WHO

It is strongly recommended that an external facilitator is contracted to lead the exercise. This is crucial, as representatives of the Local Government are just 'regular' participants themselves. As an 'interested party' they would be biased when leading the discussions and inclined to steer the process in a direction best matching their own aspirations.

An experienced facilitator is also needed to ensure that the expected result – the consensus on a vision – will indeed be achieved, that all participants get equal space for speaking out and that any conflicts that arise are handled in a professional manner.

The participants of the workshop should be representatives of the stakeholders as identified in the stakeholder analysis.

More detailed information on visioning is provided in Annex A6.

5.1.7 Tool A7: Press release

WHAT

A press release is a short article on a newsworthy fact that is circulated to various media.

It is different to a 'regular' media article as it puts the focus on, for example, a political statement issued that day, or an event that is about to commence, is currently ongoing, or has just been completed.

WHY and WHEN

A press release is issued to capture the attention of the media on a 'hot' issue and thus increase media coverage. This can help raise awareness on an issue, steer the public debate and increase interest to get involved in related activities.

Press releases can serve many different purposes during an action planning process for Integrated Water Resources Management. One of the early purposes for a Local Government is usually to announce its official commitment to embark on such a process. During the course of the process, it might be the achievement of milestones that provide 'breaking news'. At the end of a planning and implementation cycle, a press release is useful to highlight successful stories and announce the publication of a final document such as a water report.

HOW

The person in charge often drafts the text of the press release before the actual meeting, launch of a publication, or other takes place. This ensures that it is ready to be submitted to the media as soon as the event commences.

Depending on the issue covered, a press release can cause strong reactions from the people concerned. It is therefore crucial to coordinate its content, scope of circulation and target media with the relevant high-level decision-makers in Local Government, particularly if it contains politically sensitive statements issued on behalf of the Local Government.

In order to ensure that the press release reaches the right target audience, it is important for a Local Government to have a good overview of the 'media world' and the opportunities for local, national and possibly international outreach. A good collection of information on key media channels as well as personal relations to journalists can help to get messages across quickly and effectively.

WHO

Larger local authorities usually have a separate department for public relations. In smaller authorities, it might be, for example, the secretariat of the Mayor's office that is in charge of issuing press releases. In either case, a writer will be needed who has excellent communication skills.

More detailed information on writing a press release is provided in Annex A7.

5.1.8 Tool A8: Scenario building

WHAT

Scenarios are consistent descriptions of plausible future developments, although they are not detailed forecasts.

Scenario building is the step in the management cycle of identifying and elaborating different scenarios. It is a methodology that allows for the adaptive management of water resources by:

- understanding how external factors may affect water management in the future; and
- providing the basis from which to identify different strategies to deal with these factors in order to reach the previously agreed vision.

WHY and WHEN

Water management strategies need to be designed to cope with a wide range of future uncertainties. These may be directly related to variability in the hydrological cycle or a result of factors outside the water domain such as demographic change or macro-economic developments. Scenario building allows uncertainties to be accounted for in planning by developing strategies that can respond to the different ways in which the future might unfold.

It is used above all in the strategizing phase of the management cycle after stakeholders have developed a common vision. Scenario development can also revert back to the information compiled during the baseline assessment at the beginning of the cycle although more input will be needed also from other sources.

HOW

Scenario building is best done in one or more facilitated workshops with the involvement of stakeholders. Within these workshops stakeholders brainstorm on possible future developments and trends that might have an impact on the achievement of the water vision. Following the workshops, further (quantitative) information is added. The completed scenarios are the basis for creating alternative strategies for water resources management that are suitable to deal with different future developments. Scenario building may be accompanied by other tools such as modelling.

WHO

Scenario building needs to be undertaken with the different relevant stakeholders around certain water issues. Additional experts from, for example, universities might be invited to contribute with scientific knowledge. Often a Local Government will be a participant in such an exercise rather than the facilitator. In this way it can fully dedicate its attention to assumptions regarding its own future role in water resources management and the expected long-term development of its own capacities and resources. However, Local Governments are likely to play a more active role in the following creation of strategies.

More detailed information on scenario building is provided in Annex A8.

5.1.9 Tool A9: Participatory Rural Appraisal (PRA)

WHAT

Participatory Rural Appraisal (PRA) is not a single tool, but rather an approach or methodology covering a broad group of tools and activities. These are designed to assess a particular water situation by identifying and incorporating the knowledge and opinions of water users, especially those at the grassroots level.

PRA tools can broadly be split into three groups:

- Sampling tools, such as transect walks, wealth ranking, pocket voting
- Interviewing tools, such as focus group discussions, semi-structured interviews, triangulation
- Visualisation tools, such as Venn diagrams, social mapping, matrix scoring, timelines, diaries

Most of the tools have a large component of joint assessment and analysis of the issue at stake and include the involvement of stakeholders in the exercise itself.

WHY and WHEN

PRA tools are mainly used to gather information to assist with assessment, analysis and planning during an IWRM process. Some of the tools are also applied for monitoring and evaluation. PRA tools differ from conventional methods in two ways:

- They provide information that is often not easy to collect through conventional methods, particularly on local knowledge and preferences of water users and other local stakeholders.
- They help empower the participants to better understand their own situation and take more informed decisions in the IWRM process.

HOW

The use of PRA tools varies depending on the tool in question, although, as the name already suggests, they all have a participatory approach in common. A large number of manuals and guidelines exist both at sectoral and organisational level to assist with the selection and application of appropriate tools for specific purposes.

WHO

PRA tools are always based on stakeholder involvement. Many have been particularly developed for working with grassroots stakeholders. Often, the tools are used with sub-groups, for example with men and women separately.

For Local Governments, PRA tools provide a large source of ways and means to carry out an IWRM planning process in collaboration with the local community.

More detailed information on PRA, including examples of tools, is provided in Annex A9.

5.1.10 Tool A10: Logical Framework

WHAT

The logical framework, or – in short – logframe, is a matrix designed to explain the means-end relationship of a project or programme. The matrix usually consists of four columns as shown below.

1	2	3	4
Narrative Summary	**Indicators of achievement**	**Means of verification**	**Assumptions and risks**
Objective			
Purpose			
Outputs			
Activities			

The first column lists the objective, purpose, outputs and activities of a project. The remaining three columns are concerned with the achievement of these through the listing of indicators, means of verification and assumptions and risks.

The different cells in the matrix are related to one another through logical steps. Reading from bottom to top, the listed project activities, given the assumptions hold true, will result in the specified outputs; the outputs will then result in the purpose and so on. This is the vertical logic of the matrix. The indicators and the means of verifying these are horizontally linked in the matrix to the four project components. This makes up the horizontal logic.

When completed, the logframe provides a concise summary of key project components and shows the logical links between means and ends.

WHY and WHEN

The logframe is applied when planning, implementing and evaluating specific projects and programmes within, for example, a local IWRM action plan. It is valuable for carrying out logical checks during project design as well as for monitoring progress and reviewing activities and output during project implementation. The logframe confirms that there is a constant relationship between the project objective and the means with which to achieve it throughout the project life span.

HOW

Following the establishment of the project objective, the cells in the logframe matrix are completed using a set sequence of steps. Once completed, logical vertical and horizontal checks are carried out on the inputs. The logframe continues to be used and modified throughout the implementation of the project by reviewing the achievements and changing the inputs as appropriate.

WHO

Project management teams should be charged with the creation and use of the logframe. Those with a stake in the project outcome should also either participate or be represented in the design phase and review of the completed logframe as their involvement is likely to improve the end product. However they will not necessarily have to be fully included in the detailed use of the framework.

More detailed information on logical frameworks is provided in Annex A10.

5.1.11 Tool A11: Template for structure of action plan

WHAT

The IWRM action plan is the document that incorporates the outcomes of all planning steps, most of them in a summarised version. The core part of the document will focus on the projects and programmes selected to work towards the commonly agreed vision.

The template for the structure of such a plan is a proposed table of contents that can be adapted to the specific concept and the expected size of the document under different local situations.

WHY and WHEN

The action plan can be compiled once the overall IWRM strategy is in place and a variety of projects and programmes have been selected to achieve the strategic objectives and work towards the agreed vision. The structure for the template is helpful to develop an overall concept of the format and contents of the document.

HOW

The template can be used as a draft structure that needs to be adapted to the specific structure of a plan in a given situation.

WHO

The actual compilation of the IWRM plan for which the template can be used is mostly a major editorial job that might be assigned to a smaller team within the Local Government unit coordinating the process. All documents and input that go into it would have to have been developed beforehand by the steering group or the bigger stakeholder group.

An example template for the structure of an action plan is provided in Annex A11.

5.1.12 Tool A12: Template for proposal concept note

WHAT

A concept note is a short form of a proposal outlining its main components in a summarised form.

The headlines suggested with the template are: title of the project; background; objectives; outputs; activities and duration; beneficiaries and impacts; project management (including monitoring and evaluation); and budget.

WHY and WHEN

Larger projects - such as the construction of infrastructure - can often not be financed solely through the financial resources of a Local Government's budget. In such cases, additional funding from external sources will be necessary.

In the course of fundraising activities, it is important to have a shorter version of a proposal for submission to potential funders. These would usually not be expected to spend a lot of time on detailed information immediately. A concept note can be useful to draw their initial attention to a planned activity and stimulate interest. Once a funder's interest has been gained, more detailed information, that is the full proposal, may follow.

The template provided helps draft a concept note – and ultimately a full proposal – in a systematic way. It may also facilitate the sharing of tasks between the different team members working on a proposal.

HOW

The template for the concept note needs to be adapted to match the specific nature of a proposal and potentially also the specific requirements of an already identified funder. The actual concept note is then drafted following some guidance given for each section.

In most cases, both the concept note and the larger proposal will go through several rounds of drafting, with a number of relevant people providing input and comments.

WHO

Any proposal needs the involvement of different team members, such as from the technical, financial and administrative side. Input from stakeholders or other specialists with different backgrounds helps bring in the necessary expertise, but also a larger variety of ideas on how to solve a particular issue and achieve the previously agreed objectives.

To manage the proposal development in an efficient way it is advisable to assign the lead role to one specific person. This person is then responsible for the coordination of the overall proposal development, for communication with potential funders and for making sure that all different pieces of input are brought together in a consistent and coherent text.

More detailed information on developing a proposal concept note, as well as an example template, is provided in Annex 12.

5.1.13 Tool A13: Worksheet for Participatory Monitoring and Evaluation (PME)

WHAT

The Participatory Monitoring and Evaluation (PME) approach is used to monitor and evaluate project results through a participatory process built on stakeholder involvement.

The PME worksheet is a tool for this process. It helps compile the information that is contributed from stakeholders and details the processes of data collection as well as data analysis and use. It is based on project objectives and indicators developed earlier in the planning process.

WHY and WHEN

A participatory approach to monitoring and evaluation increases the likelihood that activities geared at increasing integration in local water resources management do indeed bring about the desired effects for all concerned. In contrast, a conventional non-participatory approach is easily limited to assessing the benefits or negative outcomes that are only of concern for specific groups.

Although monitoring and evaluation only becomes relevant once a project is up and running (for example at regular intervals when results become available) it nevertheless has to be considered prior to project implementation, that is already in the planning phase.

HOW

Depending on the number, size and complexity of the planned activities in a given situation, the PME worksheet is filled out in the course of one or several stakeholder workshops.

WHO

The main actors of PME are the previously identified key stakeholders who have been involved from the beginning of the IWRM process. However, It might be necessary to involve certain additional experts.

Coordinating the compilation of all data and information requires a person, team or unit to take on the responsibility of leading the process. This ‘coordination node’ needs to ensure that all stakeholders can – and do – provide their contributions to the monitoring and evaluation exercise. The responsibility for coordination also requires keeping an oversight on the complete and transparent storage of this information as well as making the outcome of the PME process available to those in charge of follow up tasks.

More detailed information on PME, including an example worksheet, is provided in Annex A13.

5.2 Further guidance on key water management themes

In addition to the tools and methodologies summarised in Section 5.1 and presented in Annex A, Annex B includes some more detailed information on four key areas of water management, namely:

- Water Resources Assessments
- Assessment and evaluation of aquatic ecosystems
- Water Demand Management
- Flood risk prevention

These four papers provide an introduction to the topic, details on how the topic is relevant for Local Government and references to additional sources of information including further tools and methodologies.

Water Resources Assessments

A good awareness of the amount of water that is available for exploitation in a region is a crucial requirement for proper planning and development. This is particularly the case in regions where resources are scarce and use is high. A water resources assessment can calculate the volume of water from a region's resources that can be exploited for economic and domestic purposes without compromising the requirements of the natural environment or causing constraints in water use elsewhere in the catchment.

The paper presented in Annex B1 describes the models and methods available to quantify existing resources and predict what resources will be available under a range of future potential management options.

Assessment and evaluation of aquatic ecosystems

Aquatic ecosystems supply various goods and services to a local community. As well as being a source of water supply, healthy freshwater systems offer facilities for recreation, local industry, wastewater treatment, tourism and flood protection. Aquatic ecosystems can, however, be fragile and vulnerable to human activity in the catchment. Changes to the natural balance can cause many of the benefits they provide to be lost.

A large number of tools exist for assessing, monitoring and rehabilitating water ecosystems. The paper presented in Annex B2 provides a brief introduction to some of the tools that are available to assist with the management of rivers, lakes and wetlands.

Water Demand Management

Reducing water demand is a sustainable approach to increasing water availability. Rather than developing infrastructure to extract more water, demand management reduces consumption thus balancing water allocation to different sectors and protecting aquatic ecosystem goods and services.

The paper presented in Annex B3 gives an introduction to water demand management and the benefits to be gained from it. It also addresses some specific demand management measures and provides reference links to further information, tools and methodologies for each of these.

Flood risk prevention

The occurrence of floods can have devastating effects on the local area. These include impacts such as loss of life and livestock, damage to buildings and infrastructure, and long-term loss of

income due to disruption caused to industries such as agriculture and tourism. Flood risk prevention measures implemented at the local level can significantly reduce such impacts.

The paper presented in Annex B4 gives an overview of some of the activities that can be undertaken by Local Governments to prevent and mitigate the impacts of flooding at the local level. It also provides information and reference links to some of the latest technical solutions to flood prevention.

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Annexes

A Tools and methodologies

B Further guidance on key water management themes

ANNEX A – Tools and methodologies

A1 IWRM checklist for Local Governments

Introduction

The IWRM checklist[1] is designed to be used by Local Government and relevant stakeholders to gain a comprehensive overview of the enabling environment, institutional roles and management instruments that are associated with managing water resources at the local level. The checklist consists of two parts. Part 1 is an overview section in which yes/no questions are answered. Part 2 contains questions requiring more detailed answers.

The checklist should be used to assess the local water resources management situation prior to embarking on a local IWRM action plan.

Objectives

The IWRM checklist helps explore the existing institutional conditions at the beginning of an IWRM process. It can help clarify both internal and external factors that will determine which individual IWRM strategy will be most adequate for a specific Local Government.

External factors such as national policies and legislation are usually beyond Local Government control. They can only be influenced indirectly and in a more long-term perspective through lobbying and advocacy via higher level institutions. However, even if no changes are expected in the near future, the Local Government must be fully aware of these external factors so as to embed local actions in the most promising ways.

Internal factors relate to institutional arrangements, technical capacities, approaches and instruments, etc. that are directly managed by the Local Government. This is where reforms for more integration in water resources management can in principle be immediately initiated. However, external conditions may still result in constraints hampering such reforms. Examples are an imbalance between responsibilities and resources assigned to Local Governments or a lack of relevant training opportunities for local officials in a given country.

The completed checklist can be a very good basis for a SWOT analysis (see A4) that is useful for contrasting internal ‘strengths’ and ‘weaknesses’ as well as external ‘threats and opportunities’, so that conclusions can be drawn more easily as the strategy develops.

Using the checklist

The tool is a list of questions that the users answer by ticking boxes or writing down brief sentences. Although the list is relatively short, completing it might be challenging, as not all information is likely to be at hand. Input will be needed from a great number of colleagues and some research will also probably be necessary to find adequate and valid answers to all questions. Furthermore, completely new questions might emerge from the connected discussions that will also need to be clarified before the planning process can move ahead. Such questions and answers should be added to the checklist.

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[1] The checklist provided in this document is based on input from the Institute for Water and Sanitation Development (IWSD), Harare, Zimbabwe.

Preparation

A person or team entrusted with completing the IWRM checklist should first study the questions thoroughly and consider the sources where the required information could come from. In order to compile the information, other colleagues will have to be involved, internal documents or statistics be reviewed, external specialists consulted, etc.

Completing the checklist

The questionnaire is completed using the different sources identified during the preparation. References and appendices will have to be added to provide evidence on the facts, figures and other details collected.

Summary and analysis

In order to share the information with other colleagues, a summary should be drawn up to highlight the most critical issues that have come out of the compilation of information. Some preliminary conclusions might also be added.

Validation

The (near-) final draft of the document should then be circulated for feedback to all those that have contributed with information, possibly also to other relevant specialists or some of the stakeholders. Comments from these people should still be taken into account for the final version of the document.

Further use

The final document should be added to the results of all other elements of the baseline assessment. As mentioned further above, it is also a valuable input for a more detailed SWOT analysis in which the information compiled will be scrutinized in terms of its capacities to foster or impair the planned IWRM process.

IWRM checklist

Part I: Overview

Questions marked with * are dealt with in more detail in Part 2 of the checklist

A. Enabling Environment			
1. Policies for water use, protection and conservation		**Yes**	**No**
a	Is there a national water resources policy?*		
b	Are there other key policies that relate to water resources?		
2. Legislative framework		**Yes**	**No**
a	Are there water rights?*		
b	Is there specific legislation for water quality?*		
c	Has there recently been a reform of water-related legislation?*		
3. Financing and incentives		**Yes**	**No**
a	Are there national investment policies for water and water resources?*		
b	Is the private sector recognized by water resources management policy?		
c	Are there policies or regulations for cost recovery and charges for use of water and water resources?		
d	Is the Local Government involved in the appraisal of investments in the area of water resources management?		

B. Institutional Roles and Capacities			
1. Organizational framework		**Yes**	**No**
a	Is there a *transboundary organization* for water resources management?*		
b	Is there a *national organization* for water resources management?*		
c	Is there a *catchment management agency* in the catchment where the Local Government is located?*		
d	Is the Local Government the lead actor for water resources management at the district/municipal level?		
e	Is there a role for service providers, such as water utilities, in water resources management?*		
2. Institutional capacities		**Yes**	**No**
a	Does the Local Government have sufficient human resources, i.e. the required number of staff with relevant knowledge and skills for water resources management?*		
b	Has there been training on IWRM for relevant staff members within the Local Government?*		
c	Has the Local Government established its own institutions for the management of water resources?		

d	Does the Local Government have the capacity for regulatory roles in water resources, such as for the enforcement of water legislation?		
3. Stakeholder involvement			
a	Has the Local Government established a permanent platform for stakeholder involvement?		
b	Are civil-society and community-based organizations part of this platform?		
c	Is the private sector part of this platform?		
d	Are knowledge and experiences on water resources management shared with stakeholders in and outside the Local Government boundaries?		

C. Management Instruments			
1. Water resources management plans		**Yes**	**No**
a	Does the Local Government have its own plan specifically dedicated to water resources management?*		
b	If yes: does the plan cover all mandates that depend on or influence the state of water resources?		
c	If no: has the Local Government taken due account of water resources issues in other local (development) plans?		
d	Is local water resources planning fully adjusted to existing plans at catchment or river basin level?		
2. Water resources assessment		**Yes**	**No**
a	Is the Local Government endowed with sufficient knowledge on water resources?		
b	Does the Local Government conduct its own assessments of water resources in the area?*		
c	Does the Local Government conduct risk assessments related to water resources in the area?		
d	Are there indicators for water resources management?		
3. Water demand management		**Yes**	**No**
a	Is demand management part of the Local Government's strategy or plan for water (resources) management?*		
b	If yes: is the approach to demand management geared at efficiency of use?		
c	Have there been attempts to improve the efficiency of water supply?		
d	Does the Local Government promote recycling and reuse of water?		
4. Regulatory instruments		**Yes**	**No**
a	Does the Local Government have its own specific regulations for water quality?		
b	Does the Local Government have its own specific regulations for water abstractions?		

c	Does the Local Government have its own specific regulations for water services?		
d	Are there controls in land-use planning and nature protection that help secure the sustainability of water resources?		
5. Economic instruments		**Yes**	**No**
a	Is the Local Government in charge of pricing water and water services?		
b	Does the Local Government impose water pollution charges on offenders?		
c	Does the Local Government issue water permits for trade purposes?		
d	Are there incentives and subsidies for water resource use?		
e	Are there levies/environmental charges on the use of water resources?		
6. Instruments for social change and conflict resolution		**Yes**	**No**
a	Has the Local Government carried out campaigns for raising awareness on water resources issues?		
b	Has the Local Government encouraged schools and other educational institutions to integrate water issues in their curricula?		
c	Do all relevant local stakeholders participate in water resources management?*		
d	Are there clear lines of responsibility and communication with all relevant stakeholders?		
e	Are decisions on water resources participatory and democratic?		
f	Has a joint vision on the future state and conditions of local water resources been agreed with these stakeholders?		
g	Does the Local Government have a conflict management procedure?		
7. Information management and exchange		**Yes**	**No**
a	Does the Local Government have an information management system on water resources in place?*		
b	Does the Local Government share data on water resources with national and international organizations?		

Part II: Detail

A. Enabling Environment

1. Policies for water use, protection and conservation

Ref. 1a **If there is a national water resources policy, was the Local Government involved in the preparation of this policy?**

Yes ☐

No ☐

If yes, what was the level of involvement?

Representation in the preparation committee ☐

Consultation by national policy makers ☐

Other, namely

.....

.....

2. Legislative frameworks

Ref. 2a **If there are water rights, who is responsible for their issuance?**

District/municipal council ☐

A ministry of the National Government ☐

Catchment management authority ☐

User committees ☐

Other, namely

.....

What role does the Local Government play in the issuance of water rights?

.....

.....

Ref. 2b **If there is specific legislation for water quality, which are the most relevant laws?**

.....

.....

Are users' rights to water legally recognised in this legislation?

Yes ☐

No ☐

Ref. 2c **If there has been any reform in recent legislation, at which level was the reform made?**

District/ provincial level ☐

Catchment level ☐

National level ☐

What was the role of the Local Government in this legislative reform?

.....

.....

3. Financing and incentives

Ref. 3a **If there are investment policies for water resources, what are they?**

.....

.....

B Institutional Roles and Capacities

1. Organizational framework

Ref. 1a **If there is a transboundary organisation for water resources management, is the Local Government involved in any of its activities?**

Yes ☐

No ☐

If yes, what is the nature of these activities and the relationship between the Local Government and this transboundary organisation?

.....

.....

Ref. 1b **If there is a national organization for water resources management, is the Local Government involved in any of its activities?**

Yes ☐

No ☐

If yes, what is the nature of these activities and the relationship between the Local Government and this national organisation?

.....

.....

Ref. 1c **If there is a Catchment Management Agency, is the Local Government involved in any of its activities?**

Yes ☐

No ☐

If yes, what is the nature of these activities and the relationship between the Local Government and this national organisation?

.....

.....

Ref. 1e **If there is a role for service providers in water resources management, what is this role and which service providers are involved?**

.....

.....

2. Institutional capacities

Ref. 2 **What form of capacity building has the Local Government received on IWRM?**

Technical training ☐

Transportation ☐

Technical equipment ☐

ICT[2] ☐

Others (please specify) .....

How many members of staff in the Local Government have roles specifically dedicated to water and water resources management?

.....

Have staff members also been employed purposely for water and water resource services?

Yes ☐

No ☐

What is the average level of technical knowledge and skills of staff members dealing with water and water resources?

High ☐

Medium ☐

Low ☐

---

[2] ICT = Information and Communication Technologies such as telephone, fax or computer lines and equip

C. MANAGEMENT INSTRUMENTS

1. Water resources management plans

Ref. 1a **If a water resources management plan exists, in what way is this plan in line with the national policy for IWRM?**

.....

.....

2. Water resources assessment

Ref. 2b **When was the last assessment of the existing water resources in the District/ Municipality?**

1 to 5 years ago ☐

6 to10 years ago ☐

10 to 15 years ago ☐

More than 15 years ago ☐

3. Water demand management

Ref. 3a **If water demand management is in place, which of the following measures does the Local Government employ?**

Recycling and reuse ☐

Metering ☐

Tariffs ☐

Subsidies for efficient use ☐

Education and communication ☐

6. Instruments for social change and conflict resolution

Ref. 6c **If the Local Government has a water resources management plan, which of the following stakeholders were involved in this plan?**

National Government ☐

Catchment Management Organization ☐

Private companies ☐

NGOs ☐

Community /user groups ☐

Agriculture ☐

Environmental agencies ☐

Industrial/trade unions ☐

If the private sector is involved, what are some of the current roles that it is playing?

.....

.....

Are there meetings with the stakeholders at local level?

Yes ☐

No ☐

If yes, how often are these meetings organised?

Monthly ☐

Half yearly ☐

Annually ☐

Other (please specify) .....

What institutions exist for conflict resolution?

Law courts ☐

Chieftaincy institutions ☐

Catchments/district councils ☐

User/local committees ☐

7. Information management and exchange

Ref. 7a **If a system for information/knowledge management and sharing is in place, what are the main instruments of the Local Government?**

Reports ☐

Workshops/ Seminars/ Meetings ☐

Newsletters ☐

Others (please specify) .....

A2 Stakeholder analysis

1. Introduction

A stakeholder analysis aims to identify which groups and individuals have a stake in water management, what their stake is, and which ones are most important and influential in relation to the issue at hand. There are various degrees of detail that can be brought into the analysis, depending on the specific purpose and when it is done. It can range from a simple first mapping of who the stakeholders are to deeper analyses of different types of relations between stakeholders.

2. Objectives

A stakeholder analysis is carried out to:

- Identify actors who have a direct or indirect interest (or 'stake') in water management
- Determine the interest and role of these actors in water management

3. Methodology

The analysis, in its simplest form, is done in a workshop or meeting setting, which already involves some of the stakeholders. During the workshop, participants are asked to list all the relevant stakeholders they can think of and their possible stakes. In a second step, the relative importance and influence of the different stakeholders is defined. After this first basic analysis, further detailed analyses can be done in subsequent workshops on relationships between stakeholders, when all stakeholders are present.

Details on each of the steps are as follows:

Step 1: Preparation

In this step, the participants should be informed of the objective of the exercise, the expected outcomes, and the follow-up activities. This should also include an explanation on how the exercise will take place, and the level of detail that is expected.

Step 2: Completing a stakeholder table

This is the basic step of a stakeholder analysis, in which the participants are asked to map all individuals or organisations that have a stake in the water resources issue at hand, and what that stake or role is.

Name of stakeholder	Stake/role

Table 1: Table for stakeholder analysis

Step 3: Identifying key, primary and secondary stakeholders

In complex water management issues, many organisations have a stake. However, this stake is not equal for everyone. In this step, a distinction is made between key, primary and secondary stakeholders.

- *Key stakeholders* include all those who can significantly influence the way in which IWRM will succeed or not
- *Primary stakeholders* are those who are directly affected by the way water is managed, either positively or negatively.
- *Secondary stakeholders* are all others with an interest, stake or intermediary role in water management

To distinguish between them, participants are asked to rank all the stakeholders from step 2 in terms of:

- their influence (i.e. their capacity to facilitate or impede an activity), and
- their importance (i.e. the priority given to them in terms of improving their particular situation).

Ranking can be done by using ordinal scores of 1 to 5 (1 being a low influence or low importance, and 5 the highest). The ranking can be shown in a table or spiderweb (see Figure 1).

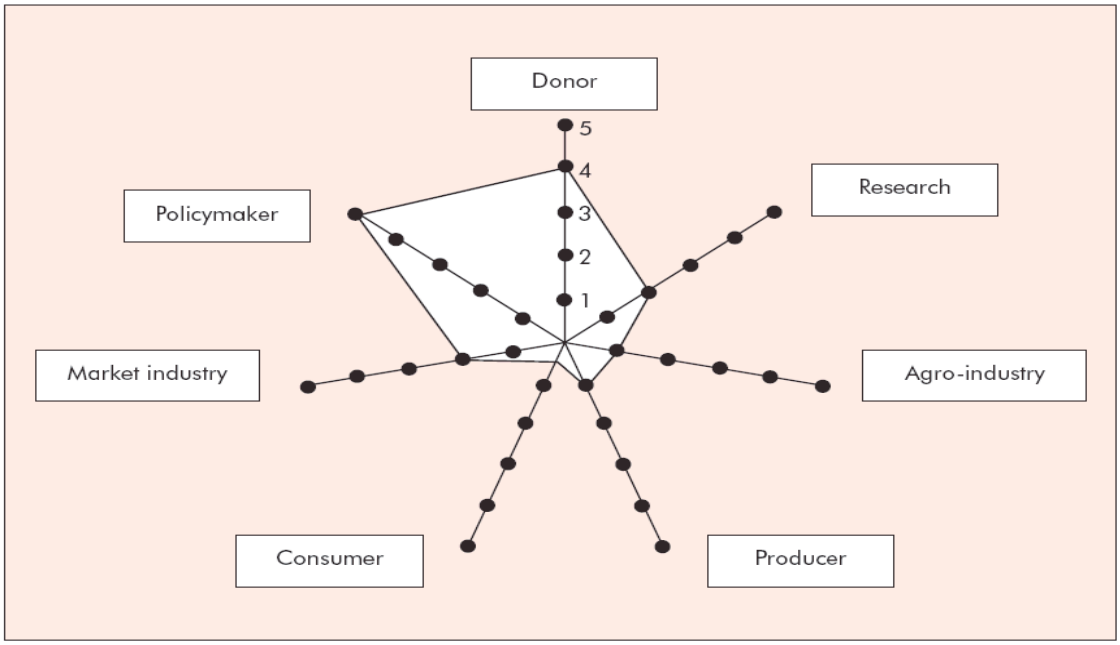


Figure 1: Example of spider-web diagram reflecting relative influence of different stakeholders in a particular situation (Engel and Salomon, 1997)

The relative influence and importance can then be compiled in a matrix (see Figure 2). The stakeholders that feature in boxes A, B and D are the key stakeholders. The ones in A and B are the primary stakeholders and the ones in C are the secondary stakeholders.

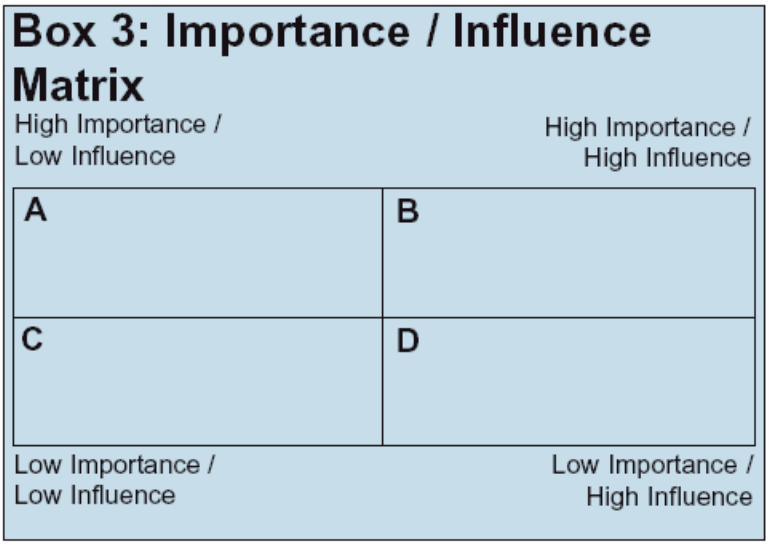


Figure 2: Example of an Importance/Influence matrix (DFID, 2002)

Step 4: Additional analyses

After these initial analyses, it may be necessary to further explore the relations between stakeholders, in terms of aspects such as power, leadership and coordination, communication, mutual dependence, etc. The sources provided below contain a range of detailed tools for such additional analysis.

4. References (selection)

UK Department for International Development (2002) *Tools for Development: a handbook for those engaged in development activity.* Performance and Effectiveness Department, Version 15, DFID, London. Available at: http://www.dfid.gov.uk/pubs/files/toolsfordevelopment.pdf

Engel, P. and M. Salomon (1997) *RAAKS Resource Box.* Royal Tropical Institute, Amsterdam, the Netherlands. Available at: http://www.kit.nl/net/KIT_Publicaties_output/ShowFile2.aspx?e=495

Salomon, M. and P. Engel (1997) *Networking for innovation; a participatory actor-oriented methodology.* Royal Tropical Institute, Amsterdam, the Netherlands.
Available at: http://www.kit.nl/net/KIT_Publicaties_output/ShowFile2.aspx?e=494.

A3 Problem tree analysis

1. Introduction

The objective of a problem tree analysis in water resources management is identifying the main water-related problems, and their main causes and effects. This is done by separating immediate from root causes of certain problems. A problem tree analysis is not only a specific tool for water resources management, but is used more widely in development-related planning processes. It is often considered one out of the broader suite of Goal Oriented Project Planning (GOPP) tools.[3]

Water resources issues are highly complex in nature, in the sense that they are often the result of a range of closely linked factors, within and outside the direct domain of water management. Apparent problems in water management are often caused by deeper underlying causes. A problem tree attempts to separate immediate causes from root causes as well as from their effects. It makes the chain of causes and effects more transparent. Finally, it may help identifying areas in which more information collection is needed to better understand causes and effects of problems.

A problem tree analysis is ideally done at the beginning of a process of addressing water resources management issues, as it is a tool to further define the problem. The problem tree can be turned in a next step into an objective tree. As this unfolds, more information may become available, and further insights be developed. The problem tree can then be updated in later stages of the planning cycle.

2. Objectives

A problem tree analysis is carried out in order to:

- identify the main water-related problems affecting stakeholders as well as their causes and effects;
- begin the process among stakeholders of analysing and understanding their water resources and services.

3. Methodology

A problem tree analysis is done in a stakeholder workshop setting. During the workshop, the group may start developing either a single big tree, or various smaller ones around certain sub-themes (e.g. water supply, catchment management, etc.) which eventually need to come together. It is important that all identified stakeholders are properly represented so that different problem perceptions are included in the analysis.

Participants at the meeting go through the following steps:

- Each participant thinks of all water-related problems in the domain of interest and puts each problem on a separate card.
- With the help of the facilitator, the group identifies the main problems shared by all and precise definitions of these are written on individual cards.
- The other cards are divided into causes and effects of the core problems. They are then stuck below and above the relevant core problem on a large sheet. There will probably be multiple different causes for each effect, and multiple effects for each cause. Some cards (such as poverty) may be both fundamental causes AND principal effects – in this case two cards are used for the same issue.

[3] See for more information for example under http://www.worldbank.org/wbi/sourcebook/sba102.htm.

- For each problem, the facilitator looks at the cards that may be the cause of it, and asks 'Are these cards sufficient to explain why this occurs?'. If the answer is no, new cards are written until all causes are identified.
- As a next step, the cards are grouped so that those that describe causes and effects of the same outcomes/causes are on the same horizontal line. Where cards are very similar a single new card is created to represent them all.
- The group then reviews the logic and alters the links until all in the group are satisfied with the result.
- The final tree is shared with all stakeholders.

4. Example

The main outcome of the exercise is a cause-effect "tree" (see Figure 1). Typically, the problems at the bottom of the tree are root causes. These are therefore the ones that may be able to impact change all along the chain. However, some of these may be outside of the domain of water management (e.g. low levels of income). The series of problems just above are often the ones that can be directly changed and could later turn into areas of work for IWRM.

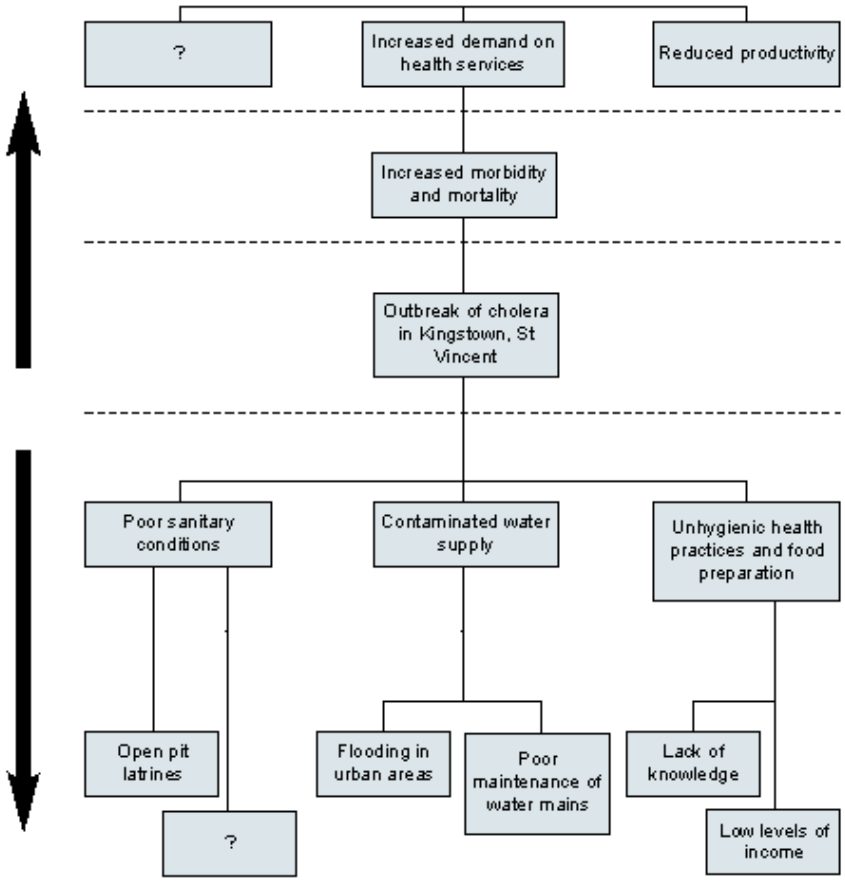


Figure 1: Example of problem tree (ODI, 2006)

As important as the tree itself is the understanding that it generates among stakeholders on how problems, causes and effects are related and how different stakeholders may perceive the same issue in different ways. This should be explored in further detail following the completion of the exercise.

5. References (selection)

UK Department for International Development (2002) *Tools for Development: a handbook for those engaged in development activity.* Performance and Effectiveness Department, Version 15, DFID London. Available at: http://www.dfid.gov.uk/pubs/files/toolsfordevelopment.pdf

Overseas Development Institute (2006) *Successful Communication Online Toolkit – Problem tree.* Available at: http://www.odi.org.uk/RAPID/Tools/Toolkits/Communication/Problem_tree.html

Von Franz, J. and N. Schall (2002) *Practitioners Guide; problem tree analysis.* GTZ, Germany. Available at: http://www.methodfinder.net/pdfmethods/methodfinder/methodfinder_method1.pdf

Wageningen University and Research Centre (2006) *Multi-stakeholder processes resource portal – problem tree.* http://portals.wi.wur.nl/msp/?Problem_tree

A4 SWOT Analysis

1. Introduction

SWOT is the acronym for **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats.

Originally developed in the private sector for marketing purposes and the introduction of new products, a SWOT analysis is of equal use in the public sector, particularly when drafting new strategies.

A SWOT analysis can be applied in a variety of situations, but is promoted here as a tool for use by Local Governments before they embark on IWRM. In this situation, a SWOT analysis is a valuable exercise to examine the internal and external factors that will influence the readiness of a Local Government to kick-off, manage and maintain an IWRM process.

The SWOT matrix can be seen overleaf. It is designed to visualise the existing potential at the local level as well as the surrounding framework conditions. Strengths and weaknesses are *internal* factors, over which the Local Government has a certain control, whereas opportunities and threats belong to *external* factors outside of such control.

The aim of a SWOT analysis is not to give an exhaustive picture of the situation under consideration. It is rather suitable to highlight key issues, i.e. those with the highest relevance for the new strategy under development. This allows further discussions to take place that can concentrate on the most important issues at stake. Following the completion of the SWOT analysis, it is easier to make decisions on what the key steps should be within an IWRM strategy.

In order to carry out a SWOT analysis for developing an IWRM strategy, the coordinator in charge should bring together a group of specialists from different Local Government departments. The wider the range of perspectives this group includes, the better.

An independent facilitator should conduct the SWOT analysis process. This consists of a brain storming exercise in which the four boxes of the SWOT matrix are completed. At the end of the session, the results should be discussed and analysed for example by:

- assessing internal strengths for dealing with external threats; and
- assessing external opportunities for mitigating internal weaknesses.

The conclusions drawn will then be an important basis for the development of a robust IWRM strategy.

2. The SWOT template

Internal (within the local administration)	**Strengths**	**Weaknesses**
	What kind of resources and capacities are available within the Local Government that can facilitate the adoption of an integrated approach to water resources management?	*What kind of resources and capacities are lacking within the Local Government or which internal situations and developments negatively affect its performance, thereby hindering the adoption of an integrated approach to water resources management?*
External (outside the local administration)	**Opportunities**	**Threats**
	Which facts and developments – such as national policies, new laws and regulations, level of community awareness, twin city arrangements, partnerships, expert networks, resource centres, capacity-building institutions, technical innovations, funding programmes, etc. - could help the Local Government to adopt an integrated approach to water resources management?	*Which facts and developments – such as general political and social developments, singular economic interests, power games, local conflicts, etc. – could jeopardise the Local Government's plan to adopt an integrated approach to water resources management?*

3 Examples for entries into a SWOT template

Internal (within the local administration)	**Strengths**	**Weaknesses**
	• New mayor is strongly committed to sustainability issues • New mayor has introduced monthly team meetings with heads of all departments • Recently introduced tariff system for waste water services yielded surplus of income that could contribute to setting up new IWRM strategy • Three new members of staff that have specialist backgrounds in natural resources management have recently been hired • …	• Payment for local government officials is below average, and there is little motivation among staff to venture into new arenas of activity • The department for water services recently lost two of its most knowledgeable colleagues to private companies • The computer equipment in most departments is out of date • …
External (outside the local administration)	**Opportunities**	**Threats**
	• The local community is highly sensitive to the vulnerability of water resources • The government announced tax reforms that could lead to more income at Local Government level • Local schools have shown a big interest in including water issues in their curricula and contributing to awareness raising • An international organisation has offered free participation in a training course on IWRM at local level • Statistics show evidence of increasing overnight stays and thus income from international tourists attracted by biodiversity of local wetlands • ….	• Unemployment, drug abuse and violence among young people are currently the biggest concerns of the local population that expects the Local Government to give highest priority to these issues • Decentralisation is still ongoing and brings a lot of uncertainty with it • Local farmers have the greatest economic and thus political power in the area, and they consider the questioning of their water needs and irrigation techniques to be a provocation • Long history of conflict between Local Government and owners of local tannery that is second most important provider of local jobs, but also responsible for most severe pollution of water resources; will therefore be difficult to bring them on board • …

A5 The Water Poverty Index

1. Introduction

Water management is a complex and difficult task. As populations grow and water resources become more scarce, this task will become even more complex. The Water Poverty Index (WPI) is mainly designed to help improve the situation for the over two billion people facing poor water endowments and poor adaptive capacity. It is a method to develop and describe community level WPI scores. Through its application, this tool can provide:

- a better understanding of the relationship between the physical extent of water availability, its ease of abstraction, and the level of community welfare it provides; and
- a mechanism for the prioritisation of water investments by which progress in the water sector can be monitored (for example towards the Millennium Development Goals).

When water allocation systems fail, poor people often have to use insecure or polluted sources, and conflicts over water use can arise. By making water management decisions more equitable and transparent, the WPI can contribute to the eradication of conditions causing the poverty trap.

The WPI is designed as a holistic tool to capture the whole range of issues that relate to water resources availability and their impacts on people. It is mainly relevant at the community, municipal and district level and can be used to determine priorities for action and to monitor progress towards targets. Monitoring real progress in the water sector requires an inter-disciplinary approach, and involves both qualitative and quantitative assessments. These need to be integrated in such a way as to allow a wide range of issues to be addressed. The process should also allow the views and values of stakeholders to be represented. In order to see how a community, country or region is progressing over time, a monitoring system is needed which is based on simple indicators. The WPI provides such a simple and easy-to-use indicator for the water sector. It can be used by water managers and planners. But, at the community level, it is also possible for people to apply it to their own situations to understand how water can best be managed to meet their own needs, and to lobby for action.

The WPI is:

- Easy to calculate
- Cost effective to implement
- Based mostly on existing data
- A transparent process
- Easy to understand

The WPI was first developed in a research project funded by the UK's Department for International Development (DFID).

2. The structure of the WPI

The Water Poverty Index is computed as a weighted average of five components **Resources** (*R*), **Access** (*A*), **Capacity** (*C*), **Use** (*U*), and **Environment** (*E*). Each of the components is first standardised so that it falls in the range 0 to 100; thus the resulting WPI value is also between 0 and 100. A low score on the WPI indicates a more extreme case of water poverty. The weight given to the elements *wi*, represents the relative importance given to each of the them.

3. The mathematical structure of the WPI

The WPI is calculated using a composite index approach. The structure of the composite approach is based on the approach used in the Human Development Index (HDI). Various elements measured in different units are aggregated together, and the five key components are combined using the general expression:

$$WPI = \frac{\sum_{i=1}^{N} w_i X_i}{\sum_{i=1}^{N} w_i}$$

where *WPI* is the Water Poverty Index value for a particular location, *Xi* refers to component *i* of the WPI structure for that location, and *wi* is the weight applied to that component. Each component is made up of a number of sub-components, and these are first combined using the same technique in order to obtain the components. For the components listed above, the equation can be re-written:

$$WPI = w_r R + w_a A + w_c C + w_u U + w_e E$$

with the condition that

$$w_r + w_a + w_c + w_u + w_e = 1$$

The weightings have to be chosen in a way that their sum is always equal to 1, this has the effect of creating a trade off between the criteria. For the purpose of this preliminary work, all weights are set to = 1 so that their existence does not have an impact on the scores. The weightings are important, but it is necessary to first start with them all equally weighted so that the importance of the individual components is not exaggerated.

4. Data for calculating the WPI

The calculation of the WPI requires data on water resources, access, capacity to manage, use and environmental impact. The data used to calculate WPI at the micro level illustrated here are mainly derived from surveys carried out in four villages for each of the three countries chosen to test the WPI. The three countries were: South Africa, Tanzania and Sri Lanka. If a component was believed to be essential in explaining the water poverty level, but the data were not contained in the survey, substitute data derived from local averages were used instead.

In any application of the WPI, data required depends on the scale of application and data availability. If data for individual sub-components do not exist, an alternative (similar) measure may be selected. However, it is important that for comparison, the same measures are used.

It should be noted that the local/municipal scale application of the WPI is most appropriate to cope with the heterogeneity of water resources and their use. Data for this level should be collected at a local, sub-national/municipal level. Much municipal level data is available both from local institutions and also from national data sources.

5. Converting data to indices – method and examples

Each of the 5 WPI components listed above has been obtained by aggregating a set of sub components again by using the composite approach. In other words, each of the five components forming the WPI is itself an index (see box 1). Details of the individual components indicators used for this community scale assessment are shown in Box 2. An illustration of the WPI scores is provided in Table 1, with specific examples from 3 countries in Table 2, and illustrated for South African communities in Figure 1.

Box 1: Converting scores to indices

Calculating indices

Scores for each index and sub-index are calculated by the formula:

$x_i - x_{min} / x_{max} - x_{min}$

where x_i , x_{max} and x_{min} are the original values for location i, for the highest value country, and for the lowest value country respectively.
The index for any one indicator lies between 0 and 100.
The maximum and minimum values are usually adjusted so as to avoid values of 0 or 100.
The aim is to get index values in the range 0 to 100 for each quantity being considered, where 0 is worst, 100 is best.
When these are combined to make a composite index, then each component is on the same basis

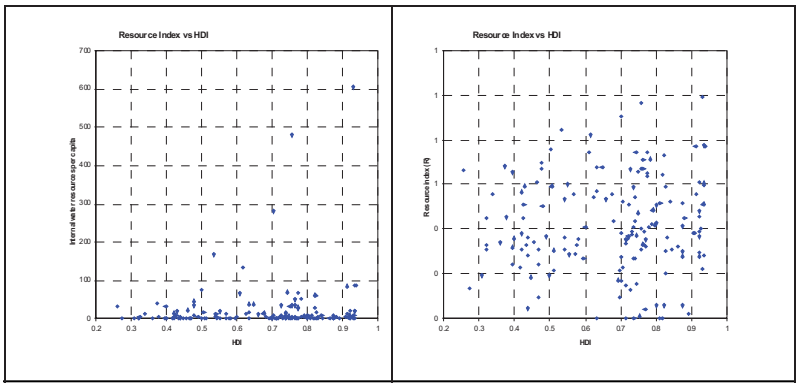
Examples based on national scale analyses:

(1) Percentage access to safe water
Values range from 12% to 100%.
Use directly as index

(2) GDP per capita (PPP)
Values range from US$ 448 to $ 31872
Calculate: Index = 100.(GDP – 300)/32000
Result has range 0.5 to 98.7

(3) Under-5 mortality rate (u)
Values range from 4 to 320 per 1000 live births
Calculate: Index = 100.(350 - u)/350
Result has range 8.6 to 98.9
High mortality –> low index value

4. With Log transformation:



Box 2: Potential indicators to be included as sub-components

RESOURCES

- **Amount of water available**
- **Measure of reliability / variability**
- **Measure of water quality**

The way this is done depends on expertise of available research team. Professional hydrological expertise is helpful to determine what is actually available for human use, in terms of ground and surface water, and management infrastructure

ACCESS

- **Total Time taken to collect domestic water per household per day** (in mins)
- **% of water collected by women**
- **% of households with access to sanitation**
- **Irrigated agriculture** (take total arable area and indicate % irrigated)
- **Garden irrigation per household** - give % hhs in community which irrigate their gardens , even with buckets etc)
- **Conflicts reported over water use or access** (never = 1, sometimes =2, many = 3, daily = 4)
- **% of households with pipe in the house/yard**
- **% with access to protected water** (well, borehole with wall or concrete apron, tap, standpipe etc.)

CAPACITY

- **Education** % of household heads completing primary education, % attending any level of secondary schooling, % having any tertiary education
- **Health -** % of children dying before 5 years of age
- **Wealth -** expressed in terms of livestock holdings, income levels, or ownership of key items (radio, bicycle, glass windows in house, non-thatched roof, watch, gas cooker, factory made furniture)
- **Employment -** % of households with at least one person employed more than 6 months per year
- **Remittances** - % of households with wage/pensions

USE

- **Domestic use** - average litres of water used per hh per day and no of persons in household (or av household size for village)
- **Industrial use -** get quantitative info from local water authority water records, or identify any local inds which need water, eg beer brewing, brick making, textiles etc), and national figs for proportion (%) of water used by industry
- **Agricultural use -** vol of water used for irrigation from water company records or from peoples estimates of how much water they use for irrigation – if any
- **Livestock -** get total number and type of each in village, calculate necessary water consumption

ENVIRONMENT

- **Erosion** - get % of fields per hh which have some erosion – from key informants in village, eg village leader, extension officer, teacher, sample of farmers
- **Wildlife** - % of households which report using wildlife (and or fish) for their own use and their opinion if the availability of these has decreased over the last 10 years
- **Vegetation** - % of households reporting a reduction in general veg cover over last 10 years, % households reporting a decrease in proximity to home of trees for fuelwood
- **Change in rainfall** - % of hh reporting perceived changes in rainfall (% stating increase and % stating decrease)

Table 1: Household data from communities converted to index scores (0-100)

Village	R	Access (A)							Capacity (C)				Use (U)				Environment (E)		
		TT	% men	San	CoLand no LC	No Conflicts	% Pp HH	% protec	% educa-ted	No Illness	wealth	% wage & inc	lpd	lnU	AU	LivU	No Erosion	no LC	En
Ethembeni	50	65	7	32	23		0	85	57	72	34		17	56	61	10	2	54	22
Latha	20	28	4	32	13		1	19	31	48	47		20	42	22	7	12	46	28
Wembezi inf	50	62	16	68	16		12	99	38	94	46		20	48		2	7	71	10
Wembezi for	50	90	33	68			99	100	61	93	72		29	47					
Nkoaranga	30	86	11	4	20	73	24	97	43	79	78	48	36	91	51	51	63	76	
Samaria	20	0	19	0	5	29	0	61	5	86	70	28	24	39	0	87	76	37	
Majengo	10	69	1	4		46	25	97	40	75	88	50	30	11		4	98		
Kijenge	20	90	10	4		83	30	97	51	93	69	40	57	8		1			
Agarauda	20	80	28	70	10	39	0	12	67	23	18	82	46	76	85	94	18	50	
Awarakotuwa	10	67	36	50		2	0	76	61	33	74	75	40	2			28		
Tharawaththa	20	47	10	40		1	0	93	52	23	9	68	32	0			42		
Tissawa	20	80	33	75	23	44	0	29	67	24	17	86	46	89	15	50	13	64	

Total Time (TT): Score derived using the total time spent on average by an household (HH) to collect water (this score gives the highest value to the lowest TT)

% men: % of time spent by men to collect water

San: % of HHs with sanitation

CoLand no LC: % of HHs cultivating land that has not experienced a loss of crops in the last 5 years

No Conflicts: % of HHs that do not experience conflicts over use of water

% Pp HH: % of HHs that have got a pipe in their house

% protected: % of HHs using water from a protected source

% educated: % of HHs that have got at least one of their members matriculated

% no illness: % of HHs that have not experienced illness that they perceive to be related with water

Wealth: Score derived by using the number of durable items belonging to a HH

% wages & inc: Score derived using both the % of HHs with at least a member earning a wage or receiving a pension and % of HHs earning income by selling farm products or craft products

lpd: Score derived using the average per capita consumption in litres.

lnU: Score derived using the percentage of HHs that use water for purposes other than drinking, washing, bathing, cleaning and cooking.

Au: Score derived using the proportion of HHs irrigating their crops and the average size of the cultivated land

LivU: Score derived using the average number of livestock owned by a HH and the minimum amount of water required per type of livestock

No erosion: % of HHs not experiencing erosion on their land

No LC: Score derived using the average number of loss of crops that a HH had in the last five years

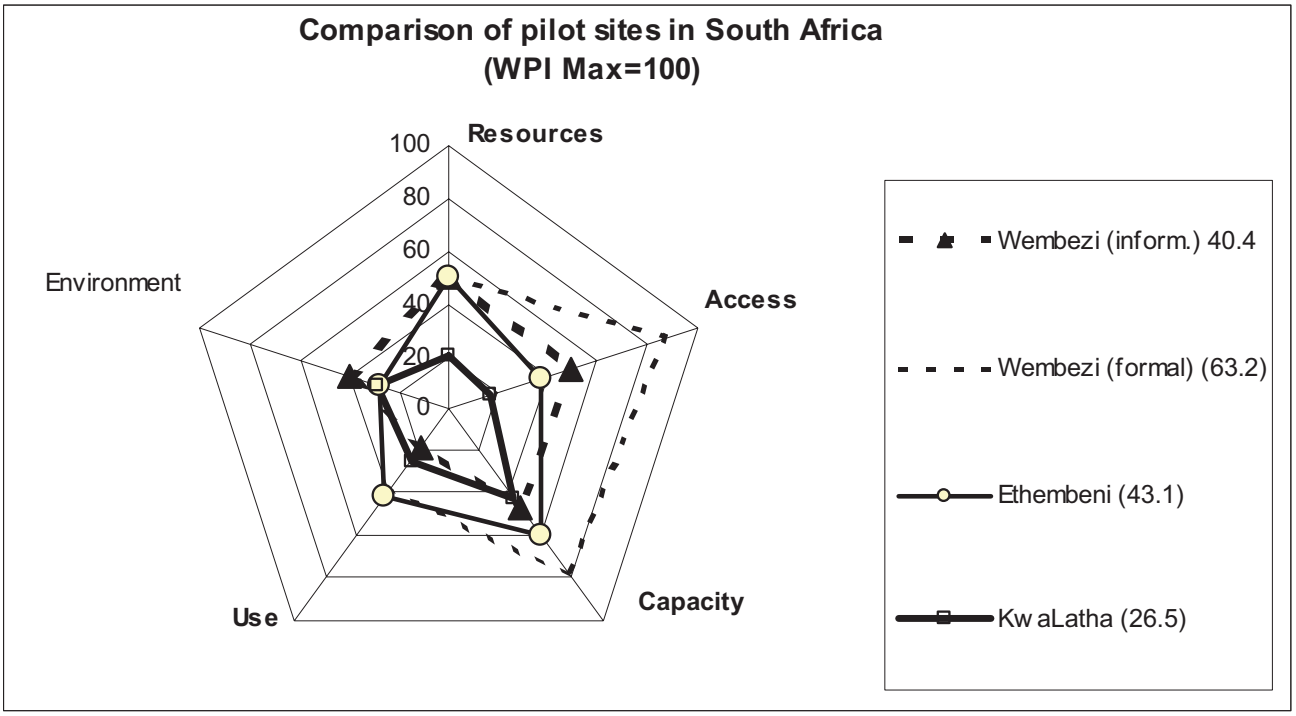
En: Score derived using the % of HHs making use of wild plants and animals

Table 2: An illustration from municipalities and small communities in South Africa, Sri Lanka and Tanzania.

		Component values					
Community		**Resources**	**Access**	**Capacity**	**Use**	**Environment**	**WPI**
South Africa							
Wembezi (inform.)	Urban	50.0	48.8	46.1	18.0	39.1	**40.4**
Wembezi (formal)	Urban	50.0	86.5	78.0	38.1		**63.2**
Ethembeni	Rural	50.0	36.6	59.8	41.5	27.7	**43.1**
KwaLatha	Rural	20.0	17.0	42.1	24.5	28.9	**26.5**
Tanzania							
Majengo	Urban	10.0	32.7	62.9	15.0	98.4	**43.8**
Kijenge	Urban	20.0	53.9	68.3	21.6		**41.0**
Nkoaranga	Rural	30.0	39.5	59.4	65.3	69.9	**52.8**
Samaria	Rural	20.0	20.9	44.7	37.7	56.1	**35.9**
Sri Lanka							
Awarakotuwa	Urban	10.0	35.2	79.6	21.2	28.1	**34.8**
Tharawaththa	Urban	20.0	26.5	50.6	16.2	42.2	**31.1**
Agarauda	Rural	20.0	38.3	64.7	74.9	34.2	**46.4**
Tissawa	Rural	20.0	47.3	52.0	50.0	38.5	**41.6**

Note: In 2 locations, no score for the environment was available, so the WPI was calculated without it.

Figure 1: How this information can be provided for policy makers – an example from South Africa



For policy makers and other users it is recommendable to display the information with this type of diagram. This allows the strengths and weaknesses of each location to be highlighted and compared.

6. Conclusion

The application of the transparent framework provided by the WPI enables a more consistent approach to decision making, and decisions can be both audited and defended. Depending on the purpose of its use, the WPI can be applied at a range of different scales. To determine the degree of need for water provision, it can be applied at the community level, and at the intermediate and national scales. Consistent representation of components at each scale facilitates meaningful comparisons, and variables can be determined by stakeholders according to local needs.

More information on the WPI is available at: http://ocwr.ouce.ox.ac.uk/research/wmpg/wpi/

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A6 Visioning

1. Introduction

The vision of an imaginary state of (local) water resources in the future informs the overall strategic direction of the IWRM process. It also serves as the point of reference for all further developments in the sector.

The vision is the starting point from which the objectives, indicators and targets of local actions for IWRM will be derived and the strategy developed.

In municipalities where another vision has already been formulated in a different field – for example, with regard to poverty alleviation, or as part of a more comprehensive integrated local development plan – the specific water resources vision should be linked to the existing one.

A vision is developed in a moderated process during which the ideas and expectations of stakeholders are compiled. Since stakeholder interests can be very diverse, even contradicting, a consensus will have to be negotiated. Conflicts will have to be managed well, as otherwise the whole process of achieving IWRM can easily fall apart completely.

The hiring of a professional and neutral person for the facilitation of a visioning process is indispensable. The Local Government needs to select the facilitator with care, since the successful outcome of the visioning process greatly depends on the skills and experience of the person who leads it.

The following sections will explain how a visioning process can or should work. In most cases, the process is conducted through one or several workshops in which stakeholders are brought together. Encouraged and guided by the facilitator, the stakeholders express their own interests and ideas that are then clustered under common headlines. Following an assessment and prioritisation of these ideas, common values are identified and a consensus is sought on the future conditions of local water resources.

The final vision should consist of a one or two page document that can be submitted to the local council for endorsement by the local political leaders.

2. Planning and organising the visioning process

2.1 Prerequisites

There are three major prerequisites before the actual planning of the visioning process can go ahead:

- A *person or a team within the local administration* has been assigned with the task of coordinating the process. The actual organisation of the workshops might be carried out directly by this person or team, or by an external company or other organisation hired for this purpose.
- The *stakeholder analysis* is complete. As a result, a comprehensive list of institutions and organisations is available which are either water users or otherwise important actors in the management of water resources.

  The Local Government will be just one of a long list of stakeholders. However, depending on both the size of the administration and the size of the stakeholder group as a whole, they may, nevertheless, be represented by several people, ideally from different departments.

- The *baseline assessment* is complete. Awareness of the major challenges and concerns regarding water resources at the local level will help concentrate the visioning process on finding the key elements that the vision should contain.

2.2 The facilitator

The facilitator of the visioning workshops needs to be a neutral and well-experienced specialist in conducting these kinds of events. Facilitation of a visioning process is completely different to chairing a meeting – and is much more of a challenge. Hiring the right person will be one of the most important factors for ensuring that the process is a success. If not taken seriously, the visioning process can end in frustration and annoyance, and the entire IWRM process might grind to a halt as a result.

Ideally, the facilitator is involved in the preparations from an early stage, so that she or he has a good understanding of the overall context of the visioning exercise and can also give her/his advice on the planned set-up (see below).

Tasks of the facilitator

The Local Goverment will have to hire the facilitator on the basis of Terms of Reference (ToR) that clearly define the expectations regarding her or his task. The overall task will be to lead the group of stakeholders participating in the process to a commonly accepted vision.

It is advisable to create trust in the facilitation by sharing the ToR with all participants. Otherwise, the group might suspect that the Local Government is manipulating them in a certain direction.

In general, the facilitator will have the following responsibilities:

Responsibilities of a facilitator

- Creating a comfortable atmosphere for learning: warm, open, friendly, and encouraging.
- Introducing written materials such as agendas, minutes, and general information.
- Guiding problem solving.
- Stimulating discussions and asking questions.
- Keeping discussions on track.
- Explaining the goals and methods.
- Setting out the ground rules and agenda.
- Making links to previous exercises.
- Being aware of and sensitive to group dynamics.
- Summarising and clarifying key points.
- Motivating participants.

Paul Markowitz (2000)

The visioning process will involve a number of specific challenges, especially when it comes to finding a consensus on the final contents and wording of the vision. Experience in conflict resolution will therefore be beneficial.

The facilitator will also have to be prepared to find the right level and style of communication for all participants, since some might be very eloquent and familiar with speaking in front of a large audience, whereas others might not even have a strong command of the common language used in the meeting.

Key characteristics of a good facilitator

In principle, the facilitator of a visioning process should have the same abilities as any facilitator who is appointed to lead the activities of a group of people to a concrete result:

A good facilitator:
- is seen as trustworthy, impartial and culturally sensitive
- speaks clearly and positively
- notices and responds when people's energy is flagging.

A suitably flexible facilitator:
- plans the agenda in advance but is flexible on the day
- ensures at the start of the meeting that the purpose is clear and agreed by those present
- has a toolbox of techniques for engaging people in different ways.

An experienced facilitator:
- focuses on guiding the meeting rather than talking
- ensures that different voices are heard and prevents one person or group from dominating the meeting
- constructively manages conflict
- clarifies where necessary, by paraphrasing what has just been said and checking accuracy
- summarises at intervals the conclusions the meeting appears to be reaching
- keeps the meeting on track and keeps an eye on the time
- helps participants draw conclusions at the end and determine clear actions.

http://www.goodpracticeparticipate.govt.nz/techniques/choosing-a-facilitator.html, accessed on 12 Feb. 2008

2.3 Formats and timing of workshop/s

A visioning exercise usually takes place in the form of one or several workshops.

In smaller communities, a workshop of two days for example might be appropriate. In larger metropolitan areas, a whole series of meetings in different parts of the agglomeration may be necessary and, additionally, towards the end of the process, a central meeting that brings the outcomes of all earlier sessions together.

The day of the week as well as starting and end times of events should be chosen with care. Early mornings, for example, might be a barrier for the participation of farmers who may be working their land before the heat of the day sets in. It might also be advisable to offer childcare during the sessions for those who would have to stay at home if unable to bring their children or siblings along.

2.4 Support staff

At least one person – if not a small team – should be available to support the facilitator, especially in cases where the group is large. A key task for supporting staff includes the documentation of the process and its results through a variety of different media and methods (taking photographs, conducting interviews, recording video footage, typing up and disseminating interim results on paper, etc.).

2.5 Venue, equipment and catering

When choosing the venue, preference should be given to bright, spacious rooms with a friendly atmosphere suitable for inspiring creativity and allowing people to move around freely. It should be possible to open windows, ideally giving views to quiet and pleasant surroundings. In addition, participants often appreciate the option to work in small groups outside of the building.

It is also important that all invited stakeholders can reach the location without undue investment of time or money. In certain cases, transport may have to be provided.

The venue should allow ample space for a variety of activities. Flexible seating arrangements and mobile furniture will be more convenient than rigid classroom settings. Lots of writing and drawing materials (including flipcharts, white boards, coloured paper, markers of different colour, etc.) and plenty of space to hang posters will support creative interaction and allow interim results to be visible to the entire group.

Finally, catering will have to be well planned. Tasty refreshments need to be offered to keep up the spirit and energy. Practical arrangements will have to be made for lunch, so that time is not wasted getting to and from a location situated a long way from the meeting venue.

2.6 Sending out invitations

Invitations should be sent out by the local administration. They should always be addressed to the most senior person of an institution or organisation who can then, if necessary, delegate a subordinate to act as a representative.

Ideally, the invitations are signed by either the Mayor or another senior political Local Government representative to underline the importance of the process.

Apart from the programme and the logistical details, the invitation should clearly state the expected outcome of the meeting and why the invitee has been chosen to be part of the process.

3. Conducting a visioning session

This section describes the typical course of a visioning session. However, it should be noted that this is one of many options and different facilitators employ different techniques. Naturally, such a process is also greatly dependent on the overall setting of the exercise, the number of participants, the relationships between the participants, the prevailing culture of communication and interaction in meetings, and many other parameters.

Opening the session

Ideally a high level local politician should open the session to re-emphasise the importance of the exercise.

Introduction

The facilitator should introduce the session by explaining the purpose of the process and programme for the day. An agreement should then be reached within the group on the basic rules for communication and conduct. The main question to be answered during the session is “Where do we want to go?” - not “How do we get there?” The latter will be discussed at a later stage in the planning process when turning the vision into a local strategy and ultimately into the action plan.

The facilitator should also explain early on that the visioning session will deliberately depart from the preceding analytical exercises – i.e. the baseline assessment – and set the scene for a more ‘playful’ approach to dealing with ideas and wishes. Participants will be asked to provide their thoughts using a number of alternative ways of communication, such as painting, drawing, etc.

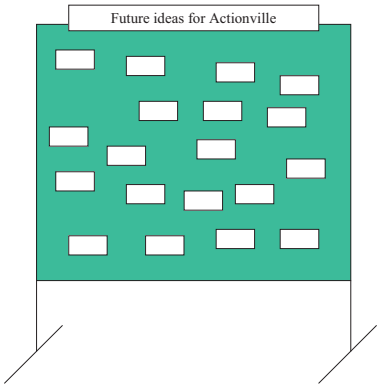
Visioning is not about ‘right’ or ‘wrong’. Some contributions might sound ‘ridiculous’ at first, but then lead to interesting and rather useful ideas during the course of interactions.

Gathering of ideas

To start the collection of ideas and the creative process in general, the facilitator may use special techniques, such as a story line for an imaginary municipality. This could be described as a place where the entire local water management approach has been reformed in a way that all water users are satisfied and the natural environment is not negatively affected by human interventions.

The group is then asked to write down on cards what they believe such a municipality might look like.

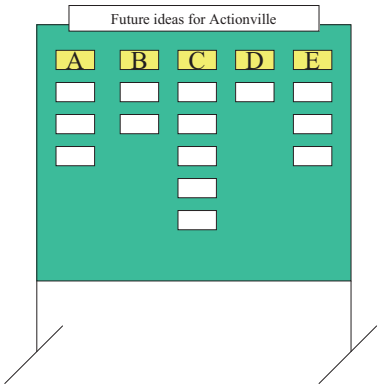
The purpose of the exercise is to get a "picture" of a virtual community that does not suffer from any mismanagement of its water resources.



All ideas are to be accepted and no discussion is necessary at this stage. The facilitator will only intervene if a card includes an action rather than a description, as actions leading to the vision are not being considered at this stage.

Clustering of ideas

The completed cards are collected on a pin board. With the support and agreement of the participants, the facilitator will then group together those ideas that refer to a common theme, area, purpose or sector and find a matching headline for each of the clusters.



Evaluation of ideas in local context/prioritisation of ideas

In the next step of the process, the facilitator asks the stakeholders which ideas on the board they would like to see realised in their own local situation and which ones they do not agree with.

There are various ways in which the participants can express their views on priorities. One option is that each participant writes a certain symbol or puts a coloured sticker on the cards indicating either agreement or disagreement (for example a tick for 'I agree' and flash for 'I disagree'; or a green sticker for 'I agree' and a red sticker for 'I disagree').

Discussion of conflicting ideas

Ideas with a high number of symbols or stickers reflecting disagreement are briefly discussed to make sure no misunderstandings have caused the negative feedback. However, some participants may also have to accept that their ideas are obviously not shared by the majority of the group.

Using clusters to formulate vision

The group is then split into as many sub-groups as there are 'headlines' – or clusters of ideas - on the pin board. Each group's task is to formulate one paragraph of the common vision for their municipality that reflects the ideas of the cluster for which they are responsible. Prior attention should be given to ideas with a positive evaluation, whereas those with more 'negative' feedback can be ignored.

The last step is to combine all paragraphs into a coherent text and agree on the final version of the emerging vision. If passages of the text do not meet with the agreement of group as a whole, they are either changed or left out.

As the overarching, long-term goal of all future activities in the area of water resources management, the final vision should be a concise, catchy and attractive text. It should use appropriate, but simple language, so that it can easily be understood by all.

Closing the workshop

Once the vision has been finalised, the facilitator – or a person from the Local Government's coordination team – should thank all participants. They should also describe the next steps to be taken in the planning process and how the vision will be used to influence these.

The value of the process and its outcome can again be strengthened if a local politician agrees to make some final remarks.

Political approval of the vision

Once the vision has found a consensus among the participants of the group process, it should be submitted to the local council for political endorsement. This will ensure that the result of the workshop will be turned into a document that politicians have explicitly committed themselves to.

Once political endorsement has been achieved, the vision can be regarded as a key reference document for observing future developments. This is of particular importance if in reality things appear to be moving in a different direction than initially expected and expressed in the vision.

Making the vision known to everybody

The vision will never become reality if it doesn't receive the attention and support of the majority of all people connected to water resources – which basically includes all members of the local community in one way or another.

Following council approval of the vision, the Local Government should, in collaboration with all other stakeholders involved in the process, take responsibility for raising awareness of it throughout the community. This includes engaging with a variety of media, such as local newspapers, TV and radio. Placards on notice boards in public spaces such as libraries or bus stops can also be very effective.

4. Checklist for implementing a visioning process

The following table summarises the typical responsibilities of the local administration when planning, organising and realising a visioning process. While some of these responsibilities might be outsourced to a private service provider, a consultancy, an NGO, or similar, it is advisable that the Local Government still oversees the process as a whole and remains accountable for its successful implementation.

Responsibility	✓
Plan budget and sources of financing	
Identify department within local administration that will be in charge of process	
Assign tasks for planning and organisation to one or several staff members	
Nominate person/s to represent Local Government as one of the stakeholders in water resources management	
Draft ToR for facilitator	
Identify and select facilitator	
Brief facilitator of overall context, objective and expected outcome of visioning exercise	
Decide about general format of process and develop programme outline	
Get local politician to officially open the process	
Select and book venue, equipment and catering	
Send out invitations to stakeholders, manage process of registration and prepare list of participants	
Announce workshop/s in local media	
For the nominated persons from the Local Government: take part in proceedings of visioning workshop	
For the cooordination team of the local administration: oversee smooth functioning of all logistical aspects and assist facilitator where needed	
Bring result of process – the actual vision – in final form and coordinate submission to local council for endorsement	
Publish vision widely	

Note: The sequence of responsibilities as presented in the table does not necessarily correspond with the chronological sequence of steps to be taken.

5. References

http://www.goodpracticeparticipate.govt.nz/techniques/choosing-a-facilitator.html accessed on 12 Feb. 2008

Paul Markowitz, *Guide to Implementing Local Environmental Action Programs in Central and Eastern Europe*, published by the Regional Environmental Center for Central and Eastern Europe, Budapest, Hungary, 2000

Naomi Luhde–Thompson, Silke Moschitz, Stefan Kuhn, Barbara Anton, *Web Course: Local Action Planning for Employment*, published by ICLEI European Secretariat, Freiburg, Germany, 2004

A7 Press releases

1. Introduction

For most Local Governments, press releases are well known as a means to convey key information on their policies, accomplishments, success stories, high-ranking visitors, important events, etc. to the wider public.

A Local Government that has decided to pay increased attention to its local water resources and establish a participatory planning process to reform its hitherto existing management practices will need the media throughout the IWRM planning and implementation process. Chances to achieve the newly set objectives would be slim without widespread awareness among the local community and all sectors of society of the benefits that sustainable management of local water resources can provide.

2. Press releases during a local IWRM planning process

There are a number of typical elements in an IWRM planning process in which a press release might be a useful media instrument to keep the public informed and interested in the process.

Press releases may, among others, be considered when:

- a comprehensive assessment of the status of local water courses is undertaken;
- workshops are being organised to bring stakeholders together to develop a local water vision;
- the local water vision has been endorsed by the local council;
- the Local Government has finalised the strategy or issued the first local water plan;
- a new organisation or institution has committed itself to support the local water reforms;
- success stories deriving from local reforms in the water sector are emerging;
- water reports summarising the results of monitoring activities are being published;
- the Local Government has received visitors from another city interested in finding out more about the local practice of IWRM; and
- the city has won an award for their outstanding achievements in managing the local water resources in a sustainable way.

If linked to an event, it is recommendable to plan and draft the press release before the event occurs. Final details can still be added at the last minute. Only in this way, can it be ensured that the text reaches the media when the issue is still newsworthy.

3. The structure of a press release

In order to achieve its purpose, a typical press release follows a number of writing 'rules' and a well-defined structure.

Writing rules

Although trying to be catchy to draw attention to a certain issue, blatant language and any clichés or jargon should be avoided. The overall style should be characterised by being concise, keeping to the facts and an economical use of adjectives.

Structure

The general rule is to start from the most important fact or message and to move on providing more and more detail. Some elements should also be added to help journalists process the press release further, such as giving the details of a contact person for questions and further information.

Particular attention should be paid to the lead paragraph that should contain all key elements of the message or information to be conveyed.

General structure	Example
FOR IMMEDIATE RELEASE To be put in the upper left hand margin, under the letterhead.	FOR IMMEDIATE RELEASE
Contact information Name, title, telephone number, fax number, and email address of the main contact person responsible for the press release.	Ms. Sadikiki Zuri Director, Public Relations Phone: 029-81973 280 Fax: 029-81973 280 Email: s.zuri@city.af
Headline In boldface type.	**Local fishermen back in business through city's new water policy**
Dateline City and date of the press release.	Waterville, 30 March 2008
Lead paragraph • What • Who • When • Where • Why	Catfish, tigerfish and pike, rarely seen locally for more than a decade, have recently reappeared in lake Majikubwa on which the town of Waterville sits. This was made public through the municipality's Local Water Report 2008, presented by the Planning Director, Mr Aki Ajene, at a press conference yesterday. The report contains the results of the yearly monitoring exercise established as an important element of realising the town's 'Water Vision 2010'.
Body of text The possible substructure could be • A quote from a key person involved (*make sure that quote is accurate and person agrees to being quoted!)* • More facts and details on lead paragraph	"My grandparents told me that they have always lived comfortably and never had any problems bringing up their five children. My grandfather was a fisherman, and in the local waters he always found an abundance of fish of all different kind." These were the words of Aki Ajene when he introduced this year's Local Water Report. In 1995, however, he recalled that the local authorities had to issue a warning for the first time. The nearby lake, Majikubwa, had become the source of a severe epidemic. Families living close to the shores had been taken ill with fever, diarrhoea and vomiting as well as cases of respiratory difficulties.

	Intensive agriculture and the outflows of smaller streams flowing through the informal settlements on the eastern side of Waterville, often used as open wastewater channels, were identified as the cause of the problem. The warning signs had been there for some time as the numbers of edible fish had been reduced to almost zero and many families had suffered due to livelihoods being based on the local supplies of fresh water. With the beginning of the third millennium, the newly elected local government decided to turn the tide. Rewarding the trust offered to her by Waterville's constituency, the Mayor, Ms Mesi Fanaka, decided to open the doors of the local city hall and to invite all those with an interest in a healthy local environment to help revive the local water courses. This was the beginning of the community's work to develop and move towards a "Water Vision 2010". This year's Local Water Report once again makes evident how the joint efforts of many members of the local community have been well invested to improve local livelihoods … …

References

Dr. Randall Hansen's Guide to Writing Successful Press Releases; http://www.stetson.edu/~rhansen/prguide.html; accessed on 19 Dec. 2007

How to Write a Press Release; http://www.infoscavenger.com/prtips.htm; accessed on 19 Dec. 2007

Michel Barton, *Media relations, A handbook for National Commission and UNESCO's partners,* published by UNESCO, 2003

10 Essential Tips to Ensure Your Press Release Makes the News; http://www.press-release-writing.com/10_essential_tips.htm; accessed on 19 Dec. 2007

The Seven Elements of a Press Release: Everything You Need to Know, LevelTen In-Site Blog, LevelTen, http://www.leveltendesign.com/blog/general/by-taylor_c/the-seven-elements-of-a-press-release-everything-you-need-to-know; accessed on 19 Dec. 2007

A8 Scenario building

1. Introduction

Availability of water resources and the demand for these is subject to a wide range of uncertainties. These can be due to variability in the hydrological cycle itself, but also as a result of factors outside the water domain, such as demographic change or macro-economic developments. By definition, many of these factors cannot be known beforehand. Water management strategies to achieve a common water resources vision will vary depending on how such factors evolve. Scenario building is a methodology that addresses these uncertainties. It allows for the identification of alternative strategies to deal with different possible scenarios that might unfold in the future. It is thus a methodology for an adaptive management of water resources.

2. Objectives

Scenario building is used:

- to understand how external factors may affect water resources management in the future;
- to provide a basis for the identification of alternative strategies suitable for dealing with these factors and to ensure that local actions will indeed be appropriate for working towards the initially agreed vision.

3. Method

Scenario building is best done in one or more workshops with the relevant stakeholders after a common vision has been developed. Once the different scenarios have been worked out, alternative strategies can be developed that allow flexible adaptation to changing circumstances.

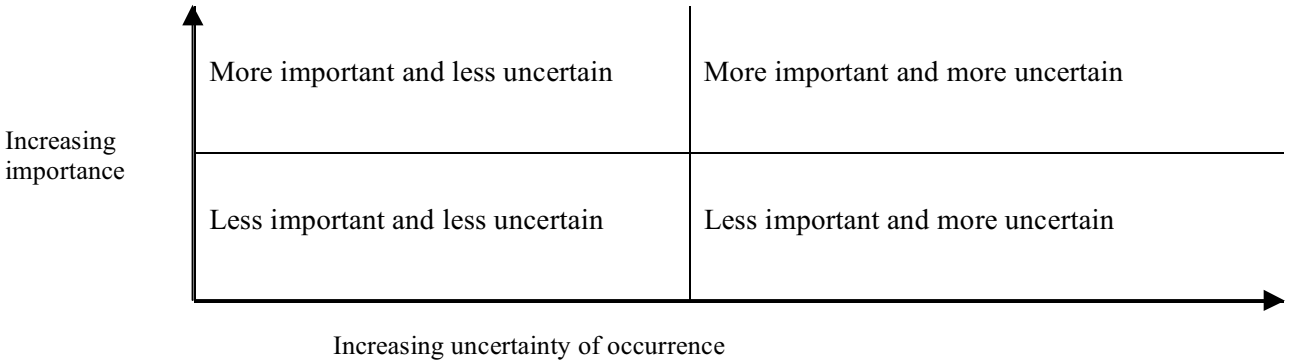
The main steps are as follows:

Step 1: Compiling factors that affect the future vision of water management and use

In the first step, stakeholders brainstorm on the various factors that are likely to influence the achievement of the vision. Factors can be both local, which the stakeholders can make changes to and influence themselves, and external, which tend to be out of the local community's control. It is important that the facilitator encourages the stakeholders to think about both factors equally.

Step 2: Defining which of the external factors are the most uncertain and the most important

The external factors are classified according to uncertainty and importance. This can be done using the following grid.



The two to three factors placed furthest to the top right of the grid (the most important and most uncertain) should be used to differentiate between possible future scenarios.

Step 3: Identifying future states of external factors to allow these to be turned into consistent narrative stories

Using the less important and/or uncertain factors placed elsewhere in the grid, a 'background story' is developed that is shared by all scenarios. The created scenarios should then be discussed amongst the stakeholders and labeled with high or low probability.

Step 4 (after the workshop): Drafting the overall background story and adding other quantitative information

Based on the workshop output, write a common 'background story' and list the key factors for as many different scenarios as are useful. Other factual information and data can be added at this stage to strengthen the scenarios. Modelling can also be carried out to examine the internal consistency of the scenarios. The final scenarios should be discussed with key stakeholders and refined as necessary.

4. Sources

Moriarty, P., Batchelor, C., and P. Laban (2005) *Using Visions, Scenarios and Strategies within the EMPOWERS Planning Cycle for IWRM.* EMPOWERS Working Paper 4. www.empowers.info

Moriarty, P, Batchelor, C. Laban, P. and H. Fahmy (2007) *The EMPOWERS Approach to Water Governance: Guidelines, Methods and Tools.* INWRDAM, Amman, Jordan

Schwartz, P. (1991). *The Art of the Long View: Planning for the Future in an Uncertain World.* Currency Doubleday, New York, USA

Van der Heijden, K. (2005). *Scenarios, the art of strategic conversation,* Wiley, Chichester, England

WUR (2006) *Multi-stakeholder process resources portal – scenario analysis* http://portals.wi.wur.nl/msp/?Scenario_analysis

A9 Participatory Rural Appraisal (PRA)

Introduction

Participatory Rural Appraisal (PRA) is a broad group of tools and activities that usually contain a large component of joint assessment and analysis based on stakeholder involvement. PRA can also be applied to assess a particular water situation. In this case they can help identify and incorporate the knowledge and opinions of water users especially at grassroots level. They can also contribute to the planning of interventions to address the issues at stake.

PRA can provide information that is often not easy to collect through conventional methods, particularly on local knowledge and the preferences of water users and other local stakeholders. PRA is also of use to the local stakeholders themselves as it can help them to better understand their own situation and take more informed decisions.

PRA Tools

The vast number of PRA tools available can be roughly categorised into three groups:

- Sampling tools, such as transect walks, wealth ranking, pocket voting
- Interviewing tools, such as focus group discussions, semi-structured interviews, triangulation
- Visualisation tools, such as Venn diagrams, social mapping, matrix scoring, timelines, diaries

Some of these have been developed in a specific context, whereas others are more generic in nature, and have been adapted to the needs of specific (sub)-sectors, such as water supply, sanitation, irrigation, agriculture, etc.

A large number of manuals, guidelines and toolboxes exist, both at a sectoral and organisational level. It is therefore beyond this paper to provide detailed descriptions of each of these. Instead three commonly used PRA tools have been chosen for their application in the area of water resources management. These are:

- social mapping;
- focus group discussions; and
- Venn diagrams.

Details of a wide range of other PRA tools and how they relate to the different water sub-sectors can be found in the following sources:

Bolt, E. and C. Fonseca (2001) *Keep It Working: a field manual to support community management of rural water supply.* IRC International Water and Sanitation Centre, Delft, the Netherlands http://www.irc.nl/page/1896

This book contains practical PRA tools to facilitate communication and community decision-making processes and checklists that help field staff to organize their work around rural water supply.

Conroy, C. (2002) *PRA tools used for research into common pool resources.* Socio-economic Methodologies for Natural Resources Research. Best Practice Guidelines. Chatham, UK: Natural Resources Institute. http://www.nri.org/publications/bpg/bpg12.pdf

This paper reviews the use of different PRA tools for their use in natural resources management.

Crawford (1997) *Marketing Research and Information Systems.* FAO, Rome, Italy. http://www.fao.org/docrep/W3241E/w3241e09.htm

The section in this book by Crawford refers specifically to rapid rural appraisal methods and tools for agricultural assessments.

ELDIS – Participatory methodologies
http://www.eldis.org/go/topics/resource-guides/participation/participation-in-development/participatory-methodology

This website contains links to guidelines and other resource material on participatory methodologies in different development sectors

IIED – Participatory Learning and Action http://www.iied.org/NR/agbioliv/pla_notes/index.html

This magazine and website publishes articles with experiences with PRA methods in different sectors, including the water sector.

WUR (2006) Multi-stakeholder processes resource portal – tools. http://portals.wi.wur.nl/msp/index.php?Tools

This website contains detailed descriptions of a number of PRA tools.

1. Social Mapping

Social mapping, also dubbed community mapping or locality mapping, is a tool for visualising the water and related issues of a specific geographic location, for example a community or sub-catchment. It focuses particularly on:

- physical characteristics, such as the location of water resources and infrastructure
- social access to these resources and services, differentiated by wealth classes, gender, etc.

There is often a spatial dimension to access to and use of water resources and services. This may be a combination of physical and social causes. Mapping allows participants to identify these spatial patterns and start analysing the underlying causes.

Mapping is often one of the first activities carried out in an assessment phase of a local IWRM action plan, as it helps to identify the key issues and geographical focus of local issues. However, it can also be referred back to in the planning or even monitoring phase.

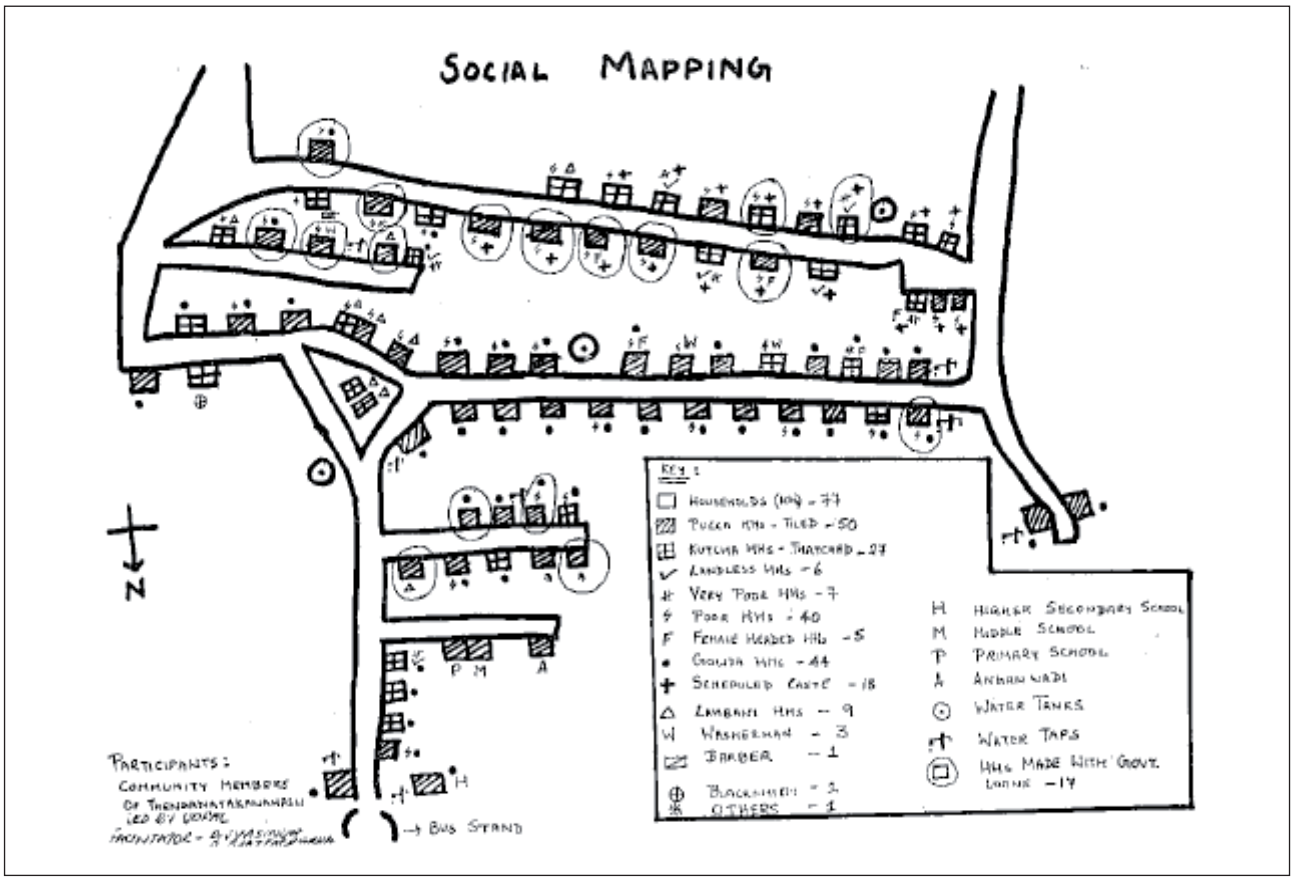
Methodology

The mapping exercise takes place in a workshop setting with the community and other relevant stakeholders. In this meeting, the participants are asked to draw a map with the most important features. The basic steps are:

- The group is asked to draw the boundaries of the geographic unit being discussed, for example of the community or the sub-catchment.
- The outline and main features of the local area are drawn, for example roads, towns, rivers and property boundaries.

- Participants are asked to add the relevant physical features. The facilitator provides guidance and focus in order to ensure that all relevant features such as water bodies and water infrastructure are added.
- Furthermore, the participants are asked to include information on social aspects. For this, the facilitator provides guiding questions, indicating, for example, the homesteads where different wealth classes live, or households with and without access to a particular water source. The exact questions depend on the specific focus of the exercise.
- Once the map is finished, participants are asked to reflect on the map they have drawn, linkages they see, spatial patterns that emerge, etc. The facilitator needs to guide the discussion and should prepare probing questions.

As said above, this exercise is carried out with stakeholders associated with the particular location of a community. Several separate exercises can take place within the same geographic area, but with different sub-groups. A comparison can then be made between the results of these separate exercises. Local government staff could facilitate the exercise, but it can also be done by a local NGO or other organisation working in the area.



The image above is an example of social mapping taken from Thenganayakanahalli village in India (Chapter 8, Participatory Learning and Action – Issue 41, International Institute of Environment and Development)

References

For the use of mapping in different sectors see for example:

Bolt, E. and C. Fonseca (2001) *Keep It Working: a field manual to support community management of rural water supply.* IRC International Water and Sanitation Centre, Delft, the Netherlands http://www.irc.nl/page/1896

WUR (2006) *Multi-stakeholder processes resource portal – locality mapping*. http://portals.wi.wur.nl/msp/index.php?Locality_mapping

2. Focus group discussions

Focus group discussions are a method of discussing particular issues among a small selected group of people, to gather their ideas and opinions about a certain topic. It consists of semi-structured discussions in a small group.

Many people do not effectively participate in larger multi-stakeholder meetings due to reasons such as power dynamics, different levels of understanding of an issue, etc. Focus groups aim to create a more closed space, in which people are more comfortable to share their ideas, experiences and opinions.

Focus group discussions can be used at any moment when needed, both to collect information, or to develop consensus to take decisions.

Methodology

Several focus groups may be held with different homogeneous groups of participants.

The main steps are:

- Focus group discussions require careful preparation. The facilitator needs to be clear on the topic of the discussion, the expected outputs and some guiding questions.
- The participants are defined; four to eight people is ideal. Mostly, several discussions are held, each one with a fairly homogeneous group of participants (for example a group of men, group of women, group of farmers, group of livestock owners, etc.).
- The facilitator explains the objective and method for the discussion and presents the group with the broad question.
- The participants discuss this question for the time period agreed upon beforehand, for example one or two hours maximum. The facilitator shouldn't intervene other than to ensure that all participants are given the opportunity to have their say. Additional probing questions may also be posed.
- It is necessary to take detailed notes during the discussions. Focus groups are best if facilitated in pairs - one person to facilitate the discussion and the other for note taking.

Local government staff may be in a good position to facilitate focus group discussions. However, at times, for example when there is a conflict or lack of trust between the community and local government, it may be better to have an outsider facilitate the discussion so that participants do not feel inhibited to speak out on certain issues.

References

For the use of focus groups in different sectors see for example:

Bolt, E. and C. Fonseca (2001) *Keep It Working: a field manual to support community management of rural water supply.* IRC International Water and Sanitation Centre, Delft, the Netherlands http://www.irc.nl/page/1896

WUR (2006) *Multi-stakeholder processes resource portal – focus groups.* http://portals.wi.wur.nl/msp/index.php?Focus_groups

3. Venn diagrams

IWRM requires different individuals and organisations to work together on water management. The Venn diagram (named after the mathematician John Venn who introduced the diagram) is a tool to visualise the relations between these individuals and organisations and their relative importance around the issue at hand. The visualisation is done by drawing circles.

The tool is typically used in the assessment phase of a local IWRM action plan to help understand the institutional context. It may also be used at the planning stage when an analysis is made of efforts required to implement plans.

Methodology

A Venn diagram analysis is carried out in a workshop or meeting session. It is best done with a mixed group of stakeholders, possibly representing a larger part of the stakeholders who need to be selected carefully. It requires a facilitator with prior experience in the method. Ideally Local Government staff should participate in the exercise, rather than facilitating it.

The Venn diagram should be developed based on the following instructions:

- Participants are asked to draw circles representing each of the stakeholders identified around a certain issue.
- The relative size of the circles should indicate the relative importance of the stakeholder with regards to the issue. So bigger circles represent stakeholders with a bigger influence on addressing an issue
- Stakeholders who are closely interacting should be drawn closer to each other, in some cases the circles might even overlap. Those who hardly interact are drawn far from each other.
- The diagram is finished when all stakeholders have been drawn.
- The diagram will be discussed with all participants, to analyse the causes for strong or weak relations, and where to focus efforts to strengthen relations.

References

Bolt, E. and C. Fonseca (2001) *Keep It Working: a field manual to support community management of rural water supply.* IRC International Water and Sanitation Centre, Delft, the Netherlands http://www.irc.nl/page/1896

WUR (2006) *Multi-stakeholder processes resource portal – Venn diagrams.* http://portals.wi.wur.nl/msp/index.php?Venn_diagrams

A10 Logical Framework

Introduction

The logical framework, or logframe for short, is a tool for designing, implementing and evaluating the actions and outcomes of projects and programmes. It does this by providing a framework within which the user can:

- provide a clear overview summary of project goals and details;
- set out the logical steps through which objectives will be reached;
- establish how the achievement of project actions and outcomes can best be monitored and evaluated;
- review achievements and progress throughout project implementation; and
- identify potential risks.

This paper provides a brief overview of what a logframe is, why it is used and how to set it up. Although a logframe is used for planning purposes throughout a wide range of sectors, this paper focuses on its use within water resources management at the local level.

1. What is a logframe?

A logframe is a matrix designed to explain the means-end relationship of a project. The left-hand column of the matrix consists of the narrative summary of the project. This is usually made up of the project objective, purpose, outputs and activities. The three remaining columns are concerned with the achievement of these project components. Columns 2 and 3 deal with the measurement of the components through the listing of indicators and the means of verifying these. Column 4 records the factors that are assumed to be necessary for the project components to be achieved. The basic design of a standard logframe matrix is shown in Figure 1.

1	2	3	4
Narrative summary	**Indicators of achievement**	**Means of verification**	**Assumptions**
Objective			
Purpose			
Outputs			
Activities			

Figure 1: Logframe template[4]

The matrix design is based on a vertical logic (columns 1 and 4) and a horizontal logic (columns 2 and 3) approach to project design. The vertical logic identifies what the project plans to do, the causal relationships between the vertical project elements (that is, if outputs are produced, then the purpose will be achieved), and the assumptions and uncertainties associated with doing this. The horizontal logic records how the project achievements will be measured.

[4] Variations of this design exist depending on the literature consulted and specific project requirements.

2. Why use a logframe?

The purpose of the logframe is for specific project or programme planning, implementation and evaluation. It allows the user to summarise all relevant information necessary to achieve the project objectives and is therefore a useful tool during the design and implementation stages of a project or programme.

Listed below are some of the advantages of using the logframe when planning and implementing a project:

- It summarises the logical links between project means and ends
- It highlights potential risks to the project
- It provides a framework to monitor and evaluate project achievements
- It provides a concise and easy to follow project summary

It is important to note that the logframe is not a fixed project plan but is rather a 'living' document. It is used not only for planning the implementation of actions, but also for monitoring and evaluating the results over time. It should therefore be reviewed and updated throughout the project life span to include the necessary responses to problems, weaknesses and lessons learnt. This has the advantage of providing a tool that enables the user to carry out adaptive management during the project and respond to setbacks and unexpected problems encountered.

3. The logframe matrix

The logframe is best developed as a participatory process in a workshop environment. This should be organised and facilitated by the project management team, who will have ultimate responsibility for the logframe development and use, but will also require the involvement of key stakeholders.

The following sections provide details of each component of the logframe to help the user complete it.

3.1 Objective, purpose, outputs and activities

The left-hand column of the logframe specifies the overall objective of the programme, the reason for doing it and the outputs from specific activities.

3.1.1 Objective

The objective defines what the project or programme aims to achieve. The objective should have been previously identified when discussing the issues and priorities of a greater strategy for improvement. It must be achievable through the implementation of feasible activities. Unlike the other components of a project set-up, which can be adapted and refined as the project progresses, the objective should remain fixed throughout.

In relation to water resources, examples of objectives may be:

- To increase the Local Government's capacity to deliver equitable and sustainable water services
- To improve safe and secure access to water resources for all society groups including the disadvantaged
- To promote effective water governance
- To reduce the risk of flooding

3.1.2 Purpose

The purpose summarises the reasons and motivations for carrying out the activities. It includes the benefits that these will achieve and to whom they are relevant. The purpose should be directly related to both the outputs of the activities and the objective.

In relation to water resources management, examples of purposes include:

- All members of the community receive a more reliable water supply service through improvements in distribution infrastructure
- River biodiversity is improved as abstractions from rivers are reduced through increased use of recycled water for irrigation
- Localised flooding is reduced through the development of sustainable urban drainage systems
- Stakeholders feel ownership of IWRM initiatives through representation in the decision-making process

3.1.3 Outputs

The purpose is achieved through the outputs, which are the deliverables from the activities. Each output should be directly linked to the relevant activity.

In relation to water resources management, examples of outputs include:

- Programme for leak detection and repair in the water supply distribution network
- Mechanism for dialogue and involvement of all stakeholders in local IWRM action plan development
- An upgraded flood warning system
- A water users group

3.1.4 Activities

The activities are the practical measures to be implemented to achieve the outputs that contribute to the purpose and objective. These need to be carefully selected to ensure that they are most relevant for ultimately achieving the goal. So as to keep the logframe to a manageable length, activities should be summarised only rather than listed in detail.

In relation to water resources management, examples of activities include:

- Organisation and facilitation of workshops to raise awareness on water and sanitation issues
- The construction of wetlands
- Identification and recruitment of consultants to undertake hydrological modelling

3.2 Indicators and means of verification

Columns two and three of the logframe are concerned with the achievement of the objective, purpose, outputs and activities. This is done through the specification of indicators to measure achievement and the means of verifying these.

3.2.1 Indicators of achievement

Indicators are used to assess progress towards the objective, purpose, outputs and activities of a project. They do this by:

- Specifying realistic targets in terms of quantity, quality and time
- Providing the basis for the monitoring, review and evaluation process

There are many different types of indicators. Some indicators can be measured through directly observable change such as water quality improvements or new water supply connections. Others are less easy to measure such as quality of life improvements or capacity development.

Indicators can be both qualitative and quantitative. They should also have a period of time associated with them. Overall indicators should aim to be specific, usable, measurable, cost-effective and available, and will ideally include a variety of types that measure the process as well as the product. They should be objectively verifiable.

It is important that indicators are carefully selected and that they are the most efficient available option for what they aim to measure. The number of indicators should be kept to a minimum due to likely cost and time limitations. However, a sufficient number must be chosen to have an adequate basis for monitoring and evaluation.

The setting of indicators can contribute to a transparent planning process and highlight issues of accountability. It is therefore important to think about who sets the indicators and who is responsible for their achievement. Ideally this should be a participatory process involving representatives of all stakeholders.This will play an important part in ensuring that the most effective indicators are selected and will also increase ownership of the projects and programmes carried out.

In relation to water resources management, examples of different types of indicators include:

- Frequency, duration and extent of water shortages
- Concentration of nitrates and phosphates in local water bodies
- Percentage of correct answers given by stakeholders in questionnaires designed to measure awareness of their own roles, rights and responsibilities, and those of others, in local water resources management
- Number of community members expressing a sense of responsibility for the value of water resources through voluntary participation in water related activities

3.2.2 Means of verification

The means of verification refer to the data and information that is collected and assessed to measure the indicators. The sources from which this will be gathered, how it will be done and by who will have to be considered when the means of verification are specified. The verification of indicators may, in some cases, require a baseline measurement to be carried out before the programme begins against which the collected data can be compared and progress judged.

In relation to water resources management, examples of means of verification include:

- Results from pumping tests
- Evaluation surveys with relevant stakeholders
- Attendance records at IWRM training events
- Information contained in a drought management plan

3.3 Assumptions

The activities designed to reach objectives will have a number of assumptions associated with them. The fourth column of the logframe identifies the external factors which are necessary to achieve the activities, outputs, purpose and objective of the logframe.

In relation to water resources management, examples of assumptions may be:

- Funds for a water resources assessment are made available on time
- All key stakeholders participate in the IWRM process in a constructive and organised manner according to their respective roles
- Estimates of future agricultural water demand are accurate
- Those trained in IWRM will continue in their current roles and will make use of their training

Risks associated with the failure of assumptions to hold true will need to be managed. Where this is not possible it will have to be decided whether an activity should go ahead in spite of the risks involved.

4 Completing the framework

Figure 4 is a guide to completing a matrix structure. The text within each entry box provides a short description of the type of information that should be entered by the user.

Narrative summary	Indicators of achievement	Means of verification	Assumptions
Objective *What is the objective which the activities are designed to achieve?*	*Quantitative measures or qualitative judgements that determine whether the goal has been achieved*	*Sources of information that exist or can be provided to allow the goal to be measured*	*External factors that are necessary to sustain the objectives in the long run*
Purpose *What are the benefits of the actions and what improvements or changes will be brought about through them?*	*Quantitative measures or qualitative judgements by which the achievement of the purpose can be judged*	*Sources of information that exist or can be provided to allow the purpose to be measured*	*External factors that are necessary to enable the purpose to contribute to the achievement of the goal*
Outputs *What outputs (deliverables) are to be produced in order to achieve the purpose?*	*The type and quality of outputs and by when they will be produced*	*The sources of information to verify the achievement of the outputs*	*The factors that are not controlled by the project but which are necessary to enable the outputs to achieve the purpose*
Activities *What activities must be achieved to accomplish the outputs?*	*The type and quality of activities and by when they will be produced*	*The sources of information to verify the achievement of the activities*	*The factors that are necessary for the activities to create the outputs*

Figure 4: Logframe Matrix Structure (Example based on Box 3, Chapter 5 in the DFID Tools for Development handbook[5]).

4.1 Recommended steps for completing the framework

The order of completing the framework is important to ensure that logical links exist between the different elements within it. The following steps can help with the design of the logframe (steps based on Boxes 10 and 11, Chapter 5 in the DFID Tools for Development handbook).

Step 1: Define the objective – What is the overall goal of the project or programme? What overall need or problem are you trying to address?

Step 2: Define the purpose – What is the rationale for what is planned? What impact do you hope to make? How will the user benefit?

[5] Tools for Development: A handbook for those engaged in development activity, Performance and Effectiveness Department, DFID, 2002

Step 3: Define the outputs – What will be the measurable end results of the planned activities? What results will the activity be directly responsible for?

Step 4: Define the activities – What will actually be done to achieve the outputs?

Step 5: Verify the vertical logic – If the given activities are carried out will the stated output result? If the output has been achieved, has the purpose been fulfilled? If the purpose has been fulfilled, has the objective been accomplished?

Step 6: Define the assumptions – What external factors are needed for the achievement of the objective, purpose, outputs and activities? These are likely to change over time as the programme progresses.

Step 7: Set indicators – What will indicate when the objective, purpose, outputs and activities have been achieved? Begin with the objective and work down the framework to the activities.

Step 8: Define means of verification – What are the data sources you will use to verify the indicators?

5 The 'If-And-Then' logic of the framework

The key requirement of a logframe is to maintain the logical links between all the entries in the matrix. To check that this relationship exists in the completed framework, the If-And-Then logic can be tested. This logic is shown in figure 5 (to be read from bottom to top).

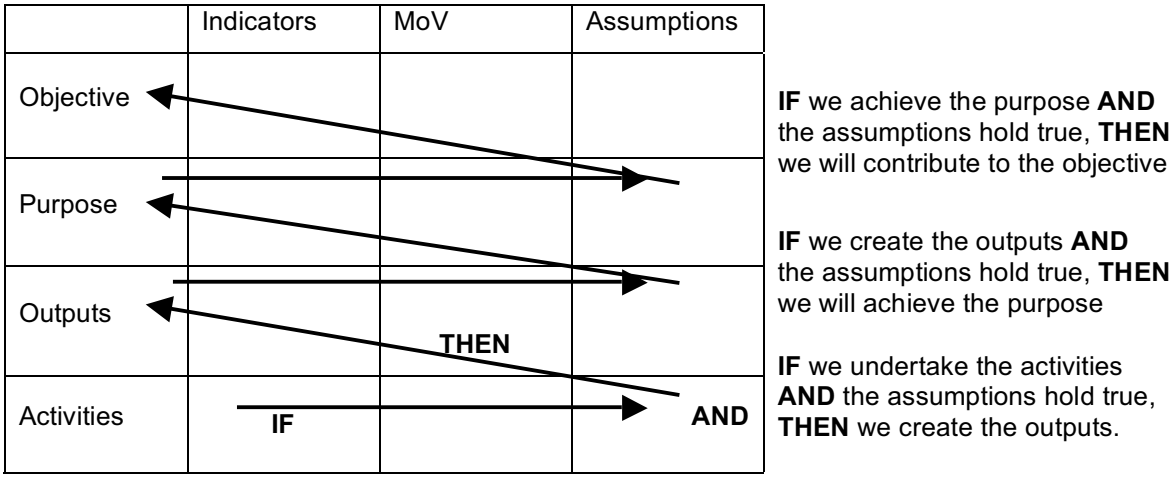


Figure 5: If-And-Then logic (based on Box 2, Chapter 5 in the DFID Tools for Development handbook)

6. Example

Improved access to clean water programme (adapted from The Logical Framework Approach: A summary of the theory behind the LFA Method, Appendix C, SIDA, 2003)

Narrative Summary	Indicators of Achievement	Means of Verification	Assumptions
Objective Improvement of health conditions of people living in areas not connected to water supply and sanitation networks	20% fewer cases of diarrhoea, scabies, eye infections, malaria, blood parasites (bilharzia) and malnutrition	Reports from health clinics in the project area	Improvements in the provision of clean water is a key factor in reducing water borne disease
Purpose Consumption of clean water shall increase, reducing incidents of water-borne diseases	xx water points erected and xx latrines constructed and their use recorded	Half-yearly project reports	Water sources remain unpolluted Adequate supply of groundwater of good quality exists Primary health care and education are still provided
Outputs 1. 50% of target group supplied with sufficient quantities of clean water	Water points brought into operation; water quality tested	Project personnel who visit all construction sites when the installations are complete Half-yearly project reports Reports from the District Development Fund Reports from the District Council	Maintenance system will continue to function
2. 50% of existing water points in the target area repaired	50% of existing water points in working order		
3. Maintenance and repair organisation commences operations	All water points included in the maintenance programme		
4. 20% of households in the target area supplied with latrines	Latrines built and used correctly		Target group is willing to adopt new habits in respect of water and sanitation
5. Hygienic habits of the target group improved	Target groups habits more hygienic	Half-yearly reports from the Ministry of Health based on examinations of the target group	
Activities 1.1 Train xx construction personnel	xx personnel attended training by set date	Training records and attendance list	Necessary finances, materials and personnel are available Target group will cooperate Implementing organisation fulfils its
1.2 Designate xx locations for water	xx locations designated	Evidence of planning approval for the	

points		designated locations	obligations
1.3 Procure materials	Existence of materials of sufficient quality and quantity by set date	Receipt of goods documentation	
1.4 Drill and construct xx wells	Existence of xx new wells by set date	Project personnel visits to sites; pumping tests	
2.1 Train xx personnel	xx personnel attended training by set date	Training records and attendance list	
2.2 Procure materials	Existence of materials of sufficient quality and quantity by set date	Receipt of goods documentation	
2.3 Repair xx old water points	xx old water points repaired to acceptable standard by set date	Project personnel visits to sites; pumping tests	
3.1 Form maintenance organisation	Existence of maintenance organisation by set date	Signed agreements by maintenance organisation members	
3.2 Establish a cost coverage mechanism	Cost coverage mechanism established and reviewed by set date	Records of agreement and review	
4.1 Procure materials	Existence of materials of sufficient quality and quantity by set date	Receipt of goods documentation	
4.2 Train xx builders	xx builders attended training by set date	Training records and attendance list	
4.3 Identify households to be supplied with latrines	Letters to selected households announcing measures	list of criteria for selection agreed by stakeholders and project personnel, list of addresses of households selected	
4.4 Build xx latrines	Existence of xx latrines to agreed design by set date	Project personnel visits to sites; quality assurance tests	
5.1 Survey assesses habits in hygiene	Survey results	Report	
5.2 Training in hygiene	Training delivered by set date	Training records and attendance list	

7. References and further reading

AusAID (2002), *AusGUIDElines, 1. The Logical Framework Approach, Australian Agency for International Development.*
Available at: http://ftp.who.int/nmh/Vision2020/eng/documents/LFA%20guidelines.pdf

DFID (2002), *Tools for Development: A handbook for those engaged in development activity, Performance and Effectiveness Department,* Version 15, DFID London.
Available at: http://www.dfid.gov.uk/pubs/files/toolsfordevelopment.pdf

SIDA (2003), *The Logical Framework Approach: A summary of the theory behind the LFA Method,* SIDA Stockholm.
Available at: http://www.sida.se/sida/jsp/sida.jsp?d=118&a=2379&language=en_US

A11 Template for structure of action plan

The action plan will be a comprehensive document reflecting the core outcomes and decisions of the planning process starting with the long-term vision up until compiling all the actions foreseen to move towards this vision.

Because of the size and complexity of the document, it is important to structure it consistently, to make clear linkages with the overall vision and finally to ensure that the proposed actions are as transparent as possible.

The actual compilation of the IWRM plan for which the template can be used is, on the whole, a major editorial job that might be assigned to a smaller team within the Local Government unit coordinating the process. All documents and input that go into it would have to have been developed beforehand by the steering group or the bigger stakeholder group.

Example of structure for an action plan

Foreword of mayor/head of council
Executive summary
1 Introduction
2 Vision for 2025
3 Strategy
- 3.1 Priority issues that have emerged from baseline assessment
- 3.2 List of strategic objectives
- 3.3 Strategy decided for Phase I: 2010 to 2015 (incl. overall indicators and targets)
- 3.4 Overall budget (expenditure and sources of income)

4 Strategic objective 1
- 4.1 Action/project 1
  - 4.1.1. Priority issue addressed/background
  - 4.1.2 Specific objectives, indicators, targets
  - 4.1.3 Description of individual activities
  - 4.1.4 Lead roles in implementations
  - 4.1.5 Time and work plan
  - 4.1.6 Monitoring and evaluation
  - 4.1.7 Obstacles and risks
  - 4.1.8 Budget
- 4.2 Action/project 2
  - 4.2.1 Priority issue addressed/background
  - 4.2.2 Specific objectives, indicators, targets
  - 4.2.3 Description of individual activities
  - 4.2.4 ……
  - …….
- 4.3 Action/project 3
  - 4.3.1 …..
  - ….
- 4.4 …..

5 Strategic objective 2
- 5.1 Action/project 1
  - 5.1.1. Priority issue addressed/background
  - 5.1.2 Specific objectives, indicators, targets
  - 5.1.3 Description of individual activities
  - 5.1.4 Lead roles in implementations
  - 5.1.5 Time and work plan
  - 5.1.6 Monitoring and evaluation
  - 5.1.7 Obstacles and risks
  - 5.1.8 Budget
- 5.2 Action/project 2
  - 5.2.1 Priority issue addressed/background
  - 5.2.2 Specific objectives, indicators, targets
  - 5.2.3 Description of individual activities
  - 5.2.4 ……
  - …….
- 5.3 Action/project 3
  - 5.3.1 …..
  - ….
- 5.4 …..

6 Strategic objective 3
- 6.1 Action/project 1

…..
- 6.2 Action/project 2

….

7 Description of planning process and stakeholders involved
8 Outlook
Appendices

A12 Template for proposal concept note

Introduction

External funding may be needed to realise some of the projects that have been developed to meet the strategic objectives of the IWRM action plan. The template provided overleaf has been designed to assist with the drafting of concept notes that can be submitted to funders to explore their interest in providing such funding.

Of course, applying for external funding involves a lot more than drafting and submitting a concept note or – at a later stage – a more detailed proposal. For this reason, there are also a few hints on the process for developing projects and some recommendations for raising the funds required to put them into practice.

Building a team for proposal development

In most cases, the development of a proposal, including the concept note, will require a small team that shares the different tasks associated with it.

- One person, with a good background on the issues addressed by the proposal, should be nominated as the lead. This person should be responsible for coordinating all inputs and can also draft some of the core sections.
- Experts with more detailed technical knowledge might be part of the team, or simply contribute to an initial brainstorming session. They can provide text contributions and later also comment on draft versions of the concept note or proposal. Experts might be available within the administration itself as well as among the group of stakeholders.
- The budget should be compiled in close cooperation with staff from the financial department.

It is also advisable to keep a person involved that represents the foreseen source of funding. If the proposal is to be submitted to the local council, one or two politicians could be informed about the overall idea to get some guidance from them that might enhance the likeliness of approval from the council. In the case of international organisations, for example, close coordination with a person in charge of grant funding can help match own interests with those of the funder.

Developing a proposal

In order to ensure that a project contributes to the implementation of an action plan, its activities should aim at meeting one of the objectives that are included in the Local Government's IWRM strategy.

As a first step, the completion of a logical framework (see Tool A10) provides a useful basis for the elaboration of a proposal. Referring the proposal to the priorities identified in the local stakeholder process and to key policies at national or regional level will help justify it, find wider support and enhance the chances of receiving external funding if necessary.

It is helpful to discuss and develop the proposal in a small team and share drafts with experts of all relevant disciplines not just from within the administration, but also from outside it.

A good choice of title for the project will be important, since this will accompany the initiative throughout its lifetime.

Before the full proposal, including all details, is written up, a shorter concept note is useful to share ideas with a wider group of colleagues and to present the proposal to the council or external funders.

Assessing funding options for realising the local IWRM action plan

Funding for most of the actions listed in the local IWRM plan will have to come from the Local Government's own resources. Depending on the institutional set-up of Local Government in a given country, these resources may to a certain extent also derive from revenues gained through the delivery of services included in the action plan itself.

In collaborative activities, stakeholders might also be willing to invest some of their own resources if the activity promises to deliver a tangible benefit for them.

Infrastructure projects in collaboration with the private sector might best be financed through models of public-private partnerships and financial mechanism such as leasing, BOT (Build – Operate – Transfer) or BOO (Build – Own – Operate).[6]

The need for external funding arises when none of the above approaches would be feasible. However, it should always be kept in mind that tapping external sources usually means financing for a limited period of time and according to the rules of an external organisation. If the issue of long-term financial viability has not been taken into consideration, many projects may collapse once the external finances are no longer available.

In case external funding is indeed the only feasible option, the rules and guidelines of each potential funder will have to be studied in detail. In most cases, forms are provided that need to be filled in following a number of detailed instructions. Also short résumés of the persons that will be involved in the project usually need to be added.

Possible sources of external funding

The following list provides some examples of institutions and organisations that could be interested in supporting the financing of a local IWRM project.

At national level:

- National Government, particularly the Department for Water Affairs or the Department for Local Government
- research organisations, such as the Water Research Commission in South Africa
- the private sector (see also above)

At international level:

- Embassies of foreign countries and local branches of their development agencies, such as (this list is not exhaustive):
  - the Delegations of the European Commission (http://ec.europa.eu/external_relations/delegations/intro/web.htm)
  - DFID - the UK Department for International Development (http://www.dfid.gov.uk)

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[6] See for example Public Private Partnership Options at http://www.fhwa.dot.gov/PPP/bot.htm

- GTZ - the German Technical Cooperation Agency (http://www.gtz.de/en/)
- DANIDA - the Danish International Development Agency (http://www.danidadevforum.um.dk/en)
- SIDA - Swedish International Development Cooperation Agency (http://www.sida.se/sida/jsp/sida.jsp?d=121&language=en_US)
- USAID - United States Agency for International Development (http://www.usaid.gov)

At regional level:

- the African Development Bank (http://www.afdb.org)

Alternative sources may also include private foundations, such as the Bill and Melinda Gates Foundation (www.gatesfoundation.org), and funding from multinational companies.

Planning your budget

The following points may be considered when planning the budget:

- The most expensive item in most projects is staff time. If the local community – as the beneficiaries of the work – can be counted on to contribute labour to support project activities the overall financial cost will be much less.
- Staff time needs to be calculated in terms of 'man days' of junior, medium and senior grade persons.
- Costs of meetings to support the work include the renting of rooms, transport, refreshments, use of equipment, etc.
- Further costs will have to cover materials, employment of expert advisors, etc.
- Overhead refers to the ongoing operating costs for running a business or institution such as the staff costs for secretarial support, rent of offices, electricity, water consumption, cleaning and security services, and the depreciation of technical equipment, furniture, vehicles, etc. They are usually calculated as a percentage on top of the staff costs. Project budgets might use the institution-specific overhead rate to calculate the budget of a proposal by adding the same percentage on top of the overall total of all project-specific costs.

It is important that the budget is realistic, as otherwise a donor will not take it serious. On the other hand, an underestimated budget might lead to a standstill or even a complete termination of activities in the midst of implementation. This can seriously affect a Local Government's reputation in project and budget management and significantly worsen future chances for external financing.

Template for proposal concept note

A concept note is a brief summary of a project or a short version of a project proposal. It might have an average length of 3 to 7 pages.

It is recommended that the development of the concept note occurs in the following sequence:

1. Description of priority issues addressed within the proposal as input to the background information section. Details on priorities can be found in the local IWRM strategy or action plan
2. Objectives (again to be found or derived from those in the local IWRM strategy or as reflected in the action plan)
3. Beneficiaries and impacts
4. What has already been done (also to feed into the background section)
5. Activities and duration
6. Outputs
7. Required inputs (for budget)
8. Project management
9. Draft budget
10. Background
11. Title

(See template overleaf)

1. Title
The title should be snappy, informative, and distinctive. It may be divided into two parts with the first one being short and catching the readers' attention and the second one more 'serious' and informative.
2. Background
The background may be composed following two guiding questions: *1. Why it is crucial to address the problem identified?* *2. What has already been done to solve the problem? (Incl. major projects or programmes carried out by other institutions and organisations if applicable).*
3. Objectives
The project-specific objectives should relate to the more general objectives as previously agreed and entered into the local IWRM action plan.
4. Outputs
The outputs of the project should be directly related to the project objectives. Typically they are tangible items, such as a newly constructed technical facility and the publication of information materials, or events, such as workshops or stakeholder meetings. Depending on the project in question, intangible items might also be mentioned, such as a rise in awareness.
5. Activities and duration
A summary of the planned activities to achieve the project objectives should be included here.

6. Beneficiaries and impacts
This section will be important for getting "buy-in" from the donor. It should contain: ● *The expected benefits, both in quantitative and qualitative terms, and when and where they will occur.* ● *The underlying assumptions and the reasons why these benefits can be expected for a specific group of beneficiaries.* ● *Considerations concerning how and by whom the impacts will be assessed.*
7. Project management (includes monitoring and evaluation)
This section should explain how the objectives will be achieved and how the project will be managed and evaluated. It should become clear who will lead the project and what roles and responsibilities the various people in charge of tasks such as financial management, monitoring and evaluation will have.
8. Budget
Before drawing up the budget, it is necessary to get an overview of the inputs needed to achieve the objectives. These may be, for example: ● *people (such as researchers, consultants, other partners' staff-time)* ● *travel costs (such as bus tickets, meal allowance)* ● *vehicles (such as rental, petrol, driver's time)* ● *equipment (such as machinery, measuring instruments and other tools)* ● *supplies (such as pumps, bricks or containers)* ● *services (such as advisory, training, coaching or consultancy services)* ● *works (such as construction)* ● *facilities (such as offices or venues for events)* *Smaller expenses for communication, stationery, mailings, etc. should be covered through the overhead.* *The budget should differentiate between own financing and the matching financing that the Local Government is requesting with the proposal.*

References

Farm Radio International, Broadcaster Discussion Group, Theme 5.2 – *How to Write a Concept Note,* http://www.farmradio.org/english/bdg/bdg5b.aspFoundation Centre, *Proposal Writing Short Course,* http://foundationcenter.org/getstarted/tutorials/shortcourse/index.html

Nebiu, B. (2002) *Project Proposal Writing.* The Regional Environmental Centre for Central and Eastern Europe, Szentendre, Hungary.
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Research on Poverty Alleviation (REPOA) 2007. G*uidelines for Preparing Concept Notes and Proposals for Research on Pro-Poor Growth and Poverty in Tanzania.* Special Paper 07.23, Dar Es Salaam, REPOA. Available at: http://www.repoa.or.tz/documents_storage/Special_Paper_07.23.pdf

UN Library Network, *Grant Proposal Writing Guidelines,*
http://www.un.org/Depts/dhl/sflib/libmgnt/grantproposals.htm

A13 Participatory Monitoring and Evaluation (PME)

1. Introduction

Participatory Monitoring and Evaluation (PME) is one of many approaches to ensure that the implementation of the different projects within the action plan – or smaller individual projects – leads to the expected outcomes. As with all other monitoring and evaluation (M&E) elements, the process for PME has to be prepared prior to project implementation.

The advantages of a participatory methodology are similar to all other applications that require the involvement of stakeholders, i.e. PME:

- strengthens ownership regarding successful outcomes of planned initiatives;
- widens the knowledge base necessary for assessing and – if required – correcting the course of action;
- increases the motivation of stakeholders to contribute ideas to corrective actions;
- creates trust in Local Government policy and action (provided that the stakeholders' input is genuinely taken into account); and
- contributes to the learning of all involved.

2. Planning steps for PME

The template provided overleaf helps to systematically prepare a PME process. Each project will have to have its own specific plan in place that addresses each of the elements listed below.

a) Project objectives and indicators

Project objectives – As specified in the project description or logical framework.

Indicators – Indicators developed with the help of key stakeholders should also already exist in the project description or logical framework.

b) Data collection (monitoring)

Sources of information – Ideally, the sources of information have already been identified together with the definition of the indicator. If not, information sources are to be selected when compiling the PME plan. This is best done with the assistance of advice from the stakeholders involved.

Baseline data – This refers to data collected during the project baseline assessment, the results of which should be available from Local Government records.

Who is involved – One of the key questions to be solved for a participatory approach. The main criteria should be the level of interest or specific expertise with which stakeholders are linked to a certain project.

Tools and methods – These can include technical tools and methods for the measurement of a variety of data, but also refer to interviews, photographic documentation of situations 'before and after', public hearings, etc.

Note: the methodologies have to match the indicators as well as the stakeholders. If M&E is solely based on a technical, highly specialised approach, certain groups of stakeholders who are very important as a source of feedback on project progress – or lack thereof – may be excluded from taking part in the process.

Regularity – The interval between M&E activities depends on the actual project and the likelihood of tangible progress resulting from it. M&E can be an on-going activity or can occur according to a defined schedule of months or weeks.

Additional information – A space for open remarks not related to any of the other categories.

c) Data analysis and use (evaluation)

How often – Evaluation might follow the intervals of monitoring or use the outcomes of several monitoring activities.

Who is involved – The group of evaluators might be smaller and more specialised than the group involved in monitoring. However, the composition of this group should not be restricted to officials of the local administration and other water specialists in the narrow sense. It would be a missed opportunity – and fully against the spirit of a participatory approach – to neglect the insights and perspectives of stakeholders representing local water uses across the local population.

Using the information – Most importantly, the information and knowledge gained from the PME process should be made available to the core group in charge of planning and implementing a particular project. Depending on the outcome, the members of this group will have to consider whether their approach for achieving certain objectives has been well chosen or needs major adjustments.

The outcome of monitoring and evaluation exercises must also be fed back to the stakeholders involved as well as to the wider public more generally. Ideally, the Local Government publishes a yearly water report – or adds a section on water issues in a broader environmental report.

At the same time, outcomes should also be 'translated' into a range of communication formats in order to make sure that the information also reaches the different groups concerned. Such formats can be, for example:

- exhibitions and oral reports in local TV programmes for those that are illiterate or not used to reading technical literature;
- briefing notes for the local council to keep its members posted about progress, successes and failures and bring conclusions derived from these into political debates;
- lectures and site visits for interested experts from other Local Governments who may consider the replication of certain activities;
- technical data, figures in comparative tables, diagrams etc. for a university or other research institute interested in studying the activities at a more scientific level.

Proposed template for a PME Planning Worksheet (including example)

Project Objectives and Indicators		**Data Collection (→ Monitoring)**						**Data Analysis and Use (→ Evaluation)**			
Project objective	*Indicators*	*Source of information*	*Baseline data needed*	*Who is involved*	*Tools and methods*	*How often needed*	*Added information*	How often	*Who is involved*	*How information is to be used*	*Who gets information*
Reduce solid waste pollution of local streams	Volume of waste in water body and at shores of local streams, differentiated according to materials (plastic, wood, metal, card board and paper, organic waste, other)	Waste as compiled and measured by eco-volunteer group;	Waste volume as recorded when project was conceived	Eco-volunteer group, sometimes with support of students and others	Collection, sorting and weighing of waste; recording in electronic data base; also photo documentary of collection activities; drawing competition for young people	Collection scheduled to happen every two months	Safety measures to be considered since sometimes waste picked up that could affect health (e.g. syringes)	Once per year	Leader of eco-volunteers; representatives of inhabitants living or working close to streams; waste manager, education officer and health officer from local administration	**Storage** in data base of local administration; **Information** (reports, briefing note, press release) **Awareness raising**: (press release; photo exhibition in local library; awarding of prizes for best drawings)	Every citizen can get printouts from database on request Reports: for project managers and local water specialists Briefing note: for local politicians Press release: for local print media and radio (and thus for dissemination to general public)

Adapted version of template taken from: Tools for Development, DFID, Version 15, Sept. 2002, page 12.12 (see references)

References:

Philip Dearden, Steve Jones, Rolf Sartorius and several staff persons from the Centre for International Development and Training (CIDT): *Tools for Development*, DFID, Version 15, Sept. 2002

Empowers Partnership, *Guidelines for Improved Local Water Governance,* Draft, Jan. 2007; http://www.empowers.info/page/2850

The World Bank, *Participation and Civic Engagement, Participatory Monitoring and Evaluation;* http://go.worldbank.org/G966Z73P30

The World Bank Community-Based Monitoring and Evaluation Team, *Sleeping on our Own Mats: An Introductory Guide to Community-Based Monitoring and Evaluation,* October 2002; available at http://info.worldbank.org/etools/docs/library/17714/communitybased.pdf

ANNEX B – Further guidance on key water management themes

B1 Water Resources Assessments

B2 Assessment and evaluation of aquatic ecosystems

B3 Water Demand Management

B4 Flood risk prevention

B1 Water Resources Assessments

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Introduction

The primary purpose for any form of water resources assessment is to know how much water is available for exploitation. Without this basic information no effective and sustainable management strategy can be developed.

Water resources fall into two main types; groundwater, which is stored beneath the surface in permeable rock formations known as aquifers, and surface water in the form of lakes, reservoirs and rivers. Which of these types of resource is most important will depend to a large extent on the local geology and climate. In humid regions with abundant rainfall, but a poorly permeable geology, surface water provides the bulk of supplies. However, at the other extreme, in dry regions underlain by extensive permeable geological formations the primary resource will be groundwater. In truth few areas depend exclusively on one type of resource or the other, but rather rely on contributions from both.

From a water supply perspective, the accessible water resource refers to the amount of water available for 'long-term' exploitation; in other words how much water can be abstracted for domestic/agricultural/industrial purposes without compromising the requirements of the environment. The 'long term' supply is dictated by the volume of water renewed to the system on a year by year basis. This annual replenishment is controlled by a combination of factors, the most important of which includes rainfall amount and distribution, evaporation, transpiration, surface and sub-surface permeability, and topography. To be able to calculate this renewable resource each component of the local water cycle needs to be quantified; these components are discussed in the following section.

Most water resource calculations are traditionally made over the area of a surface water catchment, since all surface water (and usually most groundwater) flow is contained within the boundaries of the unit. Sometimes, where groundwater is the dominant resource, calculations can be based on a hydrogeological unit such as an aquifer or group of aquifers.

The following sections describe the way in which a water resources assessment exercise can be undertaken. This includes the quantification of the individual components of the water cycle and how this data can be integrated and analyzed using various models and techniques to obtain an overall estimation of the long-term water resources.

Water Resources Assessments – Role of Local Authorities

Most Local Governments will not have specialist in-house hydrologists or hydrogeologists to undertake water resource assessments. In most cases the assessments will need to be done by consultants offering expertise in this area.

Collecting hydrological and hydrogeological data does not fall under the remit of most Local Governments, but some collation and storage of basic data such as daily rainfall, evaporation and river flows would provide a useful resource for many water related issues. This information could be collected from national meteorological offices and other government organisations dealing with the environment.

1. The major catchment processes

A simplified representation of the locations of water storage in a catchment and the major processes that take place is given in Figure 1. The diagram emphasizes the way in which surface and groundwater resources are closely coupled. The boxes represent water stored in four separate parts of the catchment; the surface (lakes, reservoirs); the soil profile (unsaturated zone); groundwater store (aquifers); and the stream network (rivers, streams). The arrows denote the movement of water into or out of these stores, via a series of processes such as for example evaporation (out of surface storage) and run-off (out of surface storage and into stream network).

To perform a comprehensive water resources assessment the volume of water in each of the 4 boxes and the different processes shown in Figure 1 need to be quantified. And to do this some basic data collection is needed.

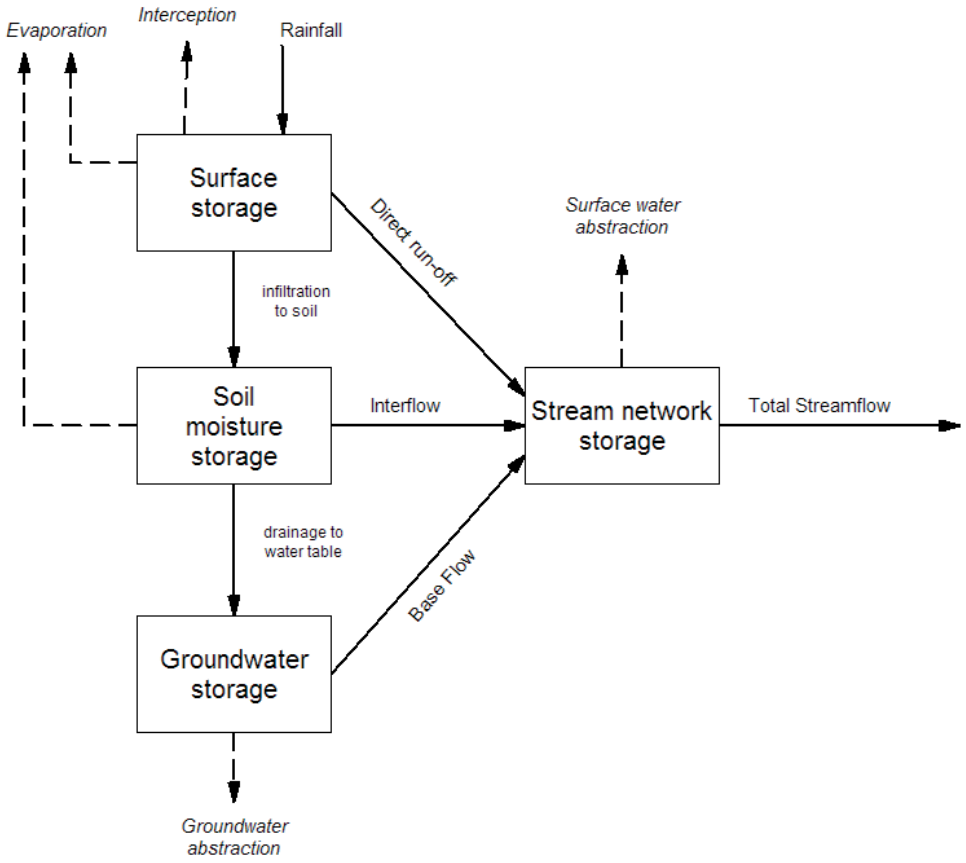

Figure 1: Representation of a catchment system indicating the major processes and water resource stores

2. Basic data collection required for a water resources assessment

2.1 Above ground processes

Rainfall: Ultimately it is the amount and distribution of rainfall in space and time that determines how much water is available for exploitation. Rainfall is measured using a network of rain gauges that should be sufficiently large to ensure that all spatial variability of rainfall throughout the catchment is taken into account. How to install and measure a rain gauge is well described by a pamphlet produced by the UK Meteorological Office (2007). Rainfall monitoring network design is discussed in most text books on hydrology; more detailed discussions can be found in publications such as Kassim and Kottegoda (1991) and Lew et al (1984).

Evaporation: Evaporation is the amount of water lost to the atmosphere either directly from the soil or open water surfaces, or as transpiration from plants (Cain.J, 1998); the two processes are often described together as evapotranspiration. This represents a loss to the system that can account for several millimeters of water per day, a loss which needs to be carefully estimated. In temperate climates evapotranspiration only takes place during the summer months, but in warmer climates it is a significant factor throughout the year. Direct measurement of actual evapotranspiration is both difficult and expensive. Instead an estimate of 'potential evapotranspiration' is usually substituted. This is a calculation of the potential rate of transpiration and evaporation under a specified unit of area and time using local meteorological data.

There are several methods to calculate potential evapotranspiration; these include:

- ***Evaporimeters;*** tanks from which direct evaporation from a free water surface is measured (Cook, 1967)
- ***Lysimeters;*** vessels filled with soil and vegetation from which water loss by evaporation and transpiration is calculated (Allen et al., 1991)
- ***Estimates from energy or water budgets;*** in this approach evapotranspiration is obtained by difference after estimating other parts of the water budget (Mosner and Aulenbach, 2003)
- ***Models for calculation of evaporation***
  - *Surface Energy Balance (Bowen-Ratio);* the Bowen Ratio method uses instrumentation to measure the amount of water vapor lost to the atmosphere as a function of time through continuous monitoring of temperature, solar radiation, rainfall, relative humidity, and wind speed and direction. Using these measurements, the potential ET can be calculated using the Penman-Monteith equation and the Bowen-ratio method (Webb, 1960).
  - *The Eddy Correlation Method;* this method measures fluctuation of the wind components, temperature and humidity at a fixed level. The turbulent fluxes are then used to calculate evapotranspiration (Kairu, 1991).
  - *Penman-Monteith Model;* the Penman-Monteith equation requires daily mean temperature, wind speed, relative humidity, and solar radiation to predict net evapotranspiration (Fisher et al., 2005).

Rainfall interception: Interception is the amount of rainfall that becomes trapped and held by vegetation before it has the chance to reach the soil. The importance of this process of course depends on the type and extent of vegetation, but in forest regions it can become significant (Roberts, 1999).

River flow: Measurement of river flow at the catchment outlet is of fundamental importance. Not only does this information provide a good indicator of the way in which the catchment responds to rainfall but, if long term records are available, it also can be used to indicate the degree to which water resources are being exploited and how much, if any, remains for future development. Furthermore the records provide a means to 'calibrate' the river flow predictions of models used in the assessment of water resources.

Stream flow can be measured directly using techniques that range from a simple gauging staff to a fully calibrated weir. The type of method used will depend on the nature of the water resources assessment. For a short term study, or one where financial constraints are tight, a gauging staff calibrated with intermittent flow measurements using a flow meter might suffice; for longer term or more detailed investigations a permanent structure such as a V notch weir will be required. Good descriptions of techniques to measure stream discharge can be found in: United States Environmental Protection Agency (1997), Ackers et al (1978), Bos (1989), and Barton (1994).

Knowing the volume of daily water flow from the catchment outlet, together with the volumes stored in lakes and reservoirs, provides a record of the surface water resources available at that moment. However, this does not provide information on what resources will be available next month, or next year, which is the type of knowledge required for water resources planning purposes. To obtain this information it is necessary to turn to the use of watershed or catchment models which, once calibrated, can provide predictions of future water resources and impacts.

Direct run-off: Direct run-off is the fraction of rainfall that flows over the surface of the catchment and discharges into the stream network. The contribution to total flow made by direct run-off can be obtained by an analysis of river flow hydrographs from the catchment outlet. Descriptions of techniques for the separation of direct run-off are given in many standard hydrology text books such as Brutsaert (2005) .

2.2 Below ground processes

Groundwater recharge: Rainfall that does not run off as surface flow infiltrates into the soil and unsaturated zone. Part of this infiltration eventually finds its way down to the groundwater table as 'recharge', which represents the renewable resource to the aquifer. It is this amount that determines the long term yield of the groundwater resource. There are a large number of techniques to calculate recharge; the most appropriate for any particular area will depend on the local climatic and geological conditions. Good general descriptions of a wide range of techniques are to be found in Lerner et al (1990) and Simmers (1988).

Groundwater discharge (base flow) into rivers: Some groundwater eventually discharges at low points in the topography either in the form of springs or seepages; sometime it discharges directly into river channels as seepage. That part of river flow which is maintained by groundwater discharge is known as base flow and can be quantified through analysis of river hydrographs (Brutsaert, 2005; Piggott et al., 2005).

Groundwater flow: Not all groundwater is discharged within the catchment area. Some may flow through the aquifer out of the catchment to discharge at more distant points. This flow can be estimated from the gradient of the groundwater table and knowledge of aquifer permeability (Todd and Mays, 2005).

3. Calculation of water resources

Individual components of a region's water resources can be calculated in isolation using some of the techniques referenced above. However, to obtain a comprehensive quantification of surface and groundwater resources it is necessary to turn to the use of numerical models. These models enable the different components of the system to be integrated to provide not only current estimates of the resource, but also predictions of future resources under changing conditions. A large number of numerical models are commercially available. They fall into two main groups:

Watershed models deal mainly with surface water resources through the simulation of river flow at the catchment outlet. Rainfall distribution, evaporation, interception, land use type, topography and geology are all used as input to simulate flow. Watershed models are also known as Catchment or Rainfall-Run off models.

Groundwater models calculate groundwater resources and movement using input of recharge, aquifer permeability and storage, groundwater abstraction and aquifer geometry.

There is a third group of models that link surface and groundwater elements, but in most cases these tend to simplify one or the other component.

3.1 Watershed models

Models used to calculate surface water resources are known as Watershed, Catchment or Rainfall-Run off models; these may be simple or complex. The input and output of the different types vary widely depending on their complexity and purpose. But in general they require input of various meteorological, geological (soil), topographical and land use data, while output is usually in the form of river flow at the catchment outlet. Models are generally calibrated by comparing historical river flow against simulated hydrographs, before they are used to predict future flows under changing climatic and management conditions. As well as quantifying the amount of run-off, they can also be used to calculate the run-off of pollutants, microbial organisms, and other chemical loads. The range and type of models is very diverse; a good description of many Watershed models is given in Singh and Frevert (2006).

There are two basic types of Watershed models:

i. **Lumped parameter models** in which the catchment is considered as a single unit behaving in accordance to an empirical response function; no attempt is made to represent physical processes or to spatially distribute parameters.

ii. **Distributed parameter model**s where the system is discretised into a set of small homogeneous units that can be used to represent spatial variability; the model operates by simulating the physical and chemical processes that take place within a system.

There are also some models known as semi-distributed lumped models that fall between these two groups.

3.1.1 Lumped parameter models

IHACRES is an example of one of the best known and well established lumped models. It was developed jointly by the Centre for Ecology and Hydrology, United Kingdom, and the Centre for Resource and Environmental Studies at the Australian National University (Jakeman et al., 1990). The acronym stands for **I**dentification of unit **H**ydrographs **A**nd **C**omponent flows from **R**ainfall, **E**vaporation and **S**treamflow data.

GR4J is a simple, reliable, continuous lumped rainfall-runoff model run at a daily time step that converts rainfall into a stream flow time series at one location (Perrin et al., 2003). The model uses a transfer function / unit hydrograph (UH) method for continuous simulation, catchment-scale (spatially lumped), rainfall-runoff modelling. It is designed for use on a PC.

HBV (**H**ydrologiska **B**yråns **V**attenbalansavdelning) is a rainfall-runoff model which includes numerical descriptions of hydrological processes at the catchment scale (Bergström, 1992). It is semi-distributed (parts of the model are lumped, others distributed) and is normally run using daily values of rainfall and air temperature, and daily or monthly estimates of potential evaporation. The model can be used for flood forecasting, spillway design floods simulation, water resources evaluation, and nutrient load estimates (Jutman, 1992).

TOPMODEL is a set of programs for rainfall-runoff modelling in single or multiple sub-catchments. It is semi-distributed and uses gridded elevation data for the catchment area. It is considered to be a physically based model because its parameters can, theoretically, be measured in situ (Beven and Kirkby, 1979, Beven et al., 1984).

3.1.2 Distributed parameter models

GSSHA (**G**ridded **S**urface **S**ubsurface **H**ydrologic **A**nalysis) is designed to simulate runoff production and to determine the controlling physical processes in watersheds, i.e. infiltration excess, saturated source areas, and groundwater discharge. It simulates streamflow and groundwater discharge to streams (Downer and Ogden, 2004).

HSPF (**H**ydrologic **S**imulation **P**rogram-Fortran) uses rainfall, temperature, evaporation, and parameters related to land use patterns, soil characteristics and agricultural practices to simulate the processes that occur in a catchment. Runoff flow rate, sediment loads, nutrients, pesticides, toxic chemicals, and other quality constituent concentrations can be predicted. The model also produces a time history of water quantity and quality at any point in the watershed (Bicknell et al., 2001).

MIKE-SHE is an advanced, but complex, integrated hydrological modeling system. It simulates water flow in the entire land-based phase of the hydrological cycle from rainfall to river flow, via various flow processes, such as overland flow, infiltration into soils, evapotranspiration from vegetation, and groundwater flow. Details can be found on the MIKE-SHE homepage (http://www.dhigroup.com/).

The above represent just a small sample of the watershed models that are available. For a comprehensive list of a wide range of surface water model links see http://www.dhigroup.com/.

3.2 Groundwater models

Groundwater resources are best estimated using groundwater models. A large number of commercial (and freeware) packages are available. A comprehensive list of more than 100 models is posted on the **I**nternational **G**roundwater **M**odelling **C**enter (**IGWMC**) Web site (http://typhoon.mines.edu/software/igwmcsoft/). Without exception, all the models deal with groundwater quantity, while many are also designed to simulate the movement of various types of solute (pollutants).

An accurate groundwater model requires a large amount of information about the aquifer. The general steps in developing a groundwater model include: (1) developing the conceptual model, (2) defining the model set-up, (3) calibrating and verifying the model, and (4) making predictions. The conceptual model represents our best idea of how the aquifer works. Developing a good conceptual model requires compiling detailed information on the geology, water quality, recharge, rivers, water

levels, hydraulic parameters, and pumping. The set-up phase defines the dimensions of the layers and cells that make up a model and ultimately helps decide which model is used.

When the model is set up and run the output needs to be calibrated and verified against measured data. This is done by comparing model simulations of historical groundwater levels against the actual data. Once a good match has been verified the model can then be used to make predictions of future water levels under changing environmental and management conditions.

Most models are physically based with spatially distributed parameters. To set up a model various data are required:

- Aquifer geometry (the extent and thickness of all aquifers and aquicludes)
- The permeability and storage capacity of all hydrogeological units
- Water table (or piezometric) surface configuration
- Borehole abstraction from aquifers
- Recharge rates

Model data is entered into a grid of cells which covers the area being modeled. These cells may either be rectangular (i.e. with 900 angles) in which case it is termed a 'finite difference grid', or they may be triangular and irregular in shape to form a 'finite element grid'. Both types of approach are well represented among the models available.

Perhaps the best known and most widely used groundwater model in use today is MODFLOW, first developed by the United States Geological Survey in 1988 (McDonald and Harbaugh, 1988). This is a finite difference code that, since its introduction, has spawned a series of spin-off codes such as MODPATH and MODTECH that include solute and contaminant transport as well as flow.

MODFLOW is a finite difference code that can be used for steady state or time varying simulation of two-dimensional, to fully three-dimensional saturated, groundwater flow. Any combination of confined – unconfined systems can be simulated provided they lie over an impermeable base. The model is capable of predicting groundwater levels, flow and groundwater discharge and, if required, can also take into account solute movement. Details and downloads of the software can be found on the USGS Web site (http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html).

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B2 Tools for assessing and evaluating aquatic ecosystems

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Introduction

A number of tools are available to quantify and assess the health of freshwater ecosystems. The tools can be applied at various stages of management as they are designed to establish baseline conditions that inform planning, assess the probable impact from proposed development actions and monitor change that facilitates adaptive management. The tools are categorised as follows:

1) Water quality assessment
2) Ecological health assessment
3) Environmental flow assessment
4) Wetland assessment

Healthy freshwater systems supply various goods used by rural subsistence based communities. These goods include freshwater (for drinking and domestic purposes), fish (for consumption and trading) and reeds used for construction and craftwork. Floodplains also provide winter grazing for cattle, which, apart from their value as a food source, are an important aspect of many African cultures. Degradation of aquatic systems through changes in flow and water quality reduces the capacity to produce these goods and negatively impacts the livelihoods of dependant communities. Local Government has a responsibility to ensure that access to these goods and services are maintained by considering the impact of water resources development on the functioning of natural systems. Local Government is also likely to have a responsibility under national environmental legislation to avoid the loss of biodiversity that results from degradation of water resources.

In addition to goods, freshwater aquatic ecosystems also provide services: rivers dilute effluent and wetlands attenuate flooding. When these natural functions are lost, they must be provided artificially at a cost to society. For example, when wetlands in a catchment are lost through alteration for agricultural purposes, additional waste treatment facilities are required to compensate for the lost water purification function provided by these systems. Wastewater treatment is a Local Government mandate and is therefore a cost they and their constituents must bear.

In addition to the above considerations, maintaining healthy freshwater systems has the following benefits for the specific Local Government mandates shown in Table 1.

Local Government Mandate	Benefits of a healthy natural water environment
Water supply	Good water quality in rivers, streams and lakes reduces treatment requirements and costs when supplying potable water.
Local Economic Development	Good water quality and sufficient flows maintain industries that rely on water ecosystems such as fishing, tourism and certain types of agriculture.
Parks and recreation	Water resources are a key feature of parklands and recreation areas. Poor water quality and loss of habitat can restrict water sports, limit recreational fishing and detract from the attractiveness of parklands.
Stormwater management	Unmodified river systems and wetlands provide natural flood protection during heavy rainfall events. Canalising and draining these features alters the water landscape's ability to retain floodwaters which can lead to increased local flooding.
Health	In areas where the local population does not have access to a treated water supply, a polluted source can have severe consequences on people's health.

Table 1: How Local Government mandates can benefit from healthy water ecosystems

The following sections do not present the tools themselves but rather give a brief description to highlight why each tool would be useful and to give Local Governments an idea of what is available to assist with aquatic ecosystem maintenance and rehabilitation. Most of the tools are designed to be used by experienced river and wetland ecologists. If Local Government lack the necessary expertise within the administration they should approach external assistance from, for example, catchment management agencies, water institutions or consultants.

1. Water Quality Assessment

The monitoring of water quality is essential for the ecological wellbeing of water resources, the supply of drinking water and the health of the local population. One of the tools available for monitoring water quality is the Water Quality Index developed by Umgeni Water.

1.1 The Water Quality Index as developed by Umgeni Water

Objective

Monitoring water quality in rivers and impoundments.

What it is

The Water Quality Index (WQI) was developed by Umgeni Water[7] to assist in the monitoring of water quality. The WQI condenses the vast amount of data obtained from more than 100 river and 12 impoundment sampling sites, into a concise statement about the status of water in a particular river reach or impoundment.

The WQI is useful in that it allows comparison of water quality at different sampling sites and enables temporal and spatial trends to be identified. It also facilitates the detection and identification of pollution sources and provides an indication of the impact of land use on water quality.

How it works

A WQI is an integrated measure of water quality obtained from selected water quality variables. Although a general index of water quality status was deemed acceptable for rivers, an index with an emphasis on variables that gave rise to treatment problems at water works was considered necessary for impoundments. Variables selected, which are common to both rivers and impoundments, include E. coli, soluble reactive phosphate, total organic carbon, electrical conductivity, suspended solids and turbidity. In addition, ammonia is included for rivers and total algal numbers and Chlorophyll a for impoundments.

The index for selected sampling points is calculated each month from the median of the weekly values. Depending on the range in which each median value fits, fixed scores are assigned to each variable. These scores are then multiplied by the respective weighting values for each variable and the total score divided by the sum of the weighting values. This provides a weighted score or class value ranging from >85 or A (excellent) to 30-45 or E (unsatisfactory) for each river or impoundment.

In addition to water authorities, the tool is potentially useful to local municipalities as the results could be used to inform planning decisions. Although experience in undertaking water sampling and analysis is necessary to collect the data used by the tool, the concise manner of the information provided enables it to be understood by both technical managers and the public.

Further information

Simpson, D.E. (1995) Water Quality Indices for Rivers and Impoundments. Water Quality Department, Scientific Services, Umgeni Water. Unpublished report.

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[7] Umgeni Water is a regional water authority in KwaZulu Natal, South Africa, with responsibilities for water supply, wastewater treatment, pollution prevention and management of water quality http://www.umgeni.co.za

2. Ecological Health Assessment

Assessing the ecological health of water resources can be done through an EcoClassification process for which a number of tools are available. EcoClassification entails the determination and categorisation of the health or integrity of various biophysical attributes of rivers compared to the natural reference condition. The process is comprised of various components including drivers (physico-chemical, geomorphology and hydrology) that provide a particular habitat template and biological responses (fish, vegetation and aquatic invertebrates). Different processes are followed to assign an ecological category (EC) to each component ranging from A – Natural, to F - Critically modified. The following tools exist to help determine the ecological health:

- DWAF Ecostatus Approach
- The South African Scoring System (SASS)
- The Fish Response Assessment Index (FRAI)
- The Index of Habitat Integrity Model (IHI)
- Riparian Vegetation Response Assessment Index (VEGRAI)

Further information about the EcoClassification process and the components can be found in the following joint Water Research Commission and Department of Water Affairs and Forestry (South Africa) report: Manual for EcoStatus Determination (Version 2) – Module A: EcoClassification and EcoStatus determination (Kleynhans, C.J. and Louw, M.D. 2007). The report can be accessed at: http://www.dwaf.gov.za/IWQS/rhp/eco/EcoStatus/ModuleA_EcoStatus/ModuleA_EcoClassification.pdf

2.1 EcoStatus Approach as developed by Department of Water Affairs and Forestry (DWAF)

Objective

Determine the ecological state of a river.

What it is

The EcoStatus approach is not a single tool but rather the collection and analysis of results from a number of other tools that make up the EcoStatus suite of models. Some of these are described individually later in this section. The EcoStatus is defined as the "totality of the features and characteristics of a river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna". This ability directly affects the capacity of the system to render environmental goods and services. The EcoStatus approach is a rule-based method that considers the biophysical components of a river in terms of drivers and biological responses and derives a single integrated index value which indicates the ecological state of the river.

The EcoStatus method is useful in that it provides a realistic and repeatable assessment of the ecological state of a river. The method is applicable to various levels of the South African Ecological Reserve concept, a legal requirement under the South African National Water Act[8], or

[8] South Africa National Water Act (No. 36 of 1998). The Act makes provision for a water 'reserve' of particular quantity and quality that must be set aside for basic human and ecological needs before water uses for industry and agriculture can be authorised.

indeed for general environmental flow requirements, and is also suitable for application in the South African River Health Programme.[9]

How it works

An Ecological Category (EC) is determined for all the driver and response components using a rule-based modelling approach. The names of the models refer to the indices, for example the Fish Response Assessment Index (FRAI) and the Index of Habitat Integrity Model (IHI). The ECs for each driver are assessed separately and the driver metrics (individual attributes within each of the driver components) are considered when assessing the biological responses. The fish and macro-invertebrate ECs are integrated to provide an indication of the instream EC. After a process of weighting, the instream EC is combined with the riparian vegetation EC to provide the EcoStatus.

Although the tool is obviously useful to National Government Water Departments and other water authorities and practitioners, the tool could also render information that is of use to Local Government. The ability to gauge the capacity of a system to produce environmental goods and services could influence various planning decisions in particular the need to develop additional infrastructure where these services have been lost.

Further information

Kleynhans, C.J. and M.D. Louw (2007) Manual for EcoStatus Determination (Version 2) – Module A: EcoClassification and EcoStatus determination. Joint Water Research Commission and Department of Water Affairs and Forestry in South Africa report. The report can be accessed at: http://www.dwaf.gov.za/IWQS/rhp/eco/EcoStatus/ModuleA_EcoStatus/ModuleA_EcoClassification.pdf

2.1.1 The Fish Response Assessment Index (FRAI)

Objective

Indication of the biological integrity of a river through fish populations

What it is

The Fish Response Assessment Index (FRAI) was produced by Kleynhans as part of the suite of EcoStatus methods. The tool provides a habitat-based cause-and-effect method that enables one to interpret the deviation of the fish assemblage from the reference condition.

FRAI provides a general indication of the biological integrity of a river which links biodiversity and habitat condition. This information is complementary to other biological assessments and is particularly useful in determining environmental flow requirements. It is most suited to larger rivers although capture of the fish can prove a challenge.

How it works

The FRAI is based on the environmental intolerance and preferences of the reference fish assemblage and the responses of these species to a particular set of drivers including geomorphology, hydrology and physico-chemical properties. The level of intolerance and preferences are categorised into metric groups such as velocity metrics, cover metrics, health

[9] Programme set up by the South African Department of Water Affairs and Forestry to serve as a source of information regarding the overall ecological status of river ecosystems in South Africa. http://www.csir.co.za/rhp

and condition metrics and flow metrics. The response of the species to changing environmental conditions is measured through surveys or inferred from the change in habitat. The frequency and occurrence of the reference and observed species are entered into the FRAI model together with a rating for each of the metric groups. An FRAI value and ecological category is then obtained.

As with many of the other ecological indices, FRAI is useful mainly by National Government Water Departments and other water authorities. Local Government could potentially use the tool to assess the ecological integrity of a river within their boundaries. However, other tools such as SASS could provide similar and more reliable information which is easier to collect.

Further information

Kleynhans, C.J. (1999) The development of a fish index to assess the biological integrity of South African rivers. Water SA 25: 265-278 (Note: an updated version of this paper is to be published in 2008 and will be available on the South African Department of Water Affairs and Forestry website).

2.1.2 The Index of Habitat Integrity Model (IHI)

Objective

The assessment of the habitat integrity of a river.

What it is

Habitat integrity refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region.

The IHI methodology is designed to obtain a broad understanding of the condition of instream and riparian zones of a river system. It is particularly useful for situations where a low level of primary data is available. The method forms part of the suite of Ecostatus tools and is designed to provide surrogate information for drivers (e.g. geomorphology, hydrology and physico-chemical conditions) where such information is lacking.

How it works

The IHI considers the current state of the instream and riparian zones. Each zone is assessed using metric groups, each with a number of metrics that enable the assessment of habitat integrity. These include:

- Hydrology
- Physico-chemical conditions
- Bed modification
- Bank modification
- Connectivity

The assessment is based on the interpretation of the deviation from a reference condition. The reference condition is determined using an impact-based approach where the intensity and extent of anthropogenic changes are used to assess the impact on the habitat integrity of a system. These changes are interpreted in terms of modifications of the drivers of the system and how these changes may impact the natural riverine habitats.

The process culminates in the production of a Habitat Integrity Category for both instream and riparian zones ranging from A-natural or unmodified to F-critically or extremely modified. There are two levels of IHI assessment, one which uses aerial footage of a river system and the other which requires site or ground-based information.

The tool is predominantly useful to National Government Water Departments and other water practitioners. The tool can be of value to Local Government when determining the impact of development on the state of riverine and instream habitats within their boundaries. This information can in turn be used to inform future planning decisions. The method forms the most cost-effective and broad-based assessment of a river's condition.

Further information

Kleynhans, C.J., Louw, M.D. and Graham, M. (in preparation) River classification manual for ecostatus determination (Version 2). Module G: Index of habitat integrity. To be published by the Water Research Commission in South Africa.

2.1.3 Riparian Vegetation Response Assessment Index (VEGRAI)

Objective

The assessment of riparian vegetation in relation to a reference condition.

What it is

VEGRAI is part of the suite of Ecostatus tools and provides a practical and rapid approach to assessing riparian vegetation conditions with the outcome of the assessment being presented as a quantitative Ecological Category (EC). The EC reflects the state of riparian vegetation in relation to a reference condition.

The VEGRAI model is typically used as one of a range of tools to describe the present ecological status (PES) of a river resource unit. It is therefore typically used in current state assessments or monitoring applications where the condition of the riparian vegetation needs to be assessed. It is also possible to use the tool to make qualitative predictions as to how the riparian vegetation is likely to respond to activities within the riparian zone or changes in catchment characteristics.

How it works

The VEGRAI model is based on an evaluation of impacts to metric groups (vegetation zones) within the resource unit being assessed. The first step involves a description of the status of riparian vegetation in both its current and reference states. Response metrics including cover, abundance and species composition are then assessed in the field as a measure of vegetation response to an impact regime. This evaluation is done for both woody and non-woody components.

Data collected in the field is then transferred to the spreadsheet model where changes to metrics are evaluated and each of the vegetation components is weighted according to its perceived importance in determining the instream habitat and condition. VEGRAI then automatically calculates the riparian zone EC which ranges from natural to critically modified.

Although the tool is designed for use by experienced riparian vegetation specialists and aquatic ecologists, the tool could be beneficial to a number of other parties and institutions including Local Government and, in particular, those officials dealing with planning.

Further information

Kleynhans, C.J., Mackenzie, J. and Louw, M.D. (2007) Manual for EcoStatus Determination (Version 2) – Module F: Riparian Vegetation Response Assessment Index (VEGRAI). Joint Water Research Commission and Department of Water Affairs and Forestry in South Africa report. This document can be accessed at: http://www.dwaf.gov.za/IWQS/rhp/eco/EcoStatus/ModuleF_VEGRAI/ModuleF_VEGRAI.pdf

2.2 The South African Scoring System (SASS)

Objective

To assess water quality and the overall condition of rivers.

What it is

The South African Scoring System or "SASS" can be used to assess river water quality and the "health" or condition of rivers. SASS is increasingly being included in the determination of the Ecological Reserve as required under the South African National Water Act. It is also recommended for determination of the environmental flow requirements of rivers and can be used in impact assessments and for the rapid assessment of the state of a river particularly where there is poor water quality. More specifically, SASS can:

- Assess the ecological state of aquatic ecosystems
- Assess the spatial and temporal trends in the ecological state
- Assess emerging problems
- Set objectives for rivers
- Assess the impacts of developments
- Predict changes in the ecosystems due to developments (Dickens & Graham, 2002)

How it works

The SASS method is based on the inherent intolerance of species particularly benthic macroinvertebrates to perturbations in their habitat. Benthic macroinvertebrates are used as they are visible to the naked eye, easy to identify and have a rapid lifecycle often based on the seasons and their largely sedentary habits.

The method is being used by numerous institutions across the SADC region such as Cape Metro Council, Umgeni Water, Umlaas Irrigation Board, Mpumalanga Parks Board, the Department of Water Affairs and Forestry (DWAF), the Council for Scientific and Industrial Research (CSIR) and many others including forestry companies and heavy industry. It has also been used (locally adapted) by the Namibian government and by researchers in Zimbabwe. Local Government may find this tool particularly useful for providing information for their integrated development plans and generally informing their spatial development planning.

Further information

Dickens, C.W.S. and Graham, P.M. (2002) The South African Scoring System (SASS) Version 5 Rapid Bioassessment Method for Rivers. African Journal of Aquatic Science 27: 1-10.

3. Environmental Flow Assessment

Environmental flow assessments are used to estimate the quantity and timing of river flows required to maintain ecological health in water resources ecosystems. This information is necessary when assessing the current state of water resources and predicting the environmental impacts of planned changes to natural flows. The following tools exist to assist in the assessment and prediction of river flows:

- Estuary Flow Method
- Building Block Methodology (BBM)
- Downstream Response to Imposed Flow Transformations (DRIFT)
- Adapted BBM-DRIFT Methodology (Zimbabwe)

3.1 Estuary Flow Method

Objective

To determine the freshwater inflow requirements of estuaries.

What it is

The Estuary Flow Method provides information that can be used to select an acceptable river flow scenario. This scenario represents the highest reduction in freshwater inflow that may occur while retaining the desired Ecological Category and protecting the aquatic ecosystem of the estuary. Consequently the tool is useful in the management of estuaries particularly with regards to balancing social and ecological needs in order to sustain water resources for current and future generations.

How it works

The tool is comprised of six key steps:

1. The geographical boundaries of the estuary are delineated.
2. The present state and reference condition are assessed and described in terms of the past and present abiotic and biotic components.
3. The present health and importance of the estuary are determined by comparing the present state and reference condition using an Estuarine Health Index.
4. The Ecological Reserve Category is determined based on the present health and the ecological importance score.
5. The Reserve for Water Quantity is set using hydrological modelling to generate river run-off scenarios for reference and present conditions and for realistic future conditions.
6. A monitoring programme is designed to improve the confidence in the Reserve Assessment, to verify predictions made during the assessment and to audit whether the Reserve is being adhered to once licenses are allocated.

The tool is useful to water engineers and scientists. In addition, the method could also be used by Local Governments that have estuaries within their boundaries, as it may provide an indication of the amount of water potentially available for human needs which in turn could influence planning decisions.

Further information

Adams JB, Bate GC, Harrison TD, Huizinga P, Taljaard S, et al. (2002) A Method to Assess the Freshwater Inflow Requirements of Estuaries and Application to the Mtata Estuary, South Africa. Estuaries: Vol. 25, No. 6 pp. 1382–1393

3.2 Building Block Methodology (BBM)

Objective

Assessment of instream inflow requirements of a river.

What it is

The Building Block Methodology (BBM) is essentially a prescriptive approach designed to construct a flow regime to maintain a river in a predetermined condition.

The quantitative information provided by the BBM can be used in the planning and design phases of a proposed water resource development. The BBM is particularly useful in that it can be applied in situations where both time and data are limited.

How it works

The BBM is comprised of three main parts:

- **Preparation for a workshop.** A structured set of activities is designed to collect and display information to workshop participants prior to the event. Topics to be dealt with and detailed in a background information document, include:
  - identification of the study area;
  - determination of the habitat integrity of the river under present conditions;
  - completion of a social survey of the study area;
  - assessment of the geomorphological characteristics of the study area;
  - completion of biological surveys at selected sites within the study area;
  - descriptions of the virgin and present daily flow regimes; and
  - determination of the desired state for the study area.
- **The BBM Workshop.** Each workshop usually includes about 20 participants ranging from water managers and hydrologists to modellers, scientists and engineers. The workshop generally lasts two to four days and includes four main components:
  - a visit to each BBM site;
  - the exchange of information;
  - compilation of the instream flow requirements (IFRs); and
  - the final session which entails a comparison of the IFRs at each site, the identification of necessary additional work and a post-mortem of the workshop activities.
- **Linking environmental and engineering concerns.** The information generated in the workshop is used in the planning phase of proposed water-resource development projects. The information can also be extended into the design, construction and operation phases and linked to a public participation process.

The tool is particularly useful for Water Departments in National Government and local river scientists and has also been used by national and provincial nature conservation organisations as their negotiating point on water allocations.

Further information

King, J. and Louw. M.D. (1998) Instream flow assessments for regulated rivers in South Africa using the Building Block Methodology. Aquatic Ecosystem Health and Management 1(2): 109-124.

3.3 Downstream Response to Imposed Flow Transformations (DRIFT)

Objective

Determine social and ecological implications of planned water resource developments

What it is

DRIFT is a scenario-based, holistic methodology for combining data and knowledge from various disciplines to produce a number of options of future flow regimes for a particular river.

Ecological Flow Assessments, including DRIFT, are valuable tools in water management as they highlight the social and ecological implications of water-resource development. In particular, they enable an understanding of actual and potential downstream impacts and their long-term implications.

How it works

DRIFT consists of four modules:

- The **Biophysical module** in which all aspects of the river ecosystem are described including hydrology, geomorphology, riparian vegetation and aquatic fauna, and predictions are made on how any part of the ecosystem may change in response to specified flow changes.
- The **Sociological module** in which social studies are carried out on river resources used for subsistence by the local population to enable predictions on how people may be affected by specified river changes.
- The **Scenario-development module** that entails the production of scenarios for specified flow changes that link the biophysical descriptions of river change to the socio-economic impacts.
- The **Economic module** in which the compensation and mitigation costs for each scenario are calculated.

These modules should be conducted in parallel with a macro-economic assessment that identifies the wider implications of the scenario, and a public participation process in which stakeholders can voice their opinion regarding the level of acceptability of each scenario.

DRIFT is a complex tool that provides valuable information for all water managers. The tool is potentially useful to Local Government for considering the implications of water infrastructure on communities within their planning processes.

Further information

King, J.M., Brown, C.A., Paxton, B.R. and February R.J. (2004) Development of DRIFT, a scenario-based methodology for environmental flow assessments. WRC Report No 1159/1/04, Pretoria.

3.4 Adapted BBM-DRIFT Methodology (Zimbabwe)

Objective

Develop future river flow scenarios.

What it is

The BBM-DRIFT methodology was developed in Zimbabwe by Mott MacDonald Ltd in collaboration with the Zimbabwe National Water Authority in response to requirements for environmental flow assessments in the Zimbabwe Water Act. The tool adapts key elements of BBM and DRIFT (see 3.2 and 3.3 above) and is used to produce future flow scenarios.

The tool is particularly useful in that it is designed for use in highly resource-limited situations including circumstances where data may be limited. As with BBM and DRIFT the tool is useful in that it highlights potential implications of infrastructure development on the flow regime of a particular river.

How it works

The BBM-DRIFT tool combines BBM's pre-workshop data collection phase with the scenario-based workshop process of DRIFT. The process comprises three phases:

- **Workshop preparation** as per BBM and DRIFT but excluding certain components such as habitat integrity and geomorphological analysis. There is also limited field data collection.
- **Workshop** which follows a simplified DRIFT process and links the main ecological, geomorphological and social impacts with elements of the flow regime using a matrix.
- **Evaluation of development options** using the matrix in which ecosystem aspects that are particularly vulnerable or important to rural livelihoods are identified together with socially and ecologically critical elements of the flow regime.

Although the BBM-DRIFT methodology provides limited coverage of key specialist disciplines, the results generated are potentially useful to Local Government in determining the impacts of planning decisions on the flow regime of a river and the associated social and ecological consequences.

Further information

Steward, H.J., Madamombe, E.K. and Topping, C.C. (2002) Adapting environmental flow methodologies for Zimbabwe. Proceedings of International Conference on Environmental Flows for Rivers. Cape Town, SA, University of Cape Town (Available on CD)

4. Wetlands

Wetlands provide a local community with a number of benefits including improved water quality, flood protection, habitats for fish and other wildlife, and recreation facilities. Maintaining and recreating a healthy wetland environment is therefore of key importance.

The Water Research Commission (WRC) in South Africa are currently developing a 'Guide to Wetland Management' series that includes background reading and a collection of tools. These include:

- WET – Health
- WET – RehabPlan
- WET – RehabEvaluate

4.1 WET – Health

Objective

Rapidly assess the health or integrity of a wetland.

What it is

The WET-Health tool provides an indication of hydrological, geomorphological and vegetation health as well as highlighting the key causes of wetland degradation. It is useful for both assessing wetland habitats and for monitoring the effects of management interventions within them. In particular the tool is useful for diagnosing problems as a key element of the tool is to examine the links between problems in the wetland and human activities that may be causing the problem. The structured nature of the tool requires users to examine and therefore learn about the wetlands they manage. The methodology adopted in WET-Health has been developed to cater for a range of functions including:

- State of Environment Assessment,
- Impact Assessment,
- Improved wetland rehabilitation and management,
- Monitoring wetland management and rehabilitation effectiveness; and
- Contribution to Ecological Reserve Determination studies.

How it works

WET-Health assesses hydrological, geomorphological and vegetation health in three separate modules. The hydrology of a wetland can be altered either through changes in water inputs as a result of changes in catchment activities, or through modifications within the wetland itself.

Both types of alterations are combined into a measure of hydrological health for a wetland. The current geomorphic health is assessed using indicators of excessive sediment inputs and/or losses for clastic and organic sediment. The future geomorphic health is assessed by estimating vulnerability to erosion and threats posed by erosional headcuts. The vegetation module evaluates changes in vegetation structure and composition as a result of current and past on-site transformation and/or disturbance. Within each of these modules, the intensity, extent and

magnitude of the impact is examined which translates into a health score. This score places a wetland into one of six ecological categories ranging from natural to critically modified.

The tool can be used extensively by Wetland Rehabilitation Agencies to inform the design and monitoring of wetland rehabilitation projects. The tool may also be useful to a wide range of other institutions and parties. These include environment agencies, water departments, wetland practitioners, catchment planners (including those in Local Government), landowners, rehabilitators and developers.

Further information

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P., and Goge, C. (In preparation) WET-Health: A technique for rapidly assessing wetland health.

4.2 WET – RehabPlan

Objective

To assist in well-planned and well-informed wetland rehabilitation.

What it is

The WET-RehabPlan document provides concise guidelines designed to help address a range of questions commonly asked by rehabilitation planners. It also directs the user to other tools in the WET-Management Series providing a framework for integrating the various assessments made during wetland rehabilitation planning.

WET-RehabPlan is designed specifically to assist in the planning and coordination of rehabilitation activities. In this regard it provides a useful framework and specific guidance for the planning of wetland rehabilitation from national and provincial through to catchment and local levels.

How it works

WET-RehabPlan is comprised of three components, namely:

- Background information on wetland rehabilitation;
- Guiding principles for rehabilitation; and
- A framework that provides step-by-step guidelines for undertaking the planning and implementation of wetland rehabilitation.

WET-RehabPlan does not provide a lot of technical detail but contains concise guidelines that are presented in a sequence of actions. Actions are detailed in a step by step process aimed at leading the user systematically through the planning process.

Further information

Kotze, D.C., Ellery, W.N., Rountree, M., Grenfell, M.C., Nxele, S.I., Breen, D.C., Dini, J. and Batchelor, A.L. (In preparation). WET-RehabPlan: Guidelines for planning wetland rehabilitation in South Africa. This document is expected to be available from the Water Research Commission by the end of 2008.

4.3 WET – RehabEvaluate

Objective

To evaluate and report on the success of wetland rehabilitation projects.

What it is

The WET-RehabEvaluate tool provides a performance evaluation technique for wetland rehabilitation initiatives. Performance evaluation is required within wetland rehabilitation projects to provide a measure of whether or not various objectives of the rehabilitation process have been met. There are numerous examples of the importance of performance evaluation including instances where rehabilitation is financed by a funding agent. These agents may require information to illustrate that the desired objectives have been met in order to maintain support for the project. Evaluation of project performance:

- Demonstrates the worth of a project;
- Provides assurance to funding agents and the public that objectives are being met;
- Allows for the implementation of strategic, adaptive management practices, timely maintenance and corrective action;
- Provides insights and experience relating to wetland rehabilitation which in turn provides opportunities for learning; and
- Shows positive or negative changes in both the physical and biological aspects of the wetland following the rehabilitation activities.

How it works

WET-RehabEvaluate highlights the importance of evaluating wetland projects as well as step by step guidelines for undertaking this monitoring and evaluation. The guidelines address both project outputs and outcomes and can be applied to projects at varying scales including national, provincial and catchment level. The evaluation includes a review of the project objectives, identification of performance indicators and standards, developing and implementing a monitoring and evaluation plan and evaluating and reporting on performance.

Although the tool could be particularly useful to wetland rehabilitation agencies and various funding agents, WET-RehabEvaluate could also be of interest to other users. Any wetland practitioners involved in rehabilitation work may benefit from using the tool as well as members of the public concerned with environmental issues and who wish to ascertain the success of particular rehabilitation projects. Local Governments that participate in wetland rehabilitation projects may also find the tool useful in assessing whether the required objectives have been met.

Further information

Cowden, C. and Kotze, D.C. (In preparation) WET-RehabEvaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects. This document is expected to be available from the Water Research Commission by the end of 2008.

4.4 Other wetland tools

Additional wetland tools that are part of the Guide to Wetland Management Series but which have not been covered in this introduction include:

- **WET – RehabPrioritise:** Background to the prioritisation of wetlands for rehabilitation and conservation purposes
- **WET – Legal:** A roadmap to the environmental law that pertains to wetlands and their rehabilitation
- **WET – EffectiveManage:** Guidelines for scoring the effectiveness of management based on 15 key questions dealing with management
- **WET – RehabMethods:** Guidelines for the selection of an appropriate type of rehabilitation intervention
- **WET – EcoServices:** Guidelines to qualitatively assess the goods and services that individual wetlands provide.

Information on each of these can be found, or will be available soon, on the South African Water Research Commission's website: http://www.wrc.org.za

B3 Water Demand Management

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Introduction

Water Demand Management (WDM) consists of various water saving components. These are based on the reduction of the quantity or quality of water required to do a specific task, amending tasks so that they can be completed with less water or lower quality water and the reduction of losses from the treatment, distribution and use of water. Examples include using non-potable water for the irrigation of parks and gardens, switching from water intensive agriculture to a crop mix that requires less water and replacing water supply pipelines that have high levels of leakage.

Managing water demand provides benefits for the natural environment and the local community. In many areas water resources are becoming increasingly stressed through rising demand caused by population growth, industrial and agricultural development, and distribution network infrastructure deterioration. In addition, the uncertain impacts of climate change may further reduce the availability of future surface and groundwater supplies.

The issue of insufficient supply to meet demand has traditionally been addressed by developing new resources through the construction of new infrastructure. This includes the building of dams, groundwater abstraction facilities, desalination plants and pipelines to transfer bulk supplies. However, in many cases the introduction of WDM measures can provide a cost effective and environmentally sustainable alternative to the creation of additional supply-side schemes.

The benefits of successful demand management initiatives can be significant. These include:

- **Economic benefits** – Reducing water demand will provide financial returns due to reductions in water treatment costs, saving of funds that would otherwise be needed for water resources development and general local economic development generated through increased water availability.
- **Social benefits** – The optimisation of water use in areas such as industry and agriculture, as well as the reduction of losses from leaking infrastructure results in a more reliable supply for domestic users as well as educational and health institutions.
- **Environmental benefits** – Demand management measures reduce the need for ground and surface water abstractions. More water is therefore available for maintaining the ecological balance and biodiversity of local water resources.

1. The role of Local Government in Water Demand Management

Local Government has many opportunities to implement WDM programmes. They are also in a good position to know which type of demand management measures are appropriate for the local area due to their understanding of living conditions, the economic situation, cultural traditions, social conflicts, etc., of the local population.

Local Government can apply demand management measures in three general areas. These are:

- The reduction of losses from the distribution network by investing in the replacement of leaking infrastructure.
- The reduction of its own consumption by introducing water efficiency measures in its municipal buildings and making use of recycled rain and greywater for non-potable uses such as parks and playing field irrigation.
- Convincing others to reduce their consumption in domestic, industrial and agricultural settings by enacting municipal bylaws, offering subsidies, increasing water metering, introducing tariffs and launching awareness raising campaigns to encourage people to save water.

Such measures can directly and indirectly impact positively on a number of Local Government mandates. These impacts are highlighted in Table 1.

The legislative power Local Government possesses enable it to enforce the implementation of WDM programmes. This could be through the stipulation of water efficiency requirements in building regulations, the allocation of funds to distribution network maintenance, and by making it a legal requirement to use recycled water for certain non-potable uses.

Such interventions may require substantial initial investment, which may at first seem unappealing to Local Government. However, WDM initiatives are likely to prove cost effective in the long-run as the savings they produce replace the need for investment in resource development schemes that would otherwise be required to cope with increased demand.

Local Government Mandate	Benefits of WDM
Water supply	• Reduced treatment costs of potable water • Increased water availability • Reduced or delayed need for costly supply-side resource development schemes
Sanitation and wastewater management	• Increased water availability for sanitation in homes, schools and health establishments • Reduced wastewater treatment costs
Local Economic Development	• Increased water availability for economic purposes such as agriculture and industry • Funds no longer needed for large water supply infrastructure development can be invested in other areas of local economic development
Stormwater management	• Rainwater harvesting captures run off from buildings thereby reducing the risk of overflows in stormwater channels and pipelines.
Housing	• Metering, water efficient fittings and recycling systems in new homes reduces water demand for new housing developments allowing them to be built in areas where a shortage of water would otherwise cause restrictions.

Table 1: Benefits of WDM on Local Government mandates

It should be noted that the benefits listed in Table 1 are not necessarily compatible with one another and will be dependent on the type of water management scheme adopted and where it is applied. For example, the use of recycled water for non-potable domestic use, such as toilet flushing, does not reduce the volume of domestic wastewater and will therefore not result in lower wastewater treatment costs. Equally, the construction of water efficient homes in areas of water scarcity may allow new homes to be built, but will not provide additional resource for local agriculture and industry.

2. Water Demand Management options

WDM is an issue throughout the world, even in countries where water availability appears to be plentiful. Many tools and methodologies have therefore been developed with the aim of reducing demand in all areas of water services and use.

The following sections provide a brief description of various demand management methods currently in use. These have been split into three categories: WDM in different sectors, WDM through the use of alternative sources of water and WDM through financial incentives. Internet links to information on each of the entries have also been provided.

It should be noted that there are numerous opportunities to carry out WDM measures and countless technologies and methods available on the market to help implement them. This paper does not attempt to cover all of these but rather aims to raise awareness of some of the more common options available and suggest references where further information can be found to assist implementation.

2.1 Water Demand Management in different sectors

2.1.1 Agricultural water demand savings

In many countries the agriculture sector is one of the largest users of water. Reducing this demand can therefore increase the availability of water resources for other social, economic and environmental needs.

Agricultural water demand is closely related to the type of crops being grown, animals being raised, the system of irrigation used and the available onsite storage facilities. Local Government can encourage the adoption of water efficient agricultural practices and techniques by offering incentives and subsidies to farmers willing to switch to less water intensive farming methods.

Such methods include the use of agricultural land to grow crops that are more suited to the local climatic conditions. This reduces demand and lessens the farmer's dependence on a reliable water source.

Irrigation is another area that can be targeted. Certain types of irrigation can waste substantial amounts of water through evaporation and wind dispersion. Savings can be made by, for example, replacing spray irrigation, where losses can be high, with more efficient trickle irrigation. The timing of irrigation is also significant, as irrigating outside the hottest part of the day and when the wind is low will help to reduce wastage.

Small onsite storage dams can play a role in reducing agricultural demand during dry periods. Water from rivers, run-off and groundwater can be abstracted during periods of high flows and stored for use when less is available from the natural environment. This reduces demand for scarce resources at times when they are most needed elsewhere.

Further information

Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture (Molden, D. International Water Management Institute, 2007).
Available at: http://www.iwmi.cgiar.org/Assessment/files_new/synthesis/Summary_SynthesisBook.pdf

Water Conservation and Water Demand Management Strategy for the Agriculture Sector (Department of Water Affairs and Forestry, South Africa, 2004).
Available at: http://www.dwaf.gov.za/docs/Other/WaterUseConservation/WCWDMAgricAug04.pdf

Waterwise on the farm: Version 2 – A simple guide to implementing a water management plan (Environment Agency of England and Wales, 2007). Available at:
http://www.environment-agency.gov.uk/commondata/acrobat/geho0307blvhepweb_432285.pdf

2.1.2 Industrial water demand savings

Industrial water use is highly varied depending on the type of industry and size of the facilities. Certain industries such as oil refineries and paper manufacturing use vast quantities of water that can create pressure on the local water resources.

Water use reduction measures can be implemented in most industries and work places by identifying opportunities to recycle wastewater and reduce losses by replacing inefficient equipment. As with agriculture, Local Government should offer incentives for industries to adopt water efficiency measures. They should also ensure that large consumers are on a metered supply, which provides businesses with a financial reason to use less water as they pay for what they use.

Industrial water audits are a common way of assessing industrial water use. Audits record the current uses of water and identify areas where this could be reduced. Measures to reduce use could include the installation of water efficient fittings and appliances, the maintenance of water infrastructure and the location of opportunities to recycle water used in the process as well as rainwater from roof surfaces. The implementation of such measures often makes economic sense as the operator saves money through reduced water bills

Further information

Industrial water demand management and cleaner production: a case of three industries in Bulawayo, Zimbabwe (Gumbo, B., Mlilo, S., Broome, J., Lumbruso, D. Paper for the 3rd WaterNet/ Warfsa Symposium, 2002). Available at:
http://www.waternetonline.ihe.nl/aboutWN/pdf/Gumbo&Mlilo&Broome&Lumbroso.pdf

Waterwise – good for business, great for the environment (Environment Agency of England and Wales, 2006). Available at:
http://www.environment-agency.gov.uk/commondata/acrobat/waterwise_2006_1407627.pdf

Environmental Fact Sheet WD-DWGB-26-7: Water Efficiency Practices for Industrial Water Users (New Hampshire Department of Environmental Services, US, 2007).
Available at: http://www.des.state.nh.us/factsheets/ws/ws-26-7.htm

2.1.3 Domestic water demand savings

Local Government can reduce domestic water demand through the introduction of water efficiency installations in the construction phase of new homes and through retrofitting in existing public

housing. Such measures include low or dual flush toilets, low flow taps and showers and the use of rainwater for outdoor purposes such as garden irrigation. Reduced flush toilets provide particular scope for savings as toilet use can in certain settings account for a large proportion of total household consumption.

Raising awareness of water as a precious resource can also have an impact on reducing domestic demand. Local campaigns promoting the wise use of water in the home can encourage the local population to think of water as a commodity like electricity or gas that should not be used wastefully. Local Government can often implement such campaigns at little cost.

Finally a more immediate domestic demand management option available to Local Governments is the introduction of water restrictions such as a ban on hosepipe and sprinkler use for domestic users irrigating non-productive gardens or washing vehicles. The implementation of such measures are particularly effective during periods of low rainfall when reservoir and groundwater stocks need to be preserved. However, this is usually seen as a short-term measure brought on by unusually dry weather conditions and may be unacceptable to the local population on a long-term basis.

Further information

Rand Water: Waterwise in the home and garden (Rand Water website).
http://www.randwater.co.za/Home_and_Garden/Water_Wise_Living.asp#

Be Waterwise – Top tips for saving water in the home and garden (Awareness raising leaflet, Environment Agency of England and Wales, 2006). Available at:
http://www.environment-agency.gov.uk/commondata/acrobat/bewaterwise_internet_1854332.pdf

Example of water restrictions (Kingaroy Shire Council, Australia, 2007).
Available at: http://www.kingaroy.qld.gov.au/pdfs/200709waternewsletter.pdf

2.1.4 Leakage reduction

Leakage due to an outdated and poorly maintained water supply distribution network can account for significant potable water losses. A recent study of 62 municipalities in South Africa found that losses through leakage accounted for approximately 29% of the total water supplied per annum (WRC Report No TT 300/07).

Local Government can reduce leakage by investing in infrastructure maintenance and replacing damaged water mains. Although locating and fixing leaks can be a complex and costly procedure that can cause disruption to traffic and inconvenience to local communities, in certain cases simple measures such as reducing water pressure in the system, responding quickly to reported leaks, and establishing a leak detection unit can go a long way in addressing the problem.

Further information

Water Demand Management Cookbook (Rand Water, 2003). Available to download from:
http://www.randwater.co.za

Leakage reduction through pressure management in Khayelitsha: Western Cape, South Africa (Mckenzie, R., Mostert, H., Wegelin, W., 2002).
Available at: http://findmoreleaks.com/downloads/Perth1_oz101.pdf

Sydney Water's leak reduction programme (Sydney Water, 2008)
http://www.sydneywater.com.au/SavingWater/ReducingLeaks/

2.2 Water Demand Management through the use of alternative sources of water

2.2.1 Rainwater harvesting

Small-scale rainwater harvesting systems are commonly used in many countries. Rainwater gathered from roof surfaces is collected for non-potable uses such as irrigation, cleaning and toilet flushing. Using rainwater for these purposes reduces demand for potable water from the distribution network.

Larger scale rainwater harvesting systems are also a possibility and Local Government is in a position to develop these. Large roof areas on schools, hospitals, sports stadiums and other municipal buildings can be utilised to gather rainwater which is collected in onsite storage tanks. The water can then be used for irrigating parks and gardens, washing municipal vehicles and, if infrastructure allows, flushing toilets in schools and offices.

Further information

Southern and Eastern African Rainwater Network (SearNet)
http://www.searnet.org/searnetfinal/home.asp

EToolkit on Rainwater Harvesting (International Rainwater Catchment Systems Association and the Rainwater Partnership) http://rainwater-toolkit.net

What is a rainwater catchment system? The experience of CREPA – FAQ sheet on rainwater catchment systems (CREPA – The Regional Centre for low cost water and sanitation, Burkino Faso)
http://www.irc.nl/page/10369

Harvesting rainwater for domestic uses: an information guide (Environment Agency of England and Wales, 2003). Available at:
http://www.environment-agency.gov.uk/commondata/105385/rainharvest_june04_886790.pdf

2.2.2 Greywater recycling

Greywater recycling, like rainwater harvesting, is an economically efficient way of making use of water that would otherwise flow straight to drainage. Greywater is usually considered to be wastewater derived from washing, cooking and other uses that do not involve human and animal waste. As with rainwater, greywater can be recycled and used for non-potable purposes such as garden watering and toilet flushing. However, unlike rainwater which is relatively easy to collect, more complex greywater systems may require changes to drainage infrastructure within houses and businesses to allow it to be separated from blackwater (water containing human and/or animal waste).

Local Government can encourage and invest in the development of large communal greywater collection systems. These have many benefits as they can provide a reliable water supply requiring minimal treatment for agricultural and industrial purposes. Although developing such a system may require significant investment in the existing infrastructure, the benefits gained can be substantial especially in water scarce areas where the opportunity to develop new supply sources may not be available.

Further information

Technical Bulletin on Greywater Treatment and Reuse in Mena (International Development Research Centre (IDRC), 2007). Available at: http://www.idrc.org/uploads/user-S/11836240891Greywater_Treatme_Eng._03061.pdf

New South Wales Department of Energy, Utilities and Sustainability website (New South Wales, Australia) http://www.deus.nsw.gov.au/water/Greywater/Greywater.asp

2.3 Water Demand Management through financial incentives

2.3.1 Metering

A key factor in the reduction of wastage in water consumption is the existence of a financial incentive to save water. Water supply customers on an unmetered fixed rate charge do not get billed based on volume consumed and are therefore more liable to use water carelessly. The installation of water meters in domestic homes and non-household premises enables the provider to bill customers for the amount of water they consume. A metered supply is therefore considered to be the fairest way to charge for water. Studies on the impact of metering in domestic households in the UK estimate that savings due to the installation of a water meter range from 5-15% (Environment Agency of England and Wales, 2007).

Local Government can look to implement a community-wide meter installation programme. However, this is only likely to be successful if accompanied by an effective billing system that enables the necessary meter readings to take place and payments to be collected. This may require considerable initial investment but once in place is likely to prove cost effective through additional revenue and the resulting water savings.

Further information

Information on water meters in the UK (Environment Agency of England and Wales) http://www.environment-agency.gov.uk/subjects/waterres/286587/1466399/?lang=_e

2.3.2 Tariffs

The introduction of tariffs is a method of charging users different rates depending on, for example, the season and/or the amount used. A common type of tariff is based on rising block charges where above a certain volume the user pays more per litre than for lesser amounts. The type of tariff opted for will depend on what is most appropriate for the local conditions. This could include varying charges based on household income, the season and types of water use.

As basic water charges are low by necessity, tariffs allow the local water supplier to charge large users a higher rate per litre whilst maintaining an affordable rate for the basic volumes all households require. This has the double benefit of discouraging people from using large amounts of water due to rising block charges, and also providing the supplier with increased revenue from those willing to pay for the privilege of using greater volumes. For tariffs to be feasible, it is necessary for widespread metering to be in place together with an effective billing and revenue collection system. This is something that Local Governments can encourage and implement through investment in the water supply system.

A number of cities in Southern Africa including Windhoek in Namibia and Durban in South Africa have successfully implemented tariff schemes.

Further information

Guidelines for compulsory national standards, and norms and standards for water services tariffs (Department of Water Affairs and Forestry, South Africa, 2002).
Available at: http://www.dwaf.gov.za/Documents/FBW/regulations/FBWRegulationsAug2002.pdf

Managing Water Demand: Price vs. Non-Price Conservation Programs – A Pioneer Institute White Paper (Olmstead, S., Stavins, R. Pioneer Institute, Public Policy Research, 2007).
Available at: http://www.pioneerinstitute.org/pdf/070718_wp_olmstead_stavins.pdf

2.4 General WDM strategies

The links below provide information and tools on WDM in general. A vast amount of additional material is available on the Internet and can be located by searching for the general phrase "Water Demand Management" or more specific search requests through a reputable search engine such as Google or Yahoo.

Water Management in Windhoek/Namibia (Lahnsteiner, J., Lempert, G.). Available at:
http://www2.gtz.de/Dokumente/oe44/ecosan/en-water-management-windhoek-namibia-2005.pdf

Information is a prerequisite for water demand management: Experiences from four cities in Southern Africa (Gumbo, B., Juizo, D., Van Der Zaag, P. Paper for the 3rd WaterNet/Warfsa Symposium, 2002).
Available at: http://www.waternetonline.ihe.nl/aboutWN/pdf/Gumbo&Juizo&Zaag.pdf

Technical Reports in Hydrology and Water Resources: Tools for water use and demand management in South Africa (Herbertson, P.W., Tate, E.L. World Meteorological Organisation, 2001).
Available at: http://www.wmo.ch/pages///prog/hwrp/documents/TD73.pdf

Water Demand Management: Definitions, Criteria & Notions of Social Innovation & Political Economy (Brooks, D., El-Fattal, L., Arafa, D. The International Development Research Centre (IDRC), 2007).
Available at: http://www.developmentgateway.org/water/rc/ItemDetail.do?itemId=1138006

Overcoming constraints to the implementation of water demand management in southern Africa: South Africa Country Report (Hazelton, D., Nkhuwa, D., Robinson, P. The International Union for the Conservation of Nature (IUCN), 2002).
Available at: http://www.sarpn.org.za/documents/d0000073/P73_IUCN.pdf

Water Supply and Sanitation: How have African cities managed this sector? What are the possible options? (Presentation by Peter Ntoyiwa Sibanda, Water Engineer, City of Bulawayo). Available at:
http://info.worldbank.org/etools/docs/library/110868/kampala/docs/Water%20Supply%20and%20Sanitation-%20P%20Sibanda.pdf

Water conservation and demand management potential in southern Africa: an untapped river (Rothert, S. International Rivers Network, Berkeley, US, 2000). Available at:
http://www.sahims.net/doclibrary/09_03/17/briefcases/water/water%20conservation%20an%20demand%20management.pdf

End Use Modelling & Water Efficiency Programs for Arid Zones: The Alice Springs Experience (Turner, A., Campbell, S., White, S., The Institute for Sustainable Futures at the University of Technology, Sydney, Australia, 2007). Available at: http://www.switchurbanwater.eu/content/download/2359/12066/file/Turner_Campbell_White.pdf

Clearwater Information Exchange: Water Conservation Resource Library (Clearwater website, Australia) http://www.clearwater.asn.au/waterconservation_infoexchange.cfm?area=true&AreaID=48&CategoryID=3

B4 Flood Risk Prevention

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1. Short background about flooding

The United Nations Environment Programme defines a flood as "the temporary inundation of normally dry land areas resulting from the overflowing of the natural or artificial confines of a river or other body of water".[10]

Floods occur generally when an area of land, usually low-lying, is covered with water. This can be, for example, due to situations where the soil and vegetation of the area is unable to absorb rainfall, or the quantities of water that runs off the land exceeds that which can be carried in river channels or remain constrained in ponds and reservoirs.

Primary effects of flooding include, for example, structural damage to buildings and infrastructure and loss of life and livestock through drowning.

Secondary effects of flooding could be the contamination of water supply, the loss of harvest and the spread of water-borne diseases.

Floods can also have more long-term consequences, such as the loss of economic activity due to the decline of tourism and rebuilding costs.

This document aims to highlight the possible roles that Local Governments can play in mitigating flood impacts and some of the existing tools that might be of interest to Local Government when considering flood prevention in their area. The information contained in this document is by no means exhaustive and focuses on floods caused by inland water bodies only (i.e. rivers and lakes).

2. The role of Local Governments in managing floods

Local Governments play important roles in flood management because they are the level of government closest to the community suffering from a disaster. Different Local Government mandates are directly or indirectly affected by flooding. Table 1 presents some of the tasks Local Government could assume when considering the prevention or limitation of the impacts of flooding.

[10] United Nations Environment Programme (UNEP), Global Resource Information Database (GRID) - Europe, Glossary http://www.grid.unep.ch/product/publication/freshwater_europe/glos.php

Local Government mandate	Examples of the tasks that Local Government mandate could play when considering flooding
Mandates that are directly related to water	
Water supply	♦ ensure supply of un-contaminated drinking water to local people during flood events ♦ protect existing drinking water supplies from contamination by flood water
Waste water treatment	♦ limit sewage overflow and thus limit the contamination of watercourses and drinking water supplies ♦ ensure that new waste water treatment plants take into account the risk of flooding if being built in a flood-prone area
Storm water management	♦ ensure good design and management of storm-water facilities ♦ develop a series of measures to harvest, store and re-use storm water
Mandates that are indirectly related to water	
Solid waste	♦ ensure the confinement of waste to prevent dispersion in the case of flooding ♦ ensure the isolation of waste to avoid leachate contamination of surface and groundwater
Land-use planning	♦ restrict the building of houses and other infrastructure on flood plains
Housing	♦ ensure that houses are not built in flood-prone areas
Parks and recreation	♦ ensure that enough parks border the river banks to serve as flood alleviation areas
Roads and transport	♦ ensure that bridges are built high enough to prevent them from forming a barrier to high river levels
Education	♦ educate the population on how to react in flood events
Health	♦ limit the spread of water-borne diseases
Disaster management	♦ develop a disaster management plan for the locality ♦ ensure that there is a coordinated approach across all relevant Local Government mandates during flood events ♦ ensure food security for people affected by flooding
Local economic development	♦ ensure that flooding has limited impacts on key sectors of the local economy such as agriculture and tourism

Table 1: Examples of the tasks that Local Government mandates can play when preparing for and managing floods

Most African National Governments have national disaster and emergency policies. Some have special national ministries, for example the Ministry of Disaster Preparedness and Refugees in Uganda, that are responsible for dealing specifically with disaster management. But according to Douglas et al. (2006), although the structures are in place to deal with natural disaster management at national level, these may not operate effectively at the local level. If provided with sufficient human and financial resources, local authorities are in an ideal position to enforce policies such as building regulations at the local level thereby reducing the risk of flooding considerably.

Douglas et al. (2006) added that local authorities are best placed to cope with flooding management in their areas, because as they administer the regulations and are concerned with land use planning, they should be involved in local disaster management. Local authorities should develop an emergency plan for critical services such as health, water, food and sanitation so that those services can be sustained even during a prolonged flood. But this only is possible if sufficient human and financial resources are given to Local Governments to carry out such responsibilities effectively (Douglas et al. 2006). When managing floods, Local Governments should have access to assistance from National Governments, regional agencies, consultants and NGOs to, for example, map flood risk areas, maintain urban stream channels, control construction on flood channels and on floodplains and provide emergency assistance (Douglas et al. 2006).

3. Flood Risk Prevention

In helping Local Governments to mitigate floods, a number of tools and management strategies are available. This section focuses on flood risk prevention, highlighting useful resources for anticipating and mitigating flood events. A further distinction is made in this section between structural (e.g. dykes) and non-structural flood alleviation options (e.g. flood policies).

3.1 Structural systems

3.1.1 SUstainable Drainage Systems (SUDS)

Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as Sustainable Drainage Systems (SUDS). SUDS can play an important role in managing runoff flow rates, thus reducing the impact of urbanisation on flooding. They do this by dealing with runoff close to where the rain falls, managing potential pollution at its source now and in the future and by protecting water resources from point pollution (such as accidental spills) and diffuse sources (See: http://www.ciria.org/suds/index.html, Accessed 14/11/2007).

SUDS are generally made up of one or more structures built to manage surface water runoff, which are used in conjunction with good management of the site. There are five general methods of control (for more information about these, see http://www.ciria.org/suds/suds_techniques.htm, Accessed 14/11/2007):

- preventing measures that minimise runoff (i.e. minimising paved areas and rainwater harvesting);
- filter strips and swales that mimic natural drainage patterns by allowing rainwater to run in sheets through vegetation, slowing and filtering the flow;
- permeable surfaces, that allow runoff to pass through the surface and be absorbed by underlying soil layers (used in place of asphalt which is not permeable);

- filter drains and infiltration devices, that work by enhancing the natural capacity of the ground to store and drain water (for example, rain falling onto sandy, permeable soil soaks into it and infiltration devices can use this natural process to dispose of surface water runoff); and
- basins and ponds, that store water, either through the temporary flooding of dry basins and flood plains, or in permanent ponds.

The measures listed above need to be incorporated at an early stage into the planning of land development so that flooding impacts can be reduced from the start. In recent years, one of the most common SUDS techniques developed and implemented has been "flood alleviation boxes". These boxes are placed underground, as with any drainage system, but are then encapsulated in an impermeable, watertight geo-membrane. These underground tanks are capable of storing a large amount of stormwater runoff that is then slowly released to prevent flooding of the surrounding areas.

3.1.2 Soft defences or managed realignment

More "natural" methods are increasingly used to manage flooding. Called "soft defences or managed realignments" they use wetlands and mudflats to provide space for floodwater, which can prevent flooding from occurring elsewhere. Gumbricht et al. (2004) highlight the importance of floods for the preservation of the Okavango Delta wetland of northern Botswana, a wetland that is potentially under threat due to water abstraction from its tributaries.

For more information on soft defences, see:
http://www.environment-agency.gov.uk/subjects/flood/1217883/1217968/1218048/?lang=_e, Accessed 16/11/2007.

3.1.3 Temporary structures

Flood barriers, flood guards, floodgates and removable dams can be installed temporarily prior to flood events to prevent damage to property and protect lives (for examples of these structures, see http://www.floodcontrol.co.uk/flood-dam.htm, Accessed 16/11/2007). Sandbags are the most common emergency flood barrier used to protect properties during flooding events. "New generations" of sandbag such as the "aqua sac" (http://www.aqua-sac.com/, Accessed 22/11/2007) and the "floodbags" (http://www.edslimited.co.uk/Products/Floodbags, Accessed 22/11/2007) can also be used. These are bags that contain water absorbent material. Their main advantage is that they are light to carry and easy to stack and can hold several litres of water.

3.2 Non structural management tools

3.2.1 Enforcing flood regulations and policies at local level

Enforcing existing flood regulations and policies is important in mitigating flood impacts. Examples include:

The South African Disaster Management Bill

The purpose of the South African disaster management bill (currently in force) is: "To provide for an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery; for the establishment of national, provincial and municipal disaster management centres; and for matters incidental thereto." Chapter 5 of the bill highlights disaster management and policies at municipal level. These include, for example, the need for municipal governments to establish and implement a policy framework for disaster management for the municipality and to set up a local disaster management centre.

For the full text of the bill. See: http://www.info.gov.za/gazette/bills/2001/b58-01.pdf, Accessed 16/11/2007

European Union Best Practices on Flood Prevention, Protection and Mitigation

Although developed and implemented in a European context, the European Union 'best practice' measures can also be of value in an African context. The measures were developed in 2003, prior to the adoption of the EU Directive 2007/60/EC[11], to present basic principles and approaches for preventing, protecting and mitigating flood impacts at river basin level and to demonstrate how to translate and implement these in practice. For more information, see: http://www.floods.org/PDF/Intl_BestPractices_EU_2004.pdf (Accessed 15/11/2007)

3.2.2 Flood risk mapping

A number of new technologies are available to help elaborate flood risk maps. These include:

LIDAR (Light Detection And Ranging) technology

LIDAR technology rapidly collects high-accuracy elevation data (greater than 1-foot accuracy) for very large areas, such as floodplains. With elevation data available for the entire floodplain, flow models can simulate more accurately where water will go during a flood (for more information, see: http://www.environment-agency.gov.uk/science/monitoring/131047/, Accessed 15/11/2007).

TRIMR2D (Transient Inundation Model for Rivers – 2 Dimensional) computer program

The TRIMR2D can simulate flood flows throughout the floodplain, and many miles downstream from the forecast point. The model works by solving equations that describe the physics of fluid flows. As well as being able to solve equations for large areas, TRIMR2D can deal with problems of large and fast flow changes.
For more information, see: (http://pubs.usgs.gov/fs/2004/3060/ (Accessed 15/11/2007).

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[11] European Union (EU) Directive 2007/60/EC on the assessment and management of flood risks was adopted on the 23rd of October 2007 and requires that the EU Member States shall for each river basin i) undertake preliminary flood risk assessments (by the 22nd of December 2011), ii) prepare flood hazard maps and flood risk maps (by the 22nd of December 2013), iii) establish flood risk management plans (by the 22nd of December 2015). For more information, see: http://eur-lex.europa.eu/LexUriServ/site/en/oj/2007/l_288/l_28820071106en00270034.pdf (Accessed 15/11/2007).

GIS (Geographic Information System)

GIS is used to process the data given by LIDAR, or by a flow model such as TRIMR2D, to make maps of the entire floodplain showing, for example, areas that are likely to be flooded, how deep the water can get, when the floodwater is likely to arrive and when the flood will be at its peak. See: http://pubs.usgs.gov/fs/2004/3060/ (Accessed 15/11/2007).

3.2.3 Flood risk management

The tools described below aim at mitigating flood impacts by establishing flood management plans. These are designed to prevent floods through better management of the different activities in the catchment that can have adverse impacts in the case of flood events (e.g. land use). The plans presented here are three examples of flood management at catchment scale.

Integrated Flood Management (IFM)

Integrated Flood Management (IFM) promotes an integrated, rather than fragmented, approach to flood management. Land and water resources development in a river basin follow the same principles that form the basis of "Integrated Water Resources Management (IWRM)", namely social equity, ecological sustainability and economic efficiency. It aims to maximize the net benefit from floodplains and to minimise loss of life from flooding. For more information, see: http://www.apfm.info/pdf/concept_paper_e.pdf (Accessed 15/11/2007)

Environment Agency of England and Wales: Catchment Flood Management Plans (CFMPs)

The "catchment flood management plans" are initiated by the Environment Agency (EA) of England and Wales in the UK and can constitute a model of flood management over a catchment area. The CFMPs aim to understand the factors that contribute to flood risk within a catchment, such as how the land is used, and to recommend the best ways of managing the risk of flooding within the catchment in the future. The plans are developed for every region in England. A consultation period was held which allowed stakeholders to comment on the draft CFMPs. Taking into account the comments made, the EA aims to have the final version of the plans ready for further public consultation by 2008. More information about these plans can be found at: http://www.environment-agency.gov.uk/subjects/flood/1217883/1217968/907676/ (Accessed 15/11/2007).

Dutch Spatial Planning Key Decision 'Room for the River'

As lands behind riverbanks become more and more utilised and populated, space for the rivers become limited. Also, the rivers are increasingly wedged by dykes and canalised, resulting in rapid water flows downstream. Recognising these issues and the need to give rivers more space, the Dutch Cabinet has created a package of measures called the Spatial Planning Key Decision 'Room for the River'. The main objective of this decision plan is comprehensive flood protection by 2015, improved overall environmental quality in the river basin region and the insurance that the space required by rivers throughout the coming decades will remain available. To satisfy these objectives, a series of measures aimed at creating more space for the rivers and lowering high water levels (e.g. displacing dykes further inland and enlarging summer beds) will be implemented. The re-enforcement of dykes is considered in the plan, but only if other measures are too expensive or inadequate.

For more information, refer to:
http://www.ruimtevoorderivier.nl/files/Files/brochures/EMAB%20PBK%20Engels.pdf (Accessed 15/11/2007)

3.2.4 Flood forecasting systems and software

Mozambique flood warning system

A simplified flood early warning system was set up on the Búzi River in Mozambique tailored specifically to the needs of the local population. The system is community based and requires the participation of local villagers who are nominated to measure precipitation rates within the Búzi basin and to gauge water levels along the river itself. Local participants receive training that allows them to identify when there is a risk of flooding and take the necessary measures to alert the local population. A system of coloured flags is used to highlight the level of flood risk is the local area. For more information see:
http://www.munichre-foundation.org/StiftungsWebsite/Projects/DisasterPrevention/Mozambique/default.htm

FloodWorks v8.5 and the National Flood Forecasting System

The use of computer technologies and GIS has contributed to recent advances in flood forecasting. But flood forecasting is highly dependent upon reliable and timely data. Research is still on-going to try and reduce the uncertainties associated with this data.

Examples of recent softwares developed for flood forecasting are the FloodWorks v8.5, used successfully in Europe and Asia (http://www.wallingfordsoftware.com/news/fullarticle.asp?ID=737, Accessed 16/11/2007), and the National Flood Forecasting System (NFFS), used by the Environment Agency of England and Wales (http://www.wldelft.nl/proj/pdf/4uk00250.scherm.pdf, Accessed 15/11/2007).

Water Management Model (WAMM)

The WAter Management Model (WAMM) is a tool aimed at improving flood forecasting and decision making during flood events.

The WAMM system helps river authorities, civil protection bodies, ministries, etc, in facilitating flood warning alarms, improving management of floods and building fast and reliable development of flood defence programmes.

The ultimate goal of WAMM is to be a fully integrated Decision Support System (DSS), which provides the user with information, overviews and model simulations to allow decisions to be made on what are the best possible lines of action during flood situations as well as assisting with the development of flood defence strategies. WAMM is designed to be integrated with warning systems that disseminate flood alerts to the relevant authorities and the general public. Flood maps will, for example, be issued through the Internet to fire brigades, civil protection associations, etc.

This project was completed in 1999. For more information see
http://www.eu-medin.org/download/lettinfo-wamm_project.pdf, (Accessed 22/11/2007)

3.2.5 Emergency Flood Plan (EFP)

Being prepared for floods also involves knowing how to react if flooding occurs. An “Emergency Flood Plan” (EFP) provides information on what to do and in which sequence to do it when floods occur.

An emergency flood plan can be developed for private houses, businesses or public organisations. At municipality level the EFP details the roles, responsibilities and actions to be taken by the local authorities, government agencies (such as the environment agencies), emergency services and health services. An example of such a plan at local level is the “Major Flooding Emergency Plan” developed for the county of Gloucestershire in the UK
See: www.gloucestershire.gov.uk/utilities/action/act_download.cfm?mediaid=17077 (Accessed 22/11/2007).

When it is clear that flooding will occur, local authorities should act according to their "Emergency Flood Plan". The responsibilities of the local authorities in the EFP may include:

- Co-ordinating the local authority response with the other municipal organisations and volunteers (e.g. police, emergency services, citizens)
- Arranging the emergency care of citizens evacuated or affected by flooding
- Arranging the emergency transport of personnel, equipment and materials
- Alleviating flood impacts by, for example, issuing sandbags and dealing with flooded roads by creating diversions.

3.2.6 Educating citizens and raising public awareness

Although it is becoming increasingly accurate, flood forecasting still contains several uncertainties and therefore preparing the population for potential flood events is essential.

Community-based flood early warning systems

Community-based flood early warning systems (CMFEWS) are "people-centred" approaches that aim at empowering individuals and communities threatened by floods to act in sufficient time and in an appropriate manner so to reduce loss of life, damage to properties and livelihoods. The community and disaster risk management workers are provided with advance information on the likelihood of flooding. This can trigger the implementation of disaster prevention and response actions to mitigate against the loss of life and damages to assets. This system empowers Local Governments and the communities to protect themselves against floods. For more information: http://www.mpowernet.org/download_pubdoc.php?doc=3439 (Accessed 15/11/2007).

Specific guidance to communities

Some specific guidance can be given to communities. For example, information is distributed to populations in flood-prone areas to protect their homes more efficiently as in the Environment Agency of England and Wales's "Damage Limitation Guide". See http://www.environment-agency.gov.uk/subjects/flood/826674/882909/483622/354508/?version=1&lang=_e (Accessed 16/11/2007).

Educational software

FloodRanger is an educational game about managing flood defences along rivers and coasts. It is aimed at flood defence practitioners, local authorities, insurers, universities and schools. The objective of the game is to defend urban areas and sites of special scientific interest while maintaining levels of housing and employment for an expanding population. The game was developed by the Office and Science and Technology in the UK as part of the Foresight programme. It is a joint project between Discovery Software Ltd. and View the World Ltd. See http://www.discoverysoftware.co.uk/FloodRanger.htm (Accessed 16/11/2007).

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Integrated Water Resources Management (IWRM) is a hot topic. It is everywhere – in the media, on the internet, at conferences – and is a buzzword amongst governments, water institutions and NGOs. Is it just a current trend that will soon be forgotten or is it here to stay? More importantly, as an official of a Local Government – is it worth exploring further?

The 'Local Government and IWRM' set of materials has been produced by African and European water and Local Government specialists. They are convinced that IWRM in the long-term is both possible and the best way forward. It can only work with Local Government involvement, and Local Governments themselves need IWRM to optimise the performance of their mandates in the local community.

The 'Local Government and IWRM' set of materials consists of:

Part I: **Reaping the Benefits – How Local Governments Gain from IWRM**

Part II: **Understanding the Context – The Role of Local Government in IWRM**

Part III: **Engaging in IWRM – Practical Steps and Tools for Local Governments**

Part IV: **Making Water Work for Local Governments – Ten Top Tips for Integration in Water Management**

This publication, Part III of the series, offers practical guidance for embarking on an IWRM process at the local level. IWRM opportunities within Local Government mandates are highlighted and steps for setting up a local IWRM action plan described.

Make your Local Government a pioneer in water sustainability – adopt IWRM!

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