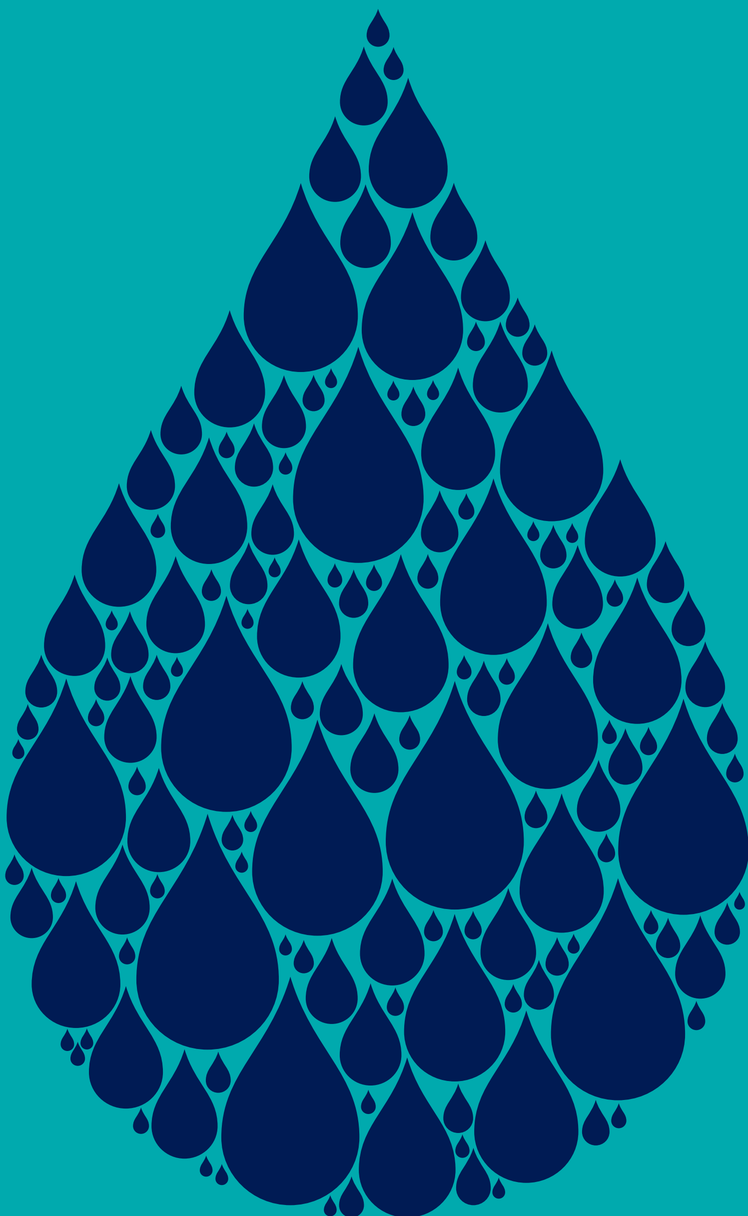
MANAGING WATER LOCALLY

An essential dimension of community water development



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Managing water locally:
An essential dimension of community water development

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PREFACE

Water resource management has been promoted globally, and is often thought to be the responsibility of national and multi-national agencies managing major river basins, including those which cross the boundaries of more than one nation state. But the potential for monitoring and managing water resources at local or community level should be better acknowledged. In particular, traditional water management practices must be recognised and used as a foundation for the development of future water management strategies.

There are many examples of effective local management, or Community-Based Water Resource Management, from across the world, some of which have been used for millennia by populations that have exploited rainfall, annual floods, groundwater and surface water to satisfy their needs. The argument of this publication is that such practices are ripe for widespread promotion. After all, those who have the greatest stake in the security of their water supply have the strongest motivation for participatory management and decision-making.

This publication is the outcome of a partnership between the Institution of Civil Engineers in Britain and two international development agencies: Oxfam and WaterAid. In 2009-10 these organisations jointly organised eight public presentations by a mix of academics and practitioners from three continents to an open audience of interested professionals. Information from the talks and the subsequent discussions constitute the content of this publication.

The publication is intended for water sector practitioners, policy-makers and donors who wish to improve their understanding of how the global issues of demographic change, environment and climate change unfold at local level, and the role that local water users can play in adapting to the impact they have on water resources. It is for those who wish to learn how trans-national principles of Integrated Water Resource Management and common-property resource management can be put into practice on the ground. Above all it is for those who wish to know how the monitoring and management of water resources at community level can contribute to greater water security for those whose livelihoods and water services are often far from secure.

This publication is by no means the last word on the subject of Community-Based Water Resource Management. Yet if it can contribute to a greater recognition of the potential of local level water resource management, and if it provides some pointers towards how current local level approaches can be improved, built upon and incorporated into national and regional water policy, then it will have achieved its purpose.

Sir Crispin Tickell

GLOSSARY

Blue water	Surface water and groundwater, including water stored in rivers, lakes, wetlands and reservoirs, and runoff that percolates into aquifers.
Common pool resources	Locally available resources that communities and households draw upon to sustain their health and livelihoods. Resources that are available for everyone to use free of charge (however, they are also finite and require management structures to be in place to reduce potential for over exploitation).
Common property regime	A social system, often based on cultural traditions, that controls and regulates the use of a common pool resource.
Community-Based Water Resource Management (CBWRM)	A strategy that enables local water users to be involved in and responsible for the management of their water resources.
Consumptive water use	Processes that put water beyond use for other purposes because it has evaporated, transpired, been incorporated into products and crops (virtual water), been consumed by humans or livestock.
Functional sustainability	The ability of a water source (eg handpump, well or borehole) to continue working as intended into the long-term future and not fail or produce decreasing yields as a result of a technical, design or construction fault.
Green water	Water stored in the soil as soil moisture and available for use by vegetation.
Infrastructure	Physical structures, both large and small, that may be used in the water sector to help it function (eg handpumps, taps, pipes and canals).

GLOSSARY

Integrated Water Resource Management (IWRM)	A process that encourages the cross-sectoral management of water, land and associated resources. IWRM is based on the Dublin Principles, which acknowledge the vulnerability of water resources, the need for a participatory approach, the importance of women in the role of water management and the economic value of water.
Light Integrated Water Resource Management (Light IWRM)	A type of IWRM that focuses specifically on the implementation of effective water resource management on a day to day basis, with a high level of involvement from governments and water companies at the local level to bridge the gap between the lowest level of private and state regulating authorities and community-based institutions.
Non-consumptive water use	Processes that make use of water but return it to the environment where it may be used for other purposes.
Sustainability	The ability of water sources and water resources to continue functioning and yielding water into the long-term future, without detriment to any water users, including the environment.
Wadi	A dry ephemeral river bed that contains water during periods of heavy rain, or an intermittent stream. Wadis tend to be associated with centres of human population because sub-surface water is sometimes available in them and they are important features for groundwater recharge.
WASH	All works related to water, sanitation and hygiene, including the provision of safe and affordable access to a clean water supply and methods of disposing of waste. This involves the provision of services and training on how to manage them.
Water resource	The wider body of water from which a water source draws its supply, including aquifers, rivers and reservoirs.

Water scarcity	Two different types of water scarcity can be identified: physical and economic[1]. Physical scarcity occurs when available water resources are insufficient to meet the demand from all sectors, including the environment; this is often due to the over-development of resources and over-commitment to various users. Economic scarcity is a social construct and occurs when there is a lack of investment in water or a lack of human capacity to keep up with growing water demand.
Water security	The continued availability of and access to safe water for all required uses. A household or nation may be considered water secure when the majority of the inhabitants are not threatened by insufficient or unreliable availability of and access to water or by too much water which may lead to flooding.
Water source	A specific point or place where water can be accessed and used, such as a well, borehole or handpump.
Water stress	Water stress occurs when there is water scarcity. Water stress may manifest itself as conflict over water, over-abstraction, poor health and disease.
Water user	Any individual, group or sector that requires an allocation of water for a purpose, whether consumptive or non-consumptive, for domestic or productive needs.

CHAPTER.01

Introduction

CHAPTER.01

Introduction

The relative roles of nation states, private companies and local institutions in managing water resources have long been debated by economists, anthropologists and water sector professionals. Each of these disciplines offers a different perspective on water management. The Integrated Water Resource Management (IWRM) model has been widely promoted as the only option for managing nations' water resources since the 1990s, yet the debate has been clouded because there has been a lack of serious alternative options for water resource management beyond state control. In particular, the role of communities has been misrepresented because they are frequently excluded from important aspects of environmental management. For many people, community-based institutions can fulfil a fundamental role in the management of common pool resources, such as water resources or forestry. This is particularly true when state capacity is weak or communities remain on the periphery of support from any government. This publication explores how local water resources can be managed successfully by community-based institutions in support of state level initiatives, where they exist.

The role of local institutions in managing common pool resources is a theme that has risen in prominence in recent years and it resonates strongly in low-income countries where conventional approaches for water resource management may be inappropriate and many states are seeking ways in which to improve on current governance strategies. This publication follows 12 months of close collaboration between the

Figure 1.1
A water queue in Ethiopia. (Credit: Roger Calow, ODI).

Institution of Civil Engineers, Oxfam GB and WaterAid – who are collectively promoting Community-Based Water Resource Management (CBWRM) as a practical mechanism for implementing sound water resource management.

PUTTING WATER RESOURCE MANAGEMENT INTO PRACTICE

Despite high profile declarations and international plans of action, IWRM theory continues to run far ahead of its application in practice. Indeed, there are too few good examples of IWRM from which to draw on recognised best practice[2]. There is a need to redefine the mechanism for water resource management – giving greater respect to the needs, priorities and possibilities of different countries and contexts. There is potential to develop creative and realistic options for water resource management, particularly at local geographical scales, involving water users.

In Chapters 2 and 4, various alternative options for water resource management are presented and explored, using experiences from Ghana and Sierra Leone to demonstrate that the implementation of a successful strategy is achievable in low-income countries. These chapters examine the role that grassroots practitioners can play in local level water resource management, through CBWRM.

COMPLEX RISK

Chapter 3 outlines how governments and non governmental organisations (NGOs) that work to improve access to water in low-income countries tend to focus on delivery of water supply assets, whether

Figure 1.2 Community water resource mapping in Al Salaam IDP Camp, North Darfur, Sudan, 2008. (Credit: St John Day, Oxfam GB).

CHAPTER.01

Introduction

they are for domestic or agricultural use. The sustainability of the service, both from a functional perspective and from an environmental (water resource) point of view, is often neglected or insufficiently emphasised. Practical guidance to improve the situation is presented later in the publication.

The pressures on global water resources are increasing and the need to put water resource management into practice at various levels is both urgent and compelling. Examples from China, Ethiopia (Figure 1.1, previous page) and Malawi (Chapter 3) set the scene for understanding why effective water resource management is more important than ever before.

RECOGNISING AND RESPECTING COMMUNITY-LED ADAPTATION

In some areas, water users are already practising communal water management by applying their own rules and traditions. In Chapter 5, examples from Peru, Spain and the Sahelian zone of Africa demonstrate the importance of recognising and respecting traditional water management techniques that continue to survive, but highlight that these now need to be strengthened to cope with increasing variability.

EXPERIENCES FROM OXFAM AND WATERAID FIELD PROGRAMMES

Chapter 6 describes on-going field experiences from India, Nepal and Niger, where country programmes have engaged with local institutions to put water resource management into practice using flexible, adaptive support mechanisms. The implementation of CBWRM in these regions has included involving communities in activities such as water resource allocation, undertaking local level monitoring, implementing rules or operating principles for day to day water usage, and establishing a management system with clearly defined rules and regulations. CBWRM gives local water users the opportunity and means to engage in water resource management, recognising the economic value of water and its role in sustaining people's livelihoods.

MOVING FROM PRACTICE TO POLICY

One of the main problems with water resource management is that national and regional water policies often do not take account of or incorporate successful operational practices which are present at the local level; the bridges between science, policy and practice are weak. Chapter 7 explores methods for involving local institutions and water users in decision-making processes (as shown in Figure 1.3), so that water policy is more accurately aligned to field realities.

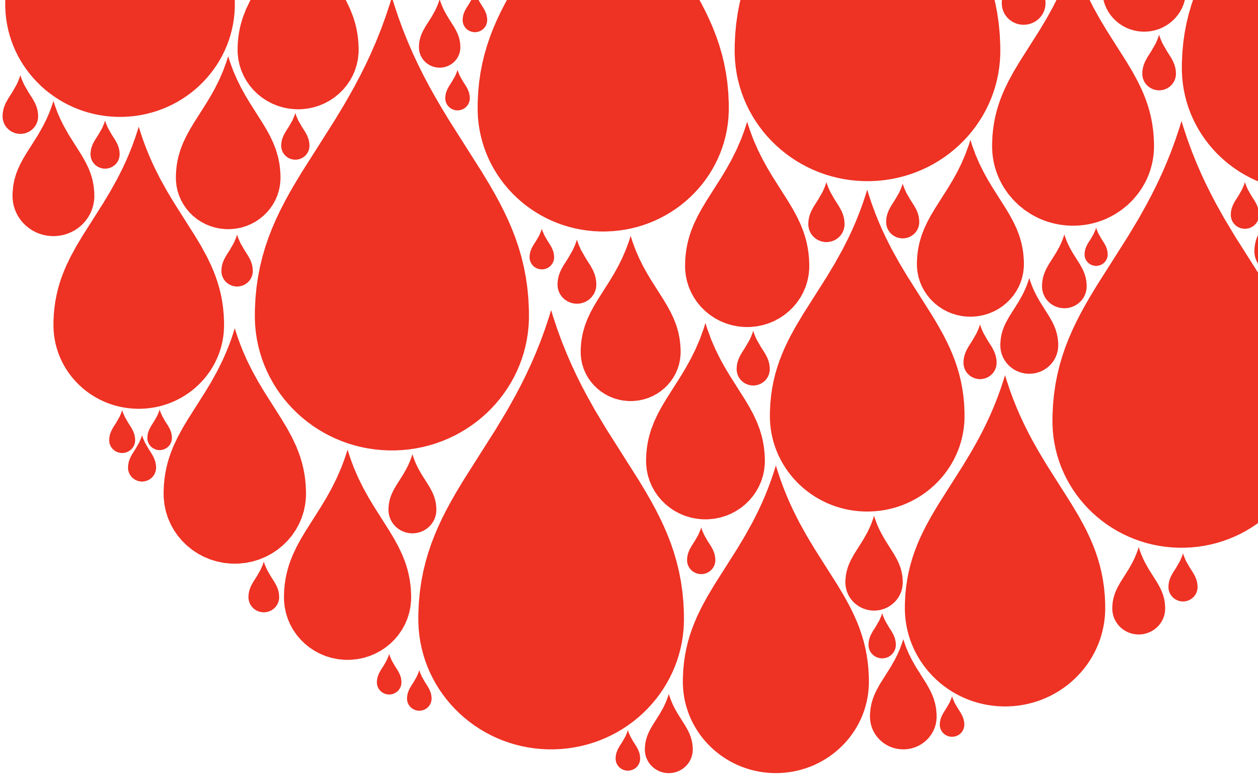
The final chapter summarises the issues and draws conclusions as to how collaboration between local institutions and communities, and water sector practitioners and policy-makers, can dramatically improve water resource management.

Figure 1.3 *Farmers in Usangu, Tanzania, discussing ideas for managing water for irrigation (Credit: Bruce Lankford, UEA).*

MESSAGE OF THIS PUBLICATION

Assessing the balance between supply of and demand for water is extremely complex, and requires hydrological monitoring to be undertaken locally. The role of community-based institutions in monitoring rainfall, groundwater fluctuations, collective abstraction, as well as bargaining over water allocation and establishing operating principles for water usage, can all complement broader water resource management frameworks, where they exist.

This approach represents new thinking within the water supply, sanitation and hygiene (WASH) sector, where previously community management structures have been promoted as a panacea for the sole purpose of maintaining physical water supply infrastructure or 'hardware'. To date, consideration of the water resources that sustain water supply systems has often been a neglected component of community management systems. This is a more fruitful approach for WASH organisations than simply advocating for the adoption of generic IWRM frameworks.



CHAPTER.02

Options for water resource management

Overview: This chapter examines some of the current mechanisms for managing water resources, including Integrated Water Resource Management, Light Integrated Water Resource Management and Community-Based Water Resource Management.

CHAPTER.02

Options for water resource management

The aim of any water resource management programme is to safeguard water security. According to Abrams, "Water security is a situation of reliable and secure access to water over time. It does not equate to constant quantity of supply as much as predictability, which enables measures to be taken in times of scarcity to avoid stress[3]." Three important considerations stand out. The first is the inclusion of the word 'predictability'. This implies that water resources are dynamic, suffering inter-annual fluctuations, and need to be monitored, so they can be managed effectively. The second is the acknowledgement that those organisations or institutions which are tasked with the responsibility of water resource management can make decisions and invoke measures to mitigate the risk of water scarcity or stress. The third is reference to 'quantity of supply'. This is important because water management approaches frequently only address issues of water quality.

Progress in achieving sustainable water resource management across many low-income countries has been slow, both for water users and governments that want to manage water resources in a more sustainable manner. A review of current water resource management mechanisms, from the perspective of communities and households, suggests that new options for water resource management need to be considered. Figure 2.1 shows how different options for water resource management can be applied at various levels.

INTEGRATED WATER RESOURCE MANAGEMENT

Integrated Water Resource Management (IWRM) is a process at the heart of many water resource planning and management initiatives. The concept of IWRM emerged in response to the perceived global water crisis in the 1990s. Since then it has been widely promoted by the Global Water Partnership, the World Water Council, donors and many water sector professionals. At this moment it is widely recognised as the mechanism for promoting and implementing sustainable water resource management[4].

It is important to note that IWRM has not been unambiguously defined – if indeed it could be. The best known definition for IWRM comes from the Global Water Partnership. It states, 'IWRM is 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 ecosystems[5].'

IWRM is a holistic approach that aims to address the fragmented nature of water resource development and management when responsibilities are shared across multiple organisations at central and local government level. The approach therefore extends beyond immediate WASH sector planning considerations and encompasses issues

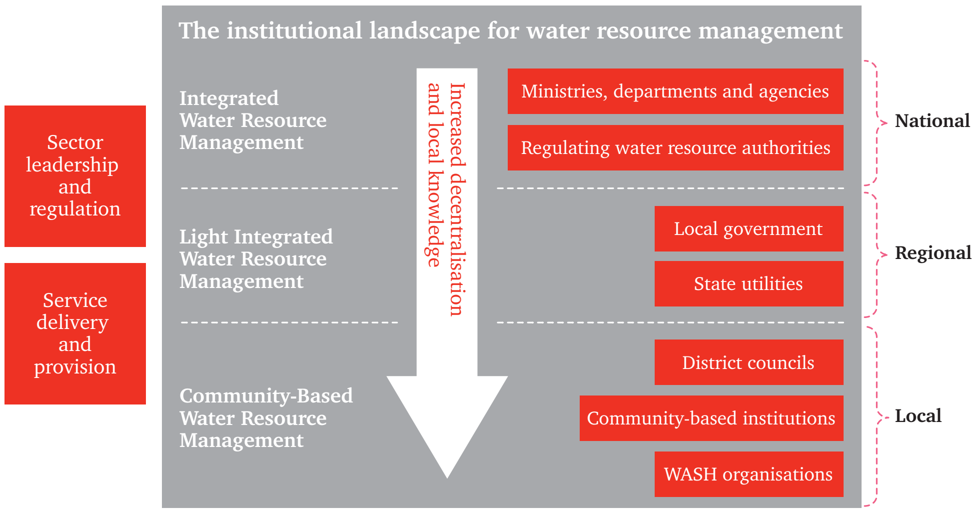


Figure 2.1
The institutional landscape for water resource management. (Credit: St John Day, Oxfam GB).

of agriculture, ecology and industrial water usage as well as flooding, drought and water quality. IWRM is often promoted within the WASH sector as an approach to support service delivery. To be effective, IWRM requires substantial political will and commitment, meaningful collaboration by multiple organisations as well as the existence of national IWRM plans, policies, water laws and regulation, adequate budget lines and sufficient technical, financial and human capacity at national and local levels. These factors are all essential aspects of the enabling environment if IWRM is to be realised.

There are some examples where IWRM can be effective, but this requires significant collaboration among all stakeholders, active participation by key water user groups, such as farmers and pastoralists, and projects designed and implemented with thorough contextual understanding. The commitment of central and local government to the IWRM process is crucial. Experience shows that IWRM is a lengthy and time consuming process that often means IWRM principles are not applied locally. IWRM clearly has good intentions, aimed at improving monitoring, allocation and management of water resources. Yet the broad scope of it may inadvertently present significant technical and institutional challenges that appear overwhelming for governments and state utilities with limited capacity. Unfortunately the IWRM mechanism does not propose an alternative approach, suitable for a more local scale, if these multiple enabling factors are not present. Without direct engagement in water resource management, there is a risk that water management policies become theoretical.

CHAPTER.02

Options for water resource management

A number of specific issues arise around IWRM:

- First, the IWRM approach is often seen as being difficult to implement, largely because global IWRM models do not consider the inherent complexities that may exist in low-income countries. It is not possible to apply one standard model to all contexts.

- Second, river basins are not necessarily the natural unit for water management, because a) they vary in terms of administrative, hydrological and socio-political complexity and b) the river basin needs to be broken down into smaller sub-catchments so communities and households can meaningfully engage.

- Third, water issues – especially in rural locations – need to be resolved locally, involving community leaders and community representatives. Water management is often a social and moral dilemma that requires participatory approaches involving local people. Niger, for example, has more than 17,000 villages, many of which are situated in drought prone, arid environments. The challenge of implementing IWRM in such a resource-poor nation is overwhelming, unless new options for water resource management can be found.

LIGHT INTEGRATED WATER RESOURCE MANAGEMENT

IWRM requires a process of devolving decision-making towards water end-users. Naturally, this requires substantial political will and effective building of technical, financial and human capacity, within district councils. One pragmatic approach to decentralise water resource management is the concept of Light IWRM[6]. This is seen as a complementary mechanism to full IWRM that can be better adapted to the local governments who work in close proximity to communities and households. Light IWRM, where it exists, must therefore address the interface between the lower levels of recognised state management and local community-based institutions. Clearly, if there is a disconnect between water users and their representatives who have access to local regulating authorities, community interest and enthusiasm to engage with authorities will diminish.

Responsibility for managing water resources often sits with national governments. However, state utilities, district councils and community-based institutions all have an important role to play. If central government does not provide the leadership, strategic guidance and continued support for putting water resource management into operation, local level stakeholders may not have sufficient information or support available to them. The effectiveness of Light IWRM is constrained by the limited capacity (human, technical and financial) that may exist in district or local government offices. This may render local authorities ineffective in managing water resources especially where other development needs are prioritised, such as education, agriculture and infrastructure. Light IWRM therefore is only possible where local government capacity is strong. If local government capacity is perceived as weak, many implementing agencies may inadvertently bypass the lowest levels of government authority when implementing community development projects. This may lead to unplanned development of groundwater and surface water resources and may inadvertently place increased burden on local government structures tasked with managing water and land resources.

COMMUNITY-BASED WATER RESOURCE MANAGEMENT

In situations where nation states are categorised as fragile or communities remain on the periphery of support from central government, Community-Based Water Resource Management (CBWRM) may be a more realistic option for involving local water users. CBWRM aims to engage directly with community-based institutions and water user groups so that they may play an active role in water resource management from the beginning. The idea is that CBWRM provides an opportunity for communities to engage in water resource management with roles and responsibilities clearly defined alongside those of regulating water authorities. CBWRM does not attempt to be a direct replacement for national IWRM plans. It provides WASH organisations with a very practical approach for engaging in water resource management as part of their ongoing service delivery work, and it recognises the need to improve management of water resources at a local level.

CBWRM provides tangible benefits for development organisations because it encourages agencies to consider aspects of water quantity and quality that sustain water supply systems. Furthermore, it encourages agencies to engage in hydrological monitoring and to undertake innovative water resource management work that can be replicated and scaled up by larger service providers. Other benefits include:

- Encourages organisations, which predominantly engage in provision of domestic water supply and sanitation services, to consider productive water requirements when designing water supply systems.

- Encourages practitioners, who are responsible for designing and implementing water supply systems, to consider issues of water quantity as well as water quality. Domestic water supply in community water supply programmes typically places low demands on available water resources. However, the risk of over-abstraction at water sources needs to be considered, especially where water usage is multipurpose. Important issues of groundwater depletion, recovery and recharge are not routinely considered in many community water supply programmes.

- Community management structures have typically focused on physical water supply infrastructure (water assets), not water resources. CBWRM therefore provides development organisations with a practical mechanism for engaging in water resource management, ensuring environmental sustainability is considered alongside operation and maintenance duties.

- The CBWRM approach is also relevant where large-scale human displacement occurs and refugee or internally displaced person camps are formed. Densely populated camps place large demands on local water resources and the protracted nature of many humanitarian crises (such as Darfur, Chad and Dadaab camp in Kenya) requires medium and long-term planning for water resource management.

Although CBWRM has not been hitherto unambiguously defined, this publication proposes the following definition:

CBWRM is about involving water users in the management of local water resources. Communities play an important role in both water quantity and quality aspects. Communities monitor resources in order to establish appropriate management techniques and communities respond to changes in water availability through collective decisions bound by clear operating principles for water usage.

At the heart of CBWRM is a continuous process of risk identification and risk management. This approach links integrally with water safety planning which is becoming increasingly prominent within water supply and food security programmes. By combining issues of water quality and water quantity, communities are provided with an opportunity to engage in resource management. This is important because often the role of communities in safeguarding the environment may have been restricted to resource mapping during assessments – not actual monitoring and management of locally available water resources.

CBWRM does have its limitations, not least the questionable ability to scale up for the management of transboundary water resources. It is not a replacement for regional or national water plans, if they exist. Indeed, without access to and influence over decision-makers, CBWRM systems may be viewed by some water authorities and decision-makers as small-scale or isolated. Its limitations are therefore expressed in association with scale and sustainability.

However, the role of community-based institutions should be formally recognised by central government and regulating water authorities, so that water users can be active participants in the bargaining process over water allocation. This will be strengthened further where domestic water usage and the needs of communities and households are prioritised over large-scale industrial users. This requires regulations to be established for water abstraction and discharge.

Figure 2.2 *Aerial view of Abu Shouk Camp, El Fasher, Darfur, 2008 (Credit: St John Day, Oxfam GB).*

CHAPTER.03

Why water resource management is important

Overview: The pressures on global water resources are increasing and the need to put water resource management into practice at various levels is both urgent and compelling. More emphasis needs to be placed on water security, both from a functional perspective and from an environmental (water resource) point of view.

CHAPTER.03

Why water resource management is important

Many of the issues faced in water resource management are part of a bigger environmental and socio-economic picture comprising a system of pressures, states and responses (Figure 3.1). Two key pressures driving the system are population growth and rapid urbanisation, which are closely accompanied by increased demands for water, food and other natural resources. In Africa, which is the main area of focus for this chapter, agriculture is largely rain-fed and farmers face the continual challenge of trying to maximise productivity in the presence of a highly variable climate. Issues associated with the combination of population-related pressures and practising agriculture in difficult environments in many countries are intensified by a state of conflict and/or weak governance. The response to this combination of pressures and states in many cases is increasing food insecurity, poverty and vulnerability, accompanied by pollution and flooding in urban areas, and the mining of soil nutrients and land clearance in rural areas. All this is leading to environmental catastrophe and a corresponding crisis for livelihoods and socio-economics, which is increasingly becoming fuelled by climate instability and change (Chapter 5).

POPULATION GROWTH AND URBANISATION

Until recently, population growth and the impact it has on issues related to water resource management have tended to be ignored – the 'elephant in the room'. However, the potentially catastrophic effect that an ever-growing global population could have on water

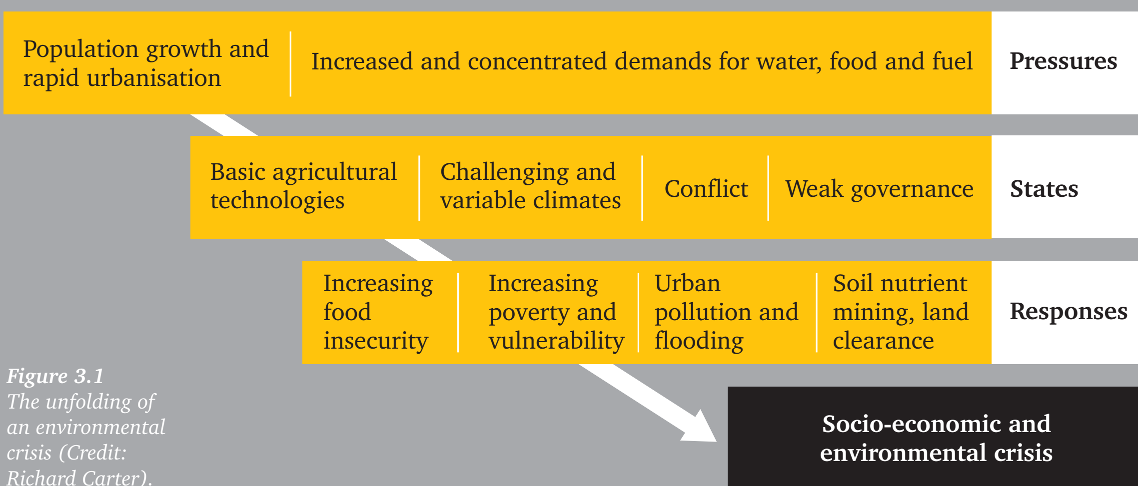


Figure 3.1 *The unfolding of an environmental crisis (Credit: Richard Carter).*

Box 3.1

Implications of rapid population growth in Ethiopia

The population of Ethiopia is expected to almost double over the coming four decades, growing from about 80 million people in 2010, to roughly 150 million by 2050. Although population levels themselves are not necessarily unsustainable, it is the rate of growth that presents a major challenge.

One cause of livelihood vulnerability in rural Ethiopia is low levels of water supply coverage, despite significant progress in recent years. Government figures suggest that rural water supply coverage is now around 60%, but high levels of breakdown and system 'downtime' mean that real access is likely to be much lower[7].

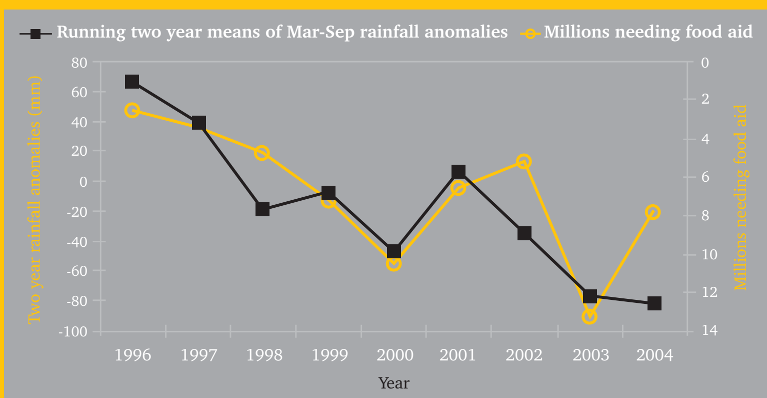


Figure 3.2
Rainfall and numbers requiring food aid for the period 1996-2004[8].

An additional cause of vulnerability in Ethiopia is the fact that less than 3% of potentially irrigable land is currently irrigated and a significant proportion of the population depend on rain-fed agriculture. Historical data for the country suggest a strong correlation between rainfall variability, GDP growth and the number of individuals requiring food aid[8]. Even in a normal year, chronic food insecurity affects approximately 10% of the population, which leads to reliance on support systems providing food aid or cash for work (Figure 3.2).

Owing to this history of drought and famine, Ethiopia is considered highly vulnerable to future population growth and climate change, although the nature of climate change, particularly for rainfall, remains uncertain. However, the water 'crisis' in Ethiopia is less about changes in climate, and more about underlying vulnerability, and an inability of the population to cope with even existing levels of climate variability.

supplies can no longer be ignored. Concerns have been raised regarding an expected population rise of approximately 15% in the UK between 2010 and 2050, yet Africa's population is set to double in the same period according to median projections by the United Nations[9]. The implications of such a dramatic population increase in Africa in the context of food insecurity, highly variable climates and weak economies and governance are likely to be severe (Box 3.1, previous page, outlines the situation in Ethiopia).

Further complications are caused by the fact that this population increase will not be evenly distributed geographically and population growth will be concentrated in urban areas. For example, the percentage of Africa's population residing in urban areas is set to rise from the current level of 40%, to greater than 50% by 2030[9], including the growth of small towns as well as larger cities. Moreover, for many countries in Africa, urban population growth rates will actually be about double the national average. In these countries the incidence of poverty will also increase rapidly as infrastructure and opportunities in urban areas fail to keep up with population growth.

In China, urbanisation is affecting both levels and patterns of water use (Box 3.2, p30). In contrast to Ethiopia, water resources in China are already heavily committed and, in areas such as the North China Plain, patterns of use are unsustainable. Industrialisation in China is also a major driver and is having significant impacts on water quality as well as demand, and rising incomes are leading to more water intensive meat production and consumption.

Despite rapid urbanisation, 80% of those without access to safe water or an improved supply in Africa are still located in rural areas, although the distinction between what can be defined as urban and rural is becoming less clear over time. Approximately 80% of these individuals depend on groundwater to meet their household domestic and productive needs. Groundwater has many advantages: it is generally of good quality, it can be developed over wide areas to meet dispersed demands, and development is relatively cheap in most areas. Despite its importance, however, groundwater resources remain poorly understood in many countries, with minimal monitoring and assessment, and most climate change studies focus on surface flows, not groundwater recharge and storage. However, dependence on groundwater across Africa is set to increase to meet the needs of growing populations. A key issue is whether there will be sufficient water in the future to meet the needs of both domestic supply and irrigation[10].

CLIMATE VARIABILITY

In many parts of the tropics and sub-tropics, but particularly Africa, the climate, and more specifically the variability of rainfall, poses a significant challenge to livelihoods and water

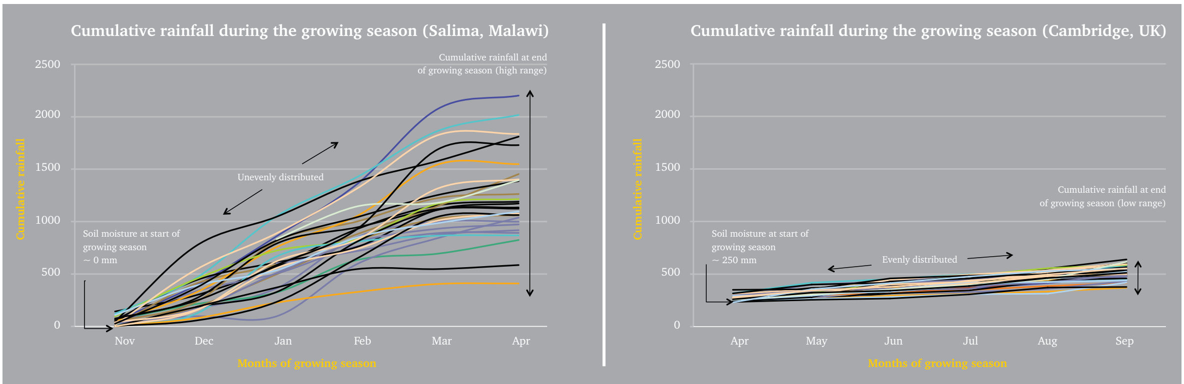


Figure 3.3 Cumulative rainfall, November to April 1977-2005, for Salima, central Malawi (left). Cumulative rainfall, April to September 1961-2008, for Cambridge, UK (right). In each case, the starting point for the graphs is the assumed soil water storage prior to the growing season rains. (Credit: Richard Carter).

resource management. For example, in Salima, central Malawi, although mean annual rainfall is considerable at around 1,250mm, annual rainfall data over a 29 year period (1977-2005) show values varying from a minimum of 450mm in 1995 to a maximum of 2,050mm in 1978. Variations in monthly rainfall can be even greater still. For example, in November (the planting season) the monthly rainfall can vary from 100% below to 100% above the long-term mean. Further complications are caused in Malawi because the overwhelming majority of annual rainfall occurs during the crop growing season (November to April). Due to the lack of rain outside this period, soil moisture is negligible by the beginning of November and crops depend entirely on seasonal rainfall to meet their water requirements. Large variations in rainfall therefore pose a major threat to rain-fed agricultural livelihoods in Malawi and many other sub-Saharan countries[1]. In contrast, in more temperate climates, rainfall is not only more evenly distributed throughout the growing season (April to September in the northern hemisphere summer), but also throughout the year, as shown in Figure 3.3.

LAND DEGRADATION

The crisis occurring in many rural environments stems from the increased need for food production as a result of population growth, which in most of sub-Saharan Africa, is achieved by expanding the area under cultivation rather than by intensifying existing cropping areas[11] (see Figure 3.5, p31). In a bid to meet growing food demands, fallow periods on farmland are also reduced and nutrient mining occurs as nutrients are taken from the soil at a much higher rate than they are returned through the addition of organic or inorganic fertiliser. New land is cleared of vegetation for the creation of additional cropland but yields continue to fall as increasingly unsuitable areas are used for production.

Factors relating to land use, and the change in that use due to population growth, alter the water balance in

CHAPTER 03

Why water resource management is important

Box 3.2

The effect of urbanisation on water use in China

In China, the diversion of water to agriculture has enabled food production to keep pace with population growth. In a rapidly urbanising and industrialising economy, however, competition for water is intensifying, leaving the Government with the challenge of mediating between the claims of different uses. Agriculture lies at the heart of allocation tensions as irrigation is the principal user of water (roughly 70%). The impact of growing water demand on river flow is seen most dramatically in northern China where flows in the Yellow River have declined over the last 40 years. In the late 1990s, the river stopped flowing into the Bohai Sea for a short period[12].

The management challenge is essentially about who gets what: farms versus cities, upstream versus downstream users, and human versus environmental needs. These are major political issues. Managing the growing competition for water puts agriculture in the spotlight because agriculture is the major water user. But agriculture's claim to water is based on social and poverty grounds, as well as concerns about food security.

Getting 'more crop per drop' and capping irrigation rights are essential if water is to be released for other users. China has made remarkable progress in introducing a modern system of water rights that is able to allocate defined shares in a reasonably transparent way to end users. Managing groundwater in this way is much more difficult, not least because of the numbers of people involved. Nonetheless, China's pragmatic and 'learning by doing' approach to water management, and economic trends that are reducing the importance of agriculture as a source of rural income, create a platform for sustainable management.

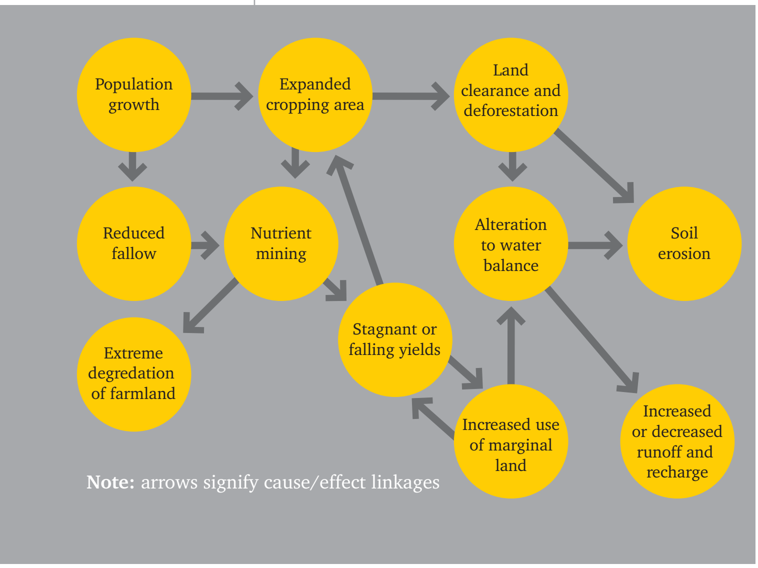
Figure 3.4 *Groundwater-based cash cropping, Bashang Plateau, northern Hebei, China (Credit: Roger Calow, ODI).*

a region (Box 3.3, p33). Although this may not necessarily have a detrimental impact, in many regions of Africa such changes have had severe consequences for soil and land quality. According to the International Centre for Soil Fertility and Agricultural Development, Alabama:

'…three quarters of Africa's farmland is plagued by severe soil degradation caused by wind and soil erosion and the loss of vital mineral nutrients… [As a consequence] agricultural productivity in Africa has remained largely stagnant for 40 years, while Asia's productivity has increased threefold[13].'

In fact, yields of maize and other cereals have increased in the vast majority of areas across the world while cereal yields in sub-Saharan Africa have actually decreased[14].

Figure 3.5 *Cause/effect diagram for environmental crisis in Africa. (Credit: Richard Carter).*



CLIMATE CHANGE

Projections of annual runoff from the Inter-governmental Panel on Climate Change (IPCC) indicate large scale changes in runoff for 2090-2099 compared with a baseline period of 1980-1999[15]. However, agreement on these changes is greater in some areas than others. The white areas in Figure 3.6 (overleaf) indicate regions where the projections made by different global climate models do not agree on the direction of changes and huge uncertainty remains about future runoff levels.

One area where projections of both rainfall and runoff from different models differ significantly is Africa[16] – widely viewed as the continent most vulnerable to climate change. Most projections suggest that rainfall and runoff will decrease in the northern Sahara and southern Africa, but across large areas of the continental interior even the direction of change is uncertain. Nonetheless, most models suggest that rainfall will become increasingly variable in both intensity and duration.

At times, statements regarding the influence of climate change on water resources are too simplistic, especially in situations where rainfall is expected to decrease. It is sometimes assumed that a decrease in rainfall will automatically result in a reduction in water resources but, although this may appear intuitively correct, the reality may be different (Box 3.3). Many challenges are associated with modelling potential future changes to water resources as a result of climate change. These include down-scaling general circulation models of projected future climate change to predict changes at regional and local levels along with the large assumptions regarding future changes to land use, land cover, land management and soil properties that drive such models. Modelling the impact of climate change on green and blue water leads to the propagation or compounding of all these uncertainties[17]. Moreover, distinguishing between the impacts of climate change and those from other drivers affecting the supply of water, demand for water, or both, is extremely difficult.

SUSTAINABILITY OF WATER SUPPLY INFRASTRUCTURE

It is important to acknowledge that water levels and yields from a water supply well or borehole can appear to fall for many different reasons. Design and construction quality issues with the well or borehole can result in low, declining or failing yields. Borehole silting can reduce yields. Pump rising main sections can corrode and leak, reducing yields, especially during dry seasons when deeper groundwater must be accessed. Wells that are not constructed to sufficient depth to accommodate seasonal fluctuations in groundwater levels or with sufficient storage to accommodate demand will suffer reduced yields. High demand at a water source can lead to localised draw down in low permeability soils/aquifers, resulting in a reduction in yields at the source. This does not necessarily mean that the water resource has been depleted.

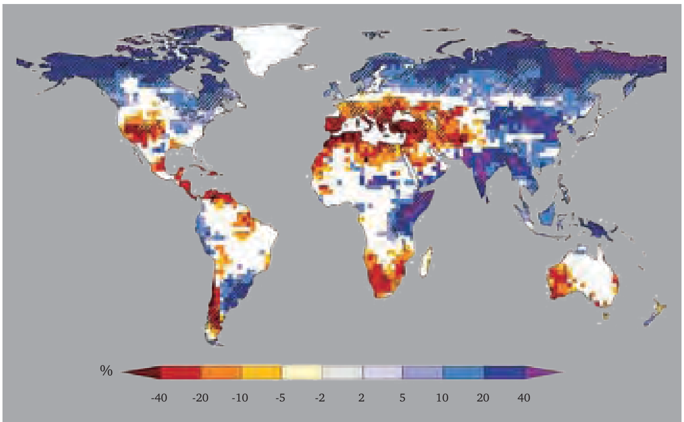


Figure 3.6
IPCC projections of annual runoff for 2090-2099 (Credit: IPCC)[15].

Broader environmental and demographic pressures can, on the other hand, result in depletion of the wider resource. The extension of water supply coverage, for example, may inadvertently lead to localised groundwater depletion if multiple agencies, operating in the same locality, are installing modern pumping devices that abstract far greater volumes of water than traditional human or animal-powered water-lifting devices. However, the collective impacts of demand increases from numerous water sources drawing from a particular water resource are rarely assessed.

Manually operated community handpumps are associated with low abstraction rates (around 0.2 litres/sec).

‘The interaction of rainfall, temperature, evapotranspiration, land use and geology make predicting changes to both surface water and groundwater resources extremely difficult.’

Box 3.3

Non-intuitive water balance results in the West African Sahel

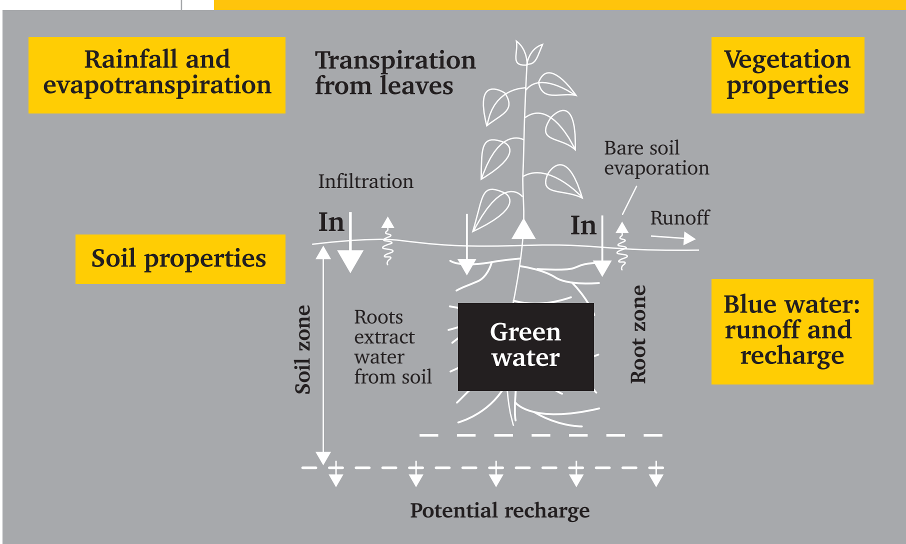
The water balance of vegetation and crops on the soil is a function of three broad factors:

1. Weather-related factors (particularly rainfall and evapotranspiration).
2. Properties of the soil (including its infiltration capacity and water-holding capacity).
3. Properties of the vegetation (including seasonality and cover).

Together these three factors determine what proportion of water enters the soil and is available for rain-fed agriculture (referred to as ‘green water’) and what proportion either runs off the soil or drains deep into the aquifers to form groundwater recharge (part of what is referred to as ‘blue water’)[19]. This is shown in Figure 3.7. The result of this green water-blue water relationship is that in some circumstances an increase in (blue) water availability may occur despite a decrease in rainfall, as experienced in the West African Sahel.

The Sahel region of West Africa is the region that has experienced the largest climatic shift globally within the duration of written records, with a trend of steadily declining rainfall since the 1960s. However, in significant areas, stream flows have increased and the water table in the region has been rising. At the same time, the population in this region of Africa has been increasing and land use has been changing, with areas of natural vegetation being replaced with arable cultivation. The explanation for this phenomenon is that the changes in land use have altered the local water balance profoundly, more than compensating for decreases in rainfall.

Figure 3.7
Factors affecting water balance in vegetation and crops[18].



Aquifer type	Deep sandstone basins	Volcanic rocks	Alluvial	Basement Complex
Groundwater potential	Moderate – high	Moderate	Moderate – high	Low
Typical borehole yield (l/s)	1-10	0.5-5	1-20	0.1-1
Typical water table depth (m)	30-110	?	2-10	15-55
Typical borehole depth (m)	200-350	50	10-40	30-75
Relative aquifer storage capacity	Very high	Moderate	Moderate – high	Low
Relative vulnerability to depletion	Very low	High	Low – moderate	High

Table 3.1
Example of aquifer properties and vulnerability to depletion[20].

Even when operated to full capacity they do not exert significant demands on groundwater resources over wide areas. It is the case however, that localised depletion may arise if they are drawing from very limited pockets of groundwater. Where more intensive mechanised abstraction is practised (more than 1 litre/sec) there is a higher risk of wider impacts on the resource. Inevitably, community water-use priorities extend beyond water for drinking and health to livelihood activities that consume far greater volumes of the resource. It is important that these wider needs, priorities and associated risks form a core component of WASH agency planning.

Table 3.1 highlights the relative vulnerability to depletion of different groundwater aquifer types across sub-Saharan Africa. It is notable that basement complex aquifers are low yielding and have high vulnerability to depletion, particularly where there is low inter-connectivity between fissures and limited groundwater movement.

It is important that the factors at play at a water source are well understood so that appropriate remedial action may be taken should problems arise. This requires a distinction to be made between design and construction issues at the water source and broader environmental issues impacting on the resource. Community-Based Water Resource Management (CBWRM) provides some of the vital tools required to help diagnose the root causes of water source and resource failure.

> 'Many drivers influence future water stress and other factors may have a greater influence [than climate change] in most regions and over most time horizons[21].'

SUMMARY

Climate change is one of many pressures on water resources, and we need to be wary of holding it responsible for other problems, including poor management. Drivers of change affecting the supply of water, the demand for water, or both, vary by location but include population growth, urbanisation, land use change, pollution, changes in income and diet, and the condition of water supply infrastructure.

Current water resource debates tend to over-emphasise issues of water availability as if water scarcity was physically determined. In Malawi, as in many parts of the tropics and sub-tropics, the variability of rainfall (as opposed to the average quantity) poses a significant challenge to livelihoods and water resource management. In Ethiopia, and throughout much of sub-Saharan Africa, the scarcity felt by millions of households is attributable to difficulties in extending and maintaining access to safe water, not to water availability. Extending reliable and affordable access therefore remains key to strengthening livelihoods and reducing poverty. If the capacity of sub-Saharan communities to maintain access to water in variable climates can be raised, then the resilience of communities to longer-term climate change will increase[22]. In China and other fast-growing economies, the rapid development of water resources – both ground and surface water – has underpinned growth and poverty alleviation. In China, the challenge is not about developing new supplies, but rather managing demand. Reducing the amount of water consumed by agriculture and getting 'more crop per drop' lies at the heart of this challenge.

CHAPTER.04

Integrated Water Resource Management in practice – experiences from Sierra Leone and Ghana

Overview: Experiences from Sierra Leone and Ghana demonstrate the contextual challenges for implementing successful water resource management strategies in low-income countries.

CHAPTER 04

Integrated Water Resource Management in practice – experiences from Sierra Leone and Ghana

Implementing Integrated Water Resource Management (IWRM) can seem overwhelming for many national and local governments given multiple issues to be addressed and the scale of coordination required. Even if water resource management policies and roadmaps are developed, much continuous effort is required to implement and sustain effective water resource management at a national and international scale. This section describes examples from Sierra Leone and Ghana, where state run water utilities continue to implement national water resource management plans.

It is important to clarify what we mean by sound water resource management. Water resource management is about monitoring and managing available water resources and land on a continuous basis. Monitoring should inform management practices and should enable regulating authorities to assess the availability of water resources. This process can inform decision-makers, at various levels, how best water resources can be allocated so they are shared appropriately among multiple user groups. Once water allocation principles are agreed upon, seasonal and daily water usage needs to be governed by rules, byelaws and at a local level operating principles among water user groups. Arrangements for the management of water resources then need to be divided between institutions, which must include community level representation. Finally, all development organisations which continue to strive to extend water supply coverage must assist in monitoring and safeguarding water resources. This is important so that water supply services can be sustained and organisations contribute to a larger process of water resource management.

SIERRA LEONE

Sierra Leone is endowed with large water resource potential. Irrespective of this significant potential, the country's water resources have contributed relatively little to socio-economic development. Conflict has played a major part and destroyed many of the systems and structures established for managing water resources. However, in January 2011, Sierra Leone launched an ambitious National Water and Sanitation Policy aimed at extending sustainable WASH coverage across the nation. Water resource management is a key component of this policy initiative. Significantly the Government of Sierra Leone has also reflected on why transferring policy into practice remains such a challenge. The Ministry of Energy and Water Resources identified the following issues during a series of policy launch workshops:

- Policy has been weak and documents have been over generalised.
- Water issues have not been prioritised in national action plans.
- There has been uncertainty over who is doing what.

- The responsibilities of institutions have required greater clarification.
- Rules and regulations have conflicted across multiple ministries, departments and agencies.
- Rules, regulations and procedures have been inadequate.
- Institutional leadership and representation has been weak.
- There has been an absence of basic tools to enable institutions to function.
- There has been no relationship between operational capacity and policy.

The achievement of sound water resource management in Sierra Leone must take place at both central and local levels. At national level, roles and responsibilities between multiple ministries and departments need to be clarified and a national Water Law, dating back to 1963, needs to be updated to reflect current thinking on water resource management. A priority for Sierra Leone is to re-establish monitoring systems so that water allocation and water resource management can be undertaken more effectively. With sound monitoring in place, and revised water laws, national programmes can be designed to address issues of water allocation and local level management. The national decentralisation policy in Sierra Leone has produced mixed results and in many places local governments operate with limited capacity (in the sense of human, technical and financial resources). Recognising the ability of water users to be active participants therefore becomes vitally important in ensuring WASH services and water resources can be managed effectively on a day to day basis. Community-based institutions can fulfil an important role in support of weakened government structures. Furthermore, engagement in water resource management by WASH organisations also provides an area of support for central government agencies that may be simultaneously addressing multiple development challenges.

The IWRM process requires active political support as well as effective and active governmental support from the outset. Unless these issues are effectively addressed, IWRM plans – where they exist – may remain theoretical, as has been the case in Sierra Leone. In many cases, piloting IWRM in smaller sub-catchments is often a much more manageable approach than promoting widespread radical changes at a national and international scale. This approach resonates with initiatives undertaken in Ghana.

There are reasons for hope. Sierra Leone has the opportunity to integrate policy, law and practice. It is drafting a national Water Resources Act and has strong intentions to establish water security plans and community-based approaches for water resource management. It also has the opportunity to avoid the challenges and mistakes of other countries by ensuring water resource management is a process that is owned nationally and applies local contextual knowledge, rather than adopting generic blueprints. Lessons learnt and documented in Sierra Leone will be extremely valuable for other countries hoping to embark on a similar process.

GHANA

Ghana is a leading example of good governance and effective water resource management for many countries in West Africa.

The White Volta river is shared between Burkina Faso and Ghana. One of the major water related challenges faced by Ghana has been the inadvertent creation of a north-south divide: large volumes of water are needed to generate hydro-electricity and support a growing population in the south of the country, while in the arid north farmers need water for expanding agricultural production. The management of transboundary water resources with Burkina Faso has, in the past, led to insufficient river flows for farmers during periods of drought, yet during periods of high rainfall, excessive water discharges from Burkina Faso have inadvertently displaced farmers. To address these challenges, Ghana has adopted the broad principles of IWRM and has put in place an effective water policy, legislation and development programme for implementing IWRM. The governments of Ghana and Burkina Faso have also been active in establishing a River Basin Authority in an effort to solve these problems.

However, these complex issues are not easily resolved. Farming communities in northern Ghana continue to be affected by flooding on an annual basis and uncertainty over transboundary water resource management remains. Few are more conscious of the risks of flooding than the farmers themselves who continue to be affected by discharges from the Bagre dam. The creation of the Volta Basin Authority has been an important milestone. The success of the Volta Basin Authority has been increased dialogue and collaboration between Ghana and Burkina Faso. However, having institutions alone will have a limited impact unless action planning is undertaken with water users. There is always the risk that top down initiatives result in a lack of engagement from grassroots stakeholders. Integration should begin at village level with the aim of scaling-up to national and transboundary levels. NGOs can play an important role in this process assisting communities to establish disaster risk reduction plans and collaborating with local authorities to try to safeguard access to water. The Ghana Water Resources Commission is the most advanced actor in the Volta Basin management structure. However, in response to current challenges an Upper Volta Basin Management Agency has been called for by parliamentarians in Ghana to develop local action plans in response to perennial flooding. The need for improved local solutions remains ever present.

Figure 4.1
Map of Ghana[23].

In a bid to help put sound water resource management into operation, the Ghanaian Water Resources Commission has undertaken extensive work to decentralise national IWRM plans, moving from state level to regional, district and local level water resource management. This has been supported by substantial political will and good governance. Having established basic management structures at various levels, responsible institutions such as the Water Resources Commission and River Basin Authorities have made impressive progress in contextualising water management issues, establishing forums for facilitating a participatory process and involving consultative committees with widespread participation by community-based institutions.

The creation of these local consultative committees has not only increased communities' access to decision-makers, but also provided a platform for WASH organisations to engage with them. This has allowed communities to become active participants in negotiating seasonal water allocation and enabled byelaws and operating principles to be established for daily water management. The creation of consultative committees identifies specific issues to address and makes interaction possible between upstream and downstream water users. The Basin Boards allow for collaboration between multiple water users at the basin level and comprise representatives from research institutions, NGOs and civil society organisations, traditional authorities and Water User Associations. The Water User Associations include a wide range of different community members, including Chiefs and landowners, farmers and herdsmen, women's groups and youth; this ensures that water users from all social groups of a community are involved in decisions around water resource management. Significantly, river basins have also been broken down into sub-catchments, allowing the identification of specific contextual challenges. For example, major issues identified and addressed in some sub-catchments include water quality, water availability and the allocation of water resources between upstream and downstream water users. To date, IWRM plans have been prepared for three river basins within Ghana, ecosystems are being restored and river banks protected, while water use is now regulated and drilling licenses are issued for drilling contractors.

Interviews conducted by Oxfam in 2009, with representatives from the Water Resources Commission, confirm that broad IWRM principles need to be adapted to local conditions, ensuring widespread participation from community-based institutions and households. Although IWRM is a continuous process, the following lessons can be concluded from Ghana's experiences to date:

- Political commitment is required so that national and local governments and state institutions own the process of implementing IWRM.
- Substantial awareness-raising of the IWRM process is required so that multiple stakeholders (individuals, implementing agencies, institutions, state owned water utilities and government) understand the role they can play.
- There is no blueprint for water resource management and specific contextual issues need to be identified at sub-catchment level.
- Consultative committees need to be established that allow community and household participation in managing water resources.
- Pilot projects need to be undertaken and scaled-up; otherwise the reform process can appear overwhelming.

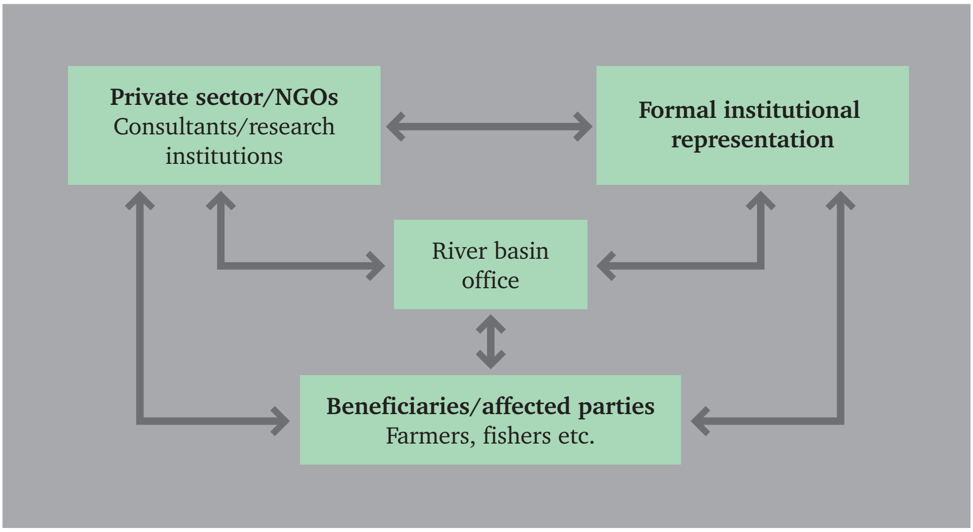


Figure 4.2 *Institutional framework at the river basin level in Ghana*[24].

CHAPTER.05

Traditional water resource management in practice

Overview: Examples from Peru, Spain and the Sahelian zone of Africa demonstrate the importance of recognising and respecting traditional water management techniques that continue to survive, but highlight that these now need to be strengthened to cope with increasing variability.

CHAPTER.05

Traditional water resource management in practice

The global and regional climate is not static and significant changes in rainfall and temperature have occurred over time[25] (Figure 5.1). Communities across the world have survived by adapting to these climatic variations using resilience-based and risk-spreading strategies that are often rooted in traditional practices. The degree of success experienced differs greatly, but the continued use of these community-based climate adaptation strategies highlights the need to recognise and support traditional approaches that may be used for water resource management.

Figure 5.1
Pillar of lake sediment in the hyper-arid central Sahara (south west Libya), indicating very different climatic conditions in these regions in the past (Credit: Nick Brooks).

CLIMATE CHANGE, ADAPTATION AND TRADITIONAL RESOURCE MANAGEMENT

One of the main characteristics of Community-Based Adaptation is to build on existing practice and combine further understanding of the potential consequences of climate change for communities with the most suitable community responses. The key issue to highlight is that many people are already coping with climate risk and variability at the community level.

'Community-Based Adaptation starts from [the] local context and engages with the capacities, knowledge and practices of coping that are present in the community. Community-Based Adaptation aims to enable communities to understand and integrate the concept of climate risk into their livelihood activities in order to cope with and respond to immediate climate variability and long-term climate change[15]'.

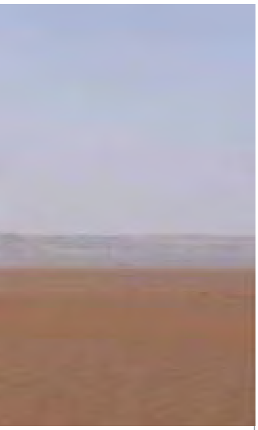
There are a number of important reasons why Community-Based Adaptation enables communities to successfully cope with the effects of climate change:

- Climate change impacts will be evident first in people's livelihoods at the local level. This provides a foundation on which to build community adaptation practices.

- Local people are better placed than outside experts to provide an understanding of the factors that make them vulnerable to the impacts of climate change. External experts may inadvertently undermine indigenous knowledge, rendering communities recipients of 'gift aid'.

- Communities often have a deep understanding of the environments in which they live and of any emerging environment-related risks;

‘Traditional livelihoods provide the foundation of Community-Based Adaptation.’



they will be able to highlight trends and patterns that otherwise may not be identified as climate change becomes evident at the local level.

- Traditional livelihoods, which provide the foundation for Community-Based Adaptation, are often built on risk-spreading practices that have emerged over a long period of time and evolved within the context of variable environments in order to deal with climatic and environmental variation and uncertainty. Furthermore, it is the most successful strategies that have been retained and continue to be used.

Although the points outlined above relate to Community-Based Adaptation and climate change, the same reasons also apply to why Community-Based Water Resource Management (CBWRM) is best placed to enable communities to cope with the effects of water stress and scarcity.

DEVELOPMENT AND MALADAPTATION

Although many blame continual and severe food insecurity and conflict in regions such as the Sahel on drought, desertification and climate change, the continued implementation of inappropriate development policies that undermine traditional coping strategies is equally responsible[26]. In some parts of the world, low impact, resilience-based strategies founded on traditional approaches may provide the only feasible approach to coping with water scarcity and water stress which may be intensified by climate change.

The consequence that undermining such community resilience can have on livelihoods and the environment is demonstrated by the events that have taken place since the 1950s and 60s in the Sahel, where entire regions are now more vulnerable to climatic variability and change, increasing the risk of climate-related disasters (Box 5.1, overleaf, and Chapter 3).

Research by Chris Reij at the International Institute for the Environment and Development indicates that many soil and water conservation methods, introduced in the developing world over the past few decades aimed at helping to reduce soil erosion and increase water availability for crops, have failed because they have ignored existing traditional systems and techniques, focusing instead on ‘modern’ methods that involve technology transfer and a reliance on machinery.

Reij suggests that indigenous methods, rather than high-tech interventions may provide the most effective foundation for future land and water management strategies, and that development should place more emphasis on building on existing skills and knowledge[27]. Examples of such indigenous practices include water harvesting systems in Somalia, water conservation techniques by the Dogon in Mali and traditional irrigation systems in Algeria, Tunisia and Morocco. In the Sahel, the recent introduction of planting pits, traditionally used in Peru, has yielded immediate benefits to subsistence farmers[28].

Box 5.1
Development pressures continue in the modern Sahel

Pastoralism is an ancient tradition and is crucial to the risk-spreading nature of livelihoods for many people in the Sahelian zone (the modern transitional zone between the arid Sahara and humid equatorial Africa)[29]. Yet, in the 1950s and 60s, the colonial administrations, who were seeking to prepare the Sahelian nations for independence, implemented a process of modernisation. This was based primarily on the commercialisation of agriculture, increasing productivity to generate economic growth. A process of agricultural intensification occurred, but crop production also expanded into historically marginal areas in the northern regions traditionally used by pastoralists, which were viewed by colonial administrators as idle land.

Rainfall was particularly high during the period 1950-70, in comparison with the rest of the 20th century (Figure 5.2), and these areas initially produced high crop yields. However, rainfall in the region declined dramatically in the early 1970s and cultivation became unsustainable. During this period the whole system collapsed as pastoralists, who had been pushed into more marginal areas by agricultural expansion, also lost their livelihoods[30].

Despite the negative impacts of the development policies implemented in the 1950s and 60s in the Sahel, little progress has been made in making development more resilient to projected large-scale climatic and environmental variability and change. Current development policies continue to pay inadequate attention to the validity of traditional livelihoods, values and practices, which often are still regarded as somehow primitive or 'backward' and in need of modernisation.

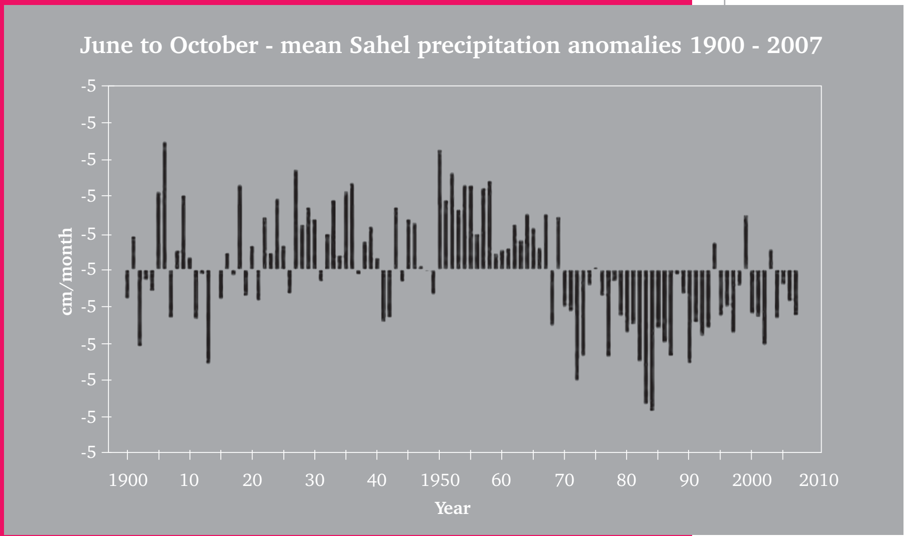


Figure 5.2
Time-series of summer rainfall anomalies (standard deviations from the long-term mean) for the Sahel region, 1900-2010[31].

‘The main challenge is a social and moral one, rather than technological.’

ADAPTING COLLECTIVELY TO WATER SCARCITY: ENCOUNTERS WITH THE MORAL ECONOMY OF WATER

The main challenge to managing communal water resources is a social and moral one, rather than technological: designing institutions or rules for sharing water when there is far less than enough to go around. Community-managed systems continue to be identified in various parts of the world and it is clear that many systems successfully cope with water stress and scarcity. However, despite their obvious differences, many systems share the same characteristics. The success of these systems is down to their robustness, which means they have the capacity to maintain key system characteristics despite major fluctuations in the environment, caused by factors such as drought.

Research on both simple communal irrigation schemes involving one community, such as in Huaynacostas, Peru (Box 5.2, p51) and more complex multi-community irrigation schemes, such as in Valencia, Spain (Box 5.3, p52) has led to the identification of a list of principles that characterise a kind of system that can be referred to as the ‘moral economy of water[32]’. In such systems, these principles are followed throughout the long dry season and even droughts, although certain changes are made to allow the systems to cope; they create a strong incentive among people to cooperate, obey the rules, and use water wisely.

It is clear that the two systems presented in this chapter evolved separately: the Valencian system is more than 1,000 years old and of Islamic origin, while the Peruvian system reportedly dates back to the Incas. In fact, the same solution to the problem of adapting collectively to water scarcity has emerged, perhaps independently, in various locations across the two countries and systems of vastly different scales and levels of complexity have been identified[33]. Many other examples of the moral economy of water exist in other parts of the world, although their degree of success varies.

THE PRINCIPLES OF THE MORAL ECONOMY OF WATER

Although the principles characterising the moral economy of water outlined below relate to successful community irrigation systems, they can be equally transferred to many other forms of community water resource management systems. The seven key principles are:

- **Autonomy.** This leaves local water users free to continue doing things in their own way, regardless of governmental laws and policies.
- **Contiguity** (irrigated areas are located immediately next to each other). In a successful system, the landscape consists of named sectors of land that are irrigated in a fixed sequence that never varies.
- **Uniformity.** First, uniformity among water rights: every plot of

land receives water with the same frequency. Second, uniformity of technique: everyone irrigates in the same way for all crops.

- **Proportionality.** Proportionality among household water rights and duties. An upper limit is imposed on irrigation time and on the amount of water used by farmers during their turns, which is relative to the amount of land owned. Contributions made by farmers to specific duties, such as system maintenance, are also relative to the size of their land.

- **Transparency**. Each member of the system knows where the water ought to be at any point in time and can confirm whether system rules are being obeyed. Farmers can easily detect and report any theft of water or favouritism that might take place, so they are able to protect and preserve their own rights.

- **Boundary maintenance.** Any expansion of the irrigation system is forbidden, unless agreed by the community members in advance, as this would increase the length of the distribution cycle and reduce the frequency of irrigation for everyone.

- **Graduated sanctions.** The penalties for breaking the system rules are quite severe, but depend on the seriousness of the offence.

The principles listed above create equity or fairness among household water rights that is clearly understood by all members of the community and effectively manages the demand for water. The effect of water scarcity is shared equally by everyone – which can be considered an act for the common good and making the best of a situation that is far from ideal. In community-managed systems, irrigation is about ensuring the effect of a scarce water supply is equitably shared among landowning households – it is not about giving optimal amounts of water to crops, as agronomists and engineers often assume. This principle of sharing scarcity can be applied to any water use sector within a community.

The principles also create a strong sense of security of 'individual' rights, which are clearly defined in terms of frequency and amount of water flow received. Just as importantly, due to the transparency of the system, those rights are easily protected by the water users themselves and so conflict is minimised.

COMMUNITY-BASED ADAPTATION AND MANAGEMENT – DEGREES OF UNCERTAINTY

Despite the potential gains to be made by the adoption of community-based approaches, their limits must be acknowledged. Environmental fluctuations can make the seven principles of the moral economy of water (outlined above) difficult to maintain and such fluctuations are likely to increase dramatically in many regions as climate change continues, whether it is seasonal low water shortages on an annual basis, or periodic drought

‘Community-managed systems ensure the effect of a scarce water supply is equitably shared among households.’

Box 5.2

Community irrigation in Huaynacostas, Peru – ‘comedy’ of the commons

Huaynacostas (a community located in the arid western Andes) has the simplest irrigation system imaginable. The system is small-scale (about 320 hectares) and land and water resources are controlled by a single user group of approximately 1,100 people. It is a smallholder subsistence system and farmers grow the typical Andean array of maize, beans, potatoes and other native crops. The community has a class system, but the differences between each group are relatively small; approximately 40% of the households have less than one hectare of land, 40% have between one and two hectares, and the ‘wealthy’ 20% of families have as much as two or three hectares.

The community has two sources of water: two alpine springs located at about 4,300 metres elevation, which have small flows that fluctuate, and annual water scarcity is severe. Even though the national Government theoretically owns and has jurisdiction over all of Peru’s water, the state is weak and poor, and the village is so remote that the community has control over its water sources.

In Huaynacostas, water is used according to a series of customary rules and procedures that follow the principles outlined in the main text. The farmers irrigate in rotation, starting at one end of the farmland and moving systematically upward: field by field and canal by canal (see Figure 5.4, p53). Water is distributed to fields, or household parcels, in the same order each time an irrigation cycle takes place.

Every plot of land receives water with the same frequency, so water scarcity is shared equally among all landowners. Water is pooled in earthen structures, called ‘atus’, and uniformity of technique means that everyone irrigates in the same way for all crops. The pooling technique imposes an upper limit on irrigation time and amount of water consumed by farmers during their turns. This creates a uniform ‘land to water’ ratio for everyone. Farmers’ contributions to the annual cleaning of the canals must also be proportional to the amount of irrigated land that they own. By obeying the rules and showing self-restraint, farmers in Huaynacostas maximise the frequency of irrigation for themselves and everyone else; there is a close correspondence between individual self-interest and the common good, and following the rules is seen by most people as the only rational way to behave.

Box 5.3

The Water Tribunal in Valencia, Spain

Early published descriptions of Valencia's community irrigation system all agree that the traditional system rules impose a basic proportionality, among both rights and duties[34]. This is one of the most famous farmer-managed irrigation systems in the world and is governed by the Water Tribunal of Valencia, a public water court that has met every week for the past 700 years and is one of the oldest democratic legal institutions in the world (Figure 5.3).

Figure 5.3
A meeting of the Water Tribunal in the huerta of Valencia, Spain (Credit: Paul Trawick, Cranfield).

Valencia's irrigation system is a multi-community system that has developed over the past 100 years. It is operated by ten separate user groups that irrigate approximately 9,100 hectares of land, coordinating the activity of more than 20,000 farmers. The vast majority of farmers have one hectare or less of land, and very few have more than three hectares. Farming here is heavily commercialised, orientated towards supplying the local market with food and even towards exports.

The system draws on two sources of water: the Turia river (the main and traditional source) and groundwater (used as a supplement to the main water supply).
The frequency of irrigation and irrigation techniques are the same for all water users. This creates an upper limit on the amount of water that farmers can use in their individual turns. Farmer duties are also directly proportional to the amount of land owned and farmers pay a fee for water use that is then used to finance the annual cleaning of the canals.

The system works extremely well and the frequency of water theft, according to the records of the Water Tribunal, has remained virtually zero, even during periods of the most acute shortages of water. These principles are the key to coping successfully with the shortage created annually by the dry season in Valencia; they are followed even when an emergency situation is declared and allow farmers to successfully adapt to drought.

Figure 5.4
The irrigation systems in Huaynacostas in the Peruvian Andes, which comprise a system of inter-linked terraces and canals (Credit: Paul Trawick, Cranfield).

emergencies. As a result, in many cases community-based strategies will form only part of a wider effort to adapt to increasing water scarcity and stress, which will involve a mixture of Community-Based Adaptation-type approaches, large infrastructural projects and perhaps the deliberate restructuring of national economies. The Middle East is an area where such a combined approach may be necessary.

In some regions, development strategies should focus on supporting and building on current livelihood approaches that can effectively cope with uncertainty, rather than the adoption of policies that undermine them. Such an approach is appropriate in areas like the Sahel in Africa, due to the high degree of both short and long-term climatic variability, regardless of climate change. In such regions, community-based approaches can provide the main focus of adaptation, with low input, low impact measures complementing traditional approaches to risk-spreading. In the climatic and development context of these regions, large infrastructural interventions are likely to be impractical due to a lack of financial capacity, as well as inappropriate due to the high level of uncertainty regarding how the climate and other influential factors will evolve in the future.

Box 5.4

Communal management of groundwater in the Valencia system

Groundwater has been increasingly used for irrigation in recent decades as improvements in drilling technology have enabled deeper wells to be constructed. Traditional rules have emerged for management and sharing of groundwater in the Valencia system. These are implemented by local well societies – cooperatives in which farmers have pooled their money in order to drill and share the costs of additional water. The use of the wells plays a crucial role in keeping commercial agriculture viable in the huerta (or garden) during droughts, such as the extreme event of 2006-2008.

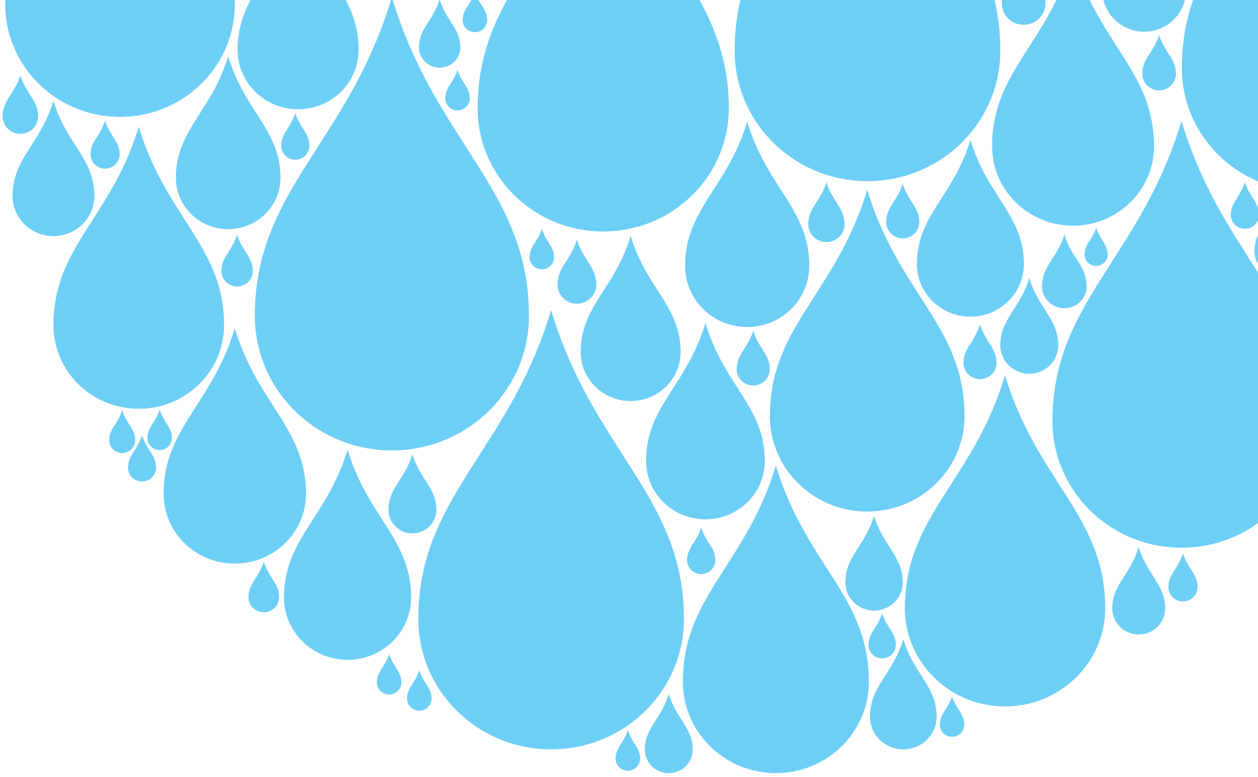
There are approximately 75 of these local well societies in the huerta of Valencia, located within most of the ten water user groups that make up the irrigation system (though not all of them). Farmers are either full members and contributors to a coop, in which case they pay a fee for each allotment of well water, or non-members who pay a higher fee (roughly twice that amount). No one who wishes to purchase well water can be excluded, perhaps because the water can only be distributed through the canal system of the larger user community within which the well society is located.

During the drought of 2006-2008 (one of the worst of the last 50 years) the cycle for use of the river water was extended, by mutual accord, for everyone in the huerta and effectively doubled in length to 15 days, which is not viable for crops with the highest water demand. In these situations, the well water was widely used by farmers to supplement the allocations of river water, providing an additional watering cycle on alternating weeks.

This had the effect of keeping the overall watering frequency for farmers using both kinds of water together at the optimal level of eight days, which is critical for most garden vegetables. Interestingly, field investigations revealed that, in the view of local farmers, this was done in such a way that both equity (uniformity and proportionality) and transparency were maintained.

SUMMARY

The key challenge is to decide where traditional methods can be improved to increase the sustainability of livelihoods, and where large-scale and/or more transformative interventions are required to address threats that community level or livelihoods-based approaches are unable to cope with. However, even in areas where community-based strategies alone may not provide an adequate coping mechanism for water stress and scarcity, community-based approaches will still provide an important contribution to water resource management within a combination of coping mechanisms (comprising strategies and measures such as desalination, water harvesting and water conservation) to ensure that future water demands are fully met.



CHAPTER.06

Experiences from Oxfam and WaterAid field programmes

Overview: Community-Based Water Resource Management (CBWRM) projects facilitated by Oxfam and WaterAid in India, Nepal and Niger demonstrate the role that grassroots practitioners can play in local level water management. Communities have been involved in activities such as water resource allocation, undertaking local level monitoring, implementing rules or operating principles for day to day water usage, and establishing a management system with clearly defined rules and regulations.

CHAPTER.06

Experiences from Oxfam and WaterAid field programmes

Oxfam and WaterAid, like many WASH organisations, have been delivering water supply and sanitation services, directly and indirectly, for many years. As outlined in previous chapters, traditionally NGOs operating in the WASH sector have focused on water supply infrastructure, and inadvertently neglected consideration of monitoring and managing water resources. Yet, there is a great deal that implementing agencies and grassroots practitioners can do to improve local water resource management. This chapter provides some examples of successful water management approaches that may be used as a basis to formulate best practice.

In order to become effective, many development organisations implementing WASH programmes will need to recognise they are themselves facing a steep learning curve that requires field experiences to be documented to enable identification of best practice. Both Oxfam and WaterAid recognise there is no generic blueprint for Community-Based Water Resource Management (CBWRM). However, it is important to recognise enabling factors and operating principles that will directly support the management of water resources locally.

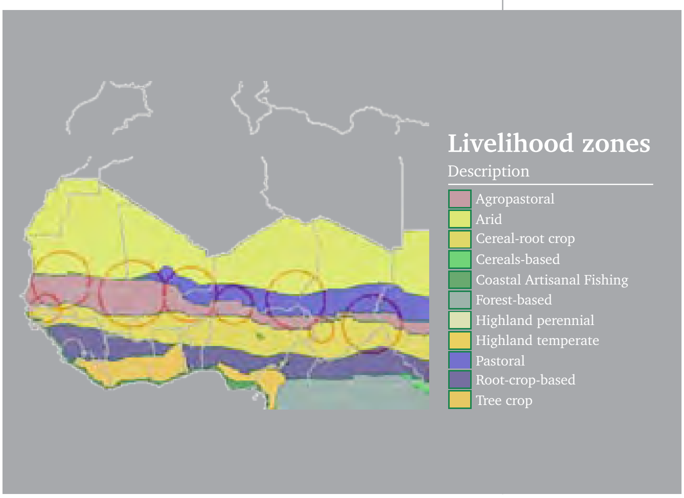
OXFAM'S PROGRAMMES – NIGER

Ongoing conflicts in the agro-pastoral and pastoralist livelihood zones of West Africa (Figure 6.1) are increasingly attributed to water stress as water rights for nomadic pastoralists are often based on a process of negotiated access to point water sources. Oxfam is one of many development agencies helping communities to safeguard their water resources in an attempt to reduce the occurrence of water disputes that are predicted to continue to occur in this region due to the effects of climate change and other demand side pressures (as outlined in Chapter 3).

WATER SECURITY PLANS

In terms of WASH interventions, continuing to assist vulnerable rural communities in these zones, as well as addressing disputes caused by competing water demands, will provide significant challenges for agencies operating in West Africa. New efforts are being made to establish more appropriate approaches for the management of water resources. One approach that has been adopted by Oxfam, and successfully used in

Figure 6.1 Historical water disputes and livelihood zones, West Africa[35].



> ‘We need partnerships for adaptation that empower communities to identify local coping strategies and enable all stakeholders to participate in water resource management[36].’

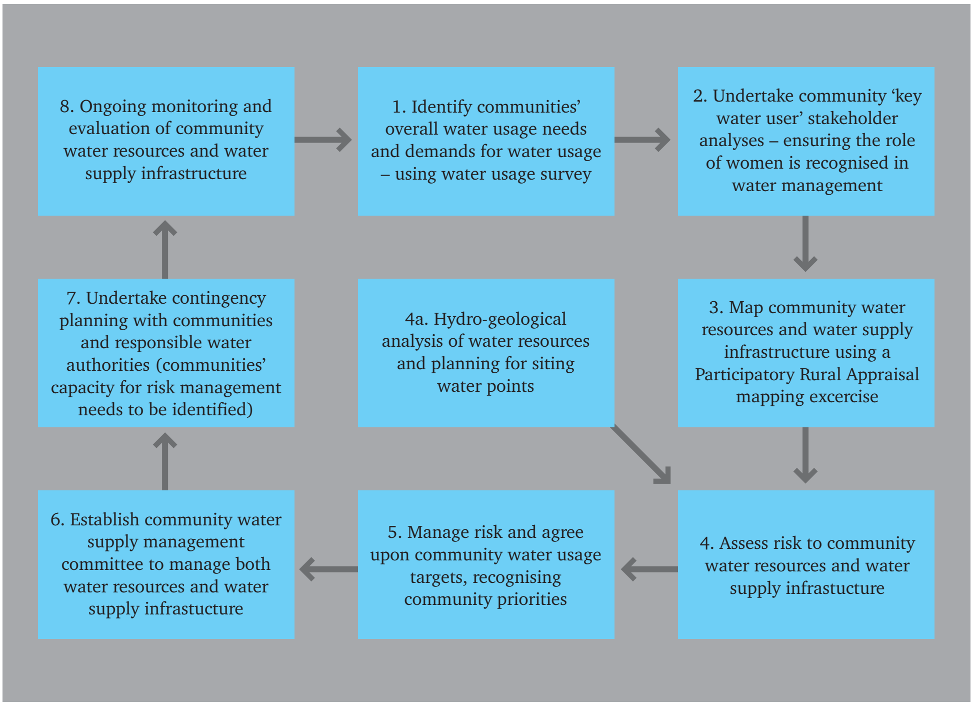


***Figure 6.2** CBWRM framework approach based on Water Safety Plans[37]. (Credit: St John Day, Oxfam GB).*

the West African country of Niger to assist WASH practitioners to engage in CBWRM, is a framework based on Water Safety Plans.

Water Safety Plans provide a pragmatic approach to water resource management and are currently the main water management tool promoted by the World Health Organisation. As a risk-based approach, Water Safety Plans involve the assessment and management of identified risks and hazards affecting water quality right through from catchment to consumer. Water Safety Plans consist of a clearly defined, step by step procedure for water safety that a number of organisations have now adopted and effectively used.

CBWRM FRAMEWORK

Although Water Safety Plans are very practical to implement they do not provide a comprehensive solution to the issue of water security and focus primarily on issues of water quality. However, by combining the principles of IWRM with the practical steps of Water Safety Plans to form a CBWRM framework (Figure 6.2), Oxfam is aiming to help communities gain water security, in terms of both water quality and quantity. The key characteristic that makes this framework successful is its process-orientated approach, which makes water resource management a continuous, cyclical and dynamic process rather than a series of stand-alone or quantitative activities. The eight distinct steps that make up the framework are explained in more detail in Box 6.1.

The backdrop to this work has been recognition of the need to strengthen and support indigenous water resource management practices. Between 2007 and 2008, Oxfam undertook a series of field interviews in Darfur and Niger to ascertain how best they could engage in water resource management. The rural communities interviewed were asked to summarise the main measures they had previously taken to safeguard and manage water resources. Prominent examples of traditional or community-led water management included:

- Communities informally observing and measuring groundwater fluctuations in open wells.
- Communities observing surface water flow in wadis and open watercourses.
- Households attempting to calculate seasonal rainfall volumes in order to pursue more efficient rain-fed agricultural production.

Box 6.1

Steps involved in the CBWRM framework

Step 1: Household and community level water use surveys help community members determine their collective water use. Community members are active participants in these surveys and are responsible for the identification of issues regarding water inequity and proportionality across their village or town. Communities determine which user groups or individuals are accessing and using greater quantities of water than others. This process highlights collective water use as well as issues of equity and proportionality. It encourages more efficient irrigation methods to be adopted and provides a baseline for bargaining over future water allocations.

Steps 2 and 3: Basic Participatory Rural Appraisal skills are used to allow local communities to map locally available water sources and identify boundaries for collective water usage. The Participatory Rural Appraisal process enables development agencies to facilitate rather than implement water resource management within a community and encourages water users to take collective action. For instance, communities in Niger have been able to map not only locally available water resources, but also land depressions that collect water during the rainy season, which are an important part of the communities' risk-spreading technique. A community plants rice in these depressions to provide an additional crop in case rainfall does not facilitate the growing of millet or sorghum.

Continued...

Steps 4, 5 and 6: Communities are assisted to conduct risk assessments and a scenario plan, as well as establish community water supply management committees. Although future climate change projections are uncertain, and the identification or quantification of risk can be extremely complex, CBWRM encourages a process of risk assessment and risk management that is integrally linked to more robust scenario planning.

Step 7: During risk assessments, communities are linked to local authorities responsible for the regulation of water use. This helps to create a mutual respect between local institutions and government authorities, and provides communities with access to and influence on decision-makers. Local water users can establish operating principles for the management of water, identifying which daily tasks can be shared between communities and regulating authorities. Scenario and contingency planning is also introduced and aims to build in more realistic scenarios to assist communities; for instance, what actions local institutions will undertake if a water point fails or drought occurs. This encourages communities (and local water authorities) to have realistic contingency plans in place, which is important for long-term sustainability.

Step 8: Ongoing monitoring and evaluation of water resources and supply infrastructure is conducted to provide feedback into the cycle and identify any changes in water use or demands that may need addressing. Monitoring of water resources also provides communities with a long-term perspective for the management of resources.

- Communities establishing rules or operating principles for water use – especially during periods of hardship or drought.
- Multiple communities negotiating access and use of water sources.
- Communities possessing robust conflict resolution mechanisms to deal with water disputes and conflict.

A key finding that emerged from this initial work is that people want to determine whether seasonal rainfall has been 'good' or 'bad', so they can have an outlook for the coming months. This knowledge and understanding has been used to explore how best community-based institutions can engage in managing water resources at the local level.

OXFAM'S EXPERIENCES IN BANIBANGOU

Oxfam and its local partner Karkara have been working with the rural communities of Banibangou commune in Niger since 2009. The Oxfam country office in Niger is assisting rural communities to undertake dry season irrigation in order to safeguard food security and improve people's health. A key component of this project is the role of water users in managing water resources and irrigation systems. The driving force for the project is the women's gardening committee, and in particular a core group of women who have emerged as leaders in starting up the project. Research undertaken through field visits, key informant interviews and focus group discussions confirms that communities have high interest and willingness to actively engage in local level water resource management. A number of key factors have contributed to local water user participation and the success of the project so far. These are:

- **External drivers and demand:** At the start of the project there was a sense of fatalism and resignation among community members that national and local government will not deliver improved water supply services in the short to medium-term. The arduous external conditions, such as drought, land degradation, limited infrastructure and limited natural resources had enforced people to take collective action to overcome continual hardships. Interviews conducted at the start of the project identified that improved availability and access to water was a priority issue for communities. However, it is important to note that local water users specifically stressed the need for both domestic and productive water. In their eyes domestic and productive water needs could not be separated and improvements in health and food security needed to be addressed together.

- **Internal attributes and leadership:** The importance of beneficiary participation in community water supply projects is well documented. However, the degree of participation is often not considered and communities may simply be recipients of external training. If lip service is paid to participation, training becomes less effective and it inadvertently becomes an approach to justify ongoing continued support to communities. The initial success of the Banibangou project has been directly due to the leadership among the women's gardening committee; a collective of 50 women who have suffered repeated water shortages, as shallow hand dug wells remained low yielding or dry for more than six months of the year, have been active from the beginning in galvanising action among its members. By March 2011 the collective had grown in number to nearly 500.

- **External attributes:** External conditions can impact, in complex ways, the collective workings of communal institutions, but they can also create high demand and lead to improved collective action. In Banibangou, subsistence farmers and livelihood groups have recognised that water is an economic input that sustains their livelihoods. By working together they now aim to bring about positive change. Members of the women's gardening committee want to see themselves and be understood by others as cooperative and trustworthy – willing to engage in collective action in order to overcome hardships – not as freeloaders or wealth maximisers.

- **Collective water use:** Community water supply projects rarely assess a community's collective water use to determine whether new water points are required or not. In this case, community members had been active participants in water use surveys and were responsible for the identification of issues regarding water inequity and proportionality across their village or town. Participatory surveys have enabled communities to determine which user groups or individuals are accessing and using greater quantities of water than others.

- **Monitoring:** Water resources can only be managed if local level hydrological monitoring is undertaken. The purpose of water quantity monitoring, in the context of CBWRM, is to detect the short, medium and long-term trends for water resources. Data collection does not need to be overly sophisticated and should support local water users to identify trends – whether water resources are depleting in excess of known seasonal variations. It is important not to overcomplicate groundwater monitoring, and this means a variety of groundwater monitoring techniques can be applied, such as dipper tapes, level logging instruments and telemetric devices, depending on context (see Appendix 2 for more details on basic techniques for monitoring groundwater and rainfall levels).

In Banibangou, the benefits of community-led monitoring have been multiple. Monitoring has been shown to provide communities with a long-term outlook and weekly monitoring has also enabled key water user groups to make collective decisions about water usage and daily abstraction. Innovative approaches need to be developed so that communities are assisted in analysing, interpreting and disseminating monitoring results. This process requires continuous external support from local government authorities to ensure analysis informs decisions about water allocation.

External factors, such as water demands from other water users outside a community's boundary, also need to be considered and this requires involvement from district councils and regulating water authorities. The introduction of hydrological monitoring has also been advantageous for Oxfam. Collected groundwater data is used to inform community management systems and it provides factual evidence for future advocacy work. Hydrological monitoring and training has encouraged participation from local governments and regulating water authorities and has formed a useful platform for providing communities with long-term external support mechanisms.

CHAPTER 06

Experiences from Oxfam and WaterAid field programmes

OPERATING PRINCIPLES FOR WATER USE

Monitoring data collected must be used to assist communities to manage local water resources. Efforts have been made to help communities and key water user groups understand their collective water use demands, along with their priorities for water use, in recognition that the uses of water are multiple. Established operating principles encompass issues of water equity; proportionality (aligned to payments for water); transparency for water use to minimise water theft; ongoing monitoring of groundwater sources; and establishing rules and regulations for water use that are decided by communities. In arid environments, rules for water use must consider resource issues and move beyond byelaws for collection of water and management of water points.

NEXT STEPS

To date, this project has been an important source of learning for Oxfam. The themes of hydrological monitoring, collective action and operating principles for water use all represent new areas of learning for the Niger country office. In order for this project to be sustainable, a number of important issues will need to be prioritised.
The first is the realisation that water resource management is a new area of interest and field programmes are undergoing a steep learning curve. The Niger country programme is continuing to document and learn from its field experiences. Traditional approaches such as 'providing communities with training' have now been replaced by a facilitator approach that recognises and respects the skills that communities already possess. This approach will need to continue. The second priority is that field staff and country offices need to be provided with continued support. Like many WASH agencies, Oxfam works on a broad range of themes and there is a need to retain focus on water issues in order to make real progress. Third, there is a need to strengthen links between community-based institutions and local government, so that communities have

Figure 6.3 *Example of a recharge well and connecting rainwater harvesting system in Patan City (Credit: Kabir Das Rajbhandari, WaterAid in Nepal).*

continued support for the analysis and interpretation of hydrological data, contingency planning and maintenance of the irrigation system. Local government capacity is weak, but this should not provide an excuse to bypass local systems and work in isolation.

WATERAID'S EXPERIENCES IN NEPAL

In the Kathmandu valley, the formal water supply infrastructure is unable to keep pace with rising water demand and communities have relied on increased unregulated groundwater abstraction to provide sufficient water. This has severely reduced groundwater levels as the abstraction rate exceeds the recharge rate. Soil-water percolation and groundwater recharge are inhibited by impervious urban surfaces. As a consequence of groundwater exploitation and reduced recharge, traditional sources of water, such as wells and spring-fed stone spouts in Patan City are drying up. As a solution to the problem, WaterAid in Nepal is exploring the potential of rainwater harvesting systems to increase groundwater recharge and reduce water scarcity[38].

HYDROLOGICAL MONITORING

Rainwater harvesting and recharge systems were set up and channelled into 28 traditional wells and 25 soak pits throughout the community. Water levels in the 28 wells were continually monitored by volunteers from the community at 15 day intervals for a period of three years (2008–2011).

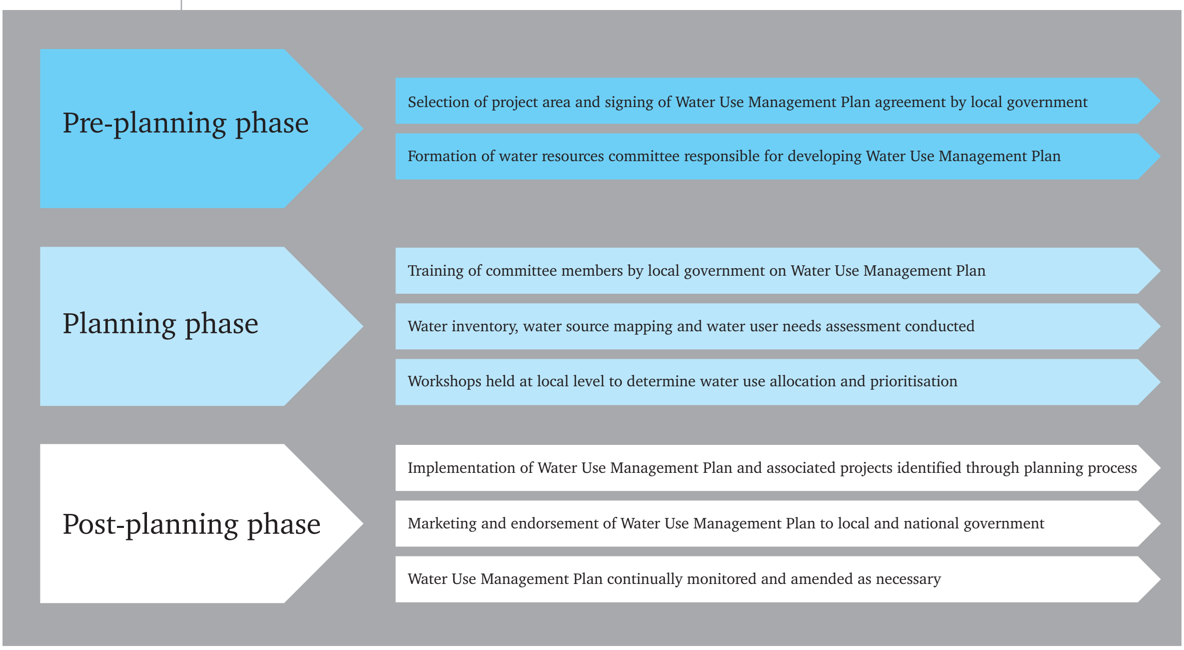


Figure 6.4 *Phases and steps involved in the development of a Water Use Management Plan (Credit: Kabir Das Rajbhandari, WaterAid in Nepal).*

Box 6.2

Water Use Management Plan process

Pre-planning phase: Water resource management committee and sub-committees responsible for the development of the Water Use Management Plan in their specific area are formed. The first role of the committee is to agree upon the proposed principles of water resource management in the village.

Planning phase: The community receives training and conducts a water source inventory within the village, classifying sources in terms of categories such as type, location and flow rate (both surface and groundwater sources are documented). In order to establish meaningful water allocations, flow rates are measured in the dry season when water availability is at a minimum. Data from the inventory are used to produce a village water resources map, which is reviewed and assessed by the water resources committee in each area. An assessment of water demand is also carried out. The current proportion of water from each source used by different users is determined to highlight where water sources are not being fully utilised. Using results from the water demand assessment and the inventory, water resource committees propose a system of water allocation and prioritisation that ensures equity among all water users.

Post-planning phase: The Water Use Management Plan is implemented and steps taken to obtain endorsement of the plan within governmental planning schemes. Monitoring and evaluation of the plan is continually conducted via monitoring of water sources and rainfall. Changing land use that impacts on water use is also observed. These data enable the plan to be regularly updated by the sub-committee and changes incorporated where necessary.

Water levels in another 49 wells in the area were also monitored by the community over the same period to assess the impact of recharge on the water level across the whole aquifer. The community also monitored rainfall and water quality during the project.

The wells were selected based on the ease with which water level monitoring could be conducted, as well as the cooperation of their owners. Collective action in gathering hydrological data was important as the more data that is collected, the more valuable the results are. However, care was also taken to ensure that the volume of data collected was not so large that the task was overwhelming for the community, or the data too time consuming to analyse. Involving the local community in the data collection process increased their ownership of the scheme and reduced project costs.

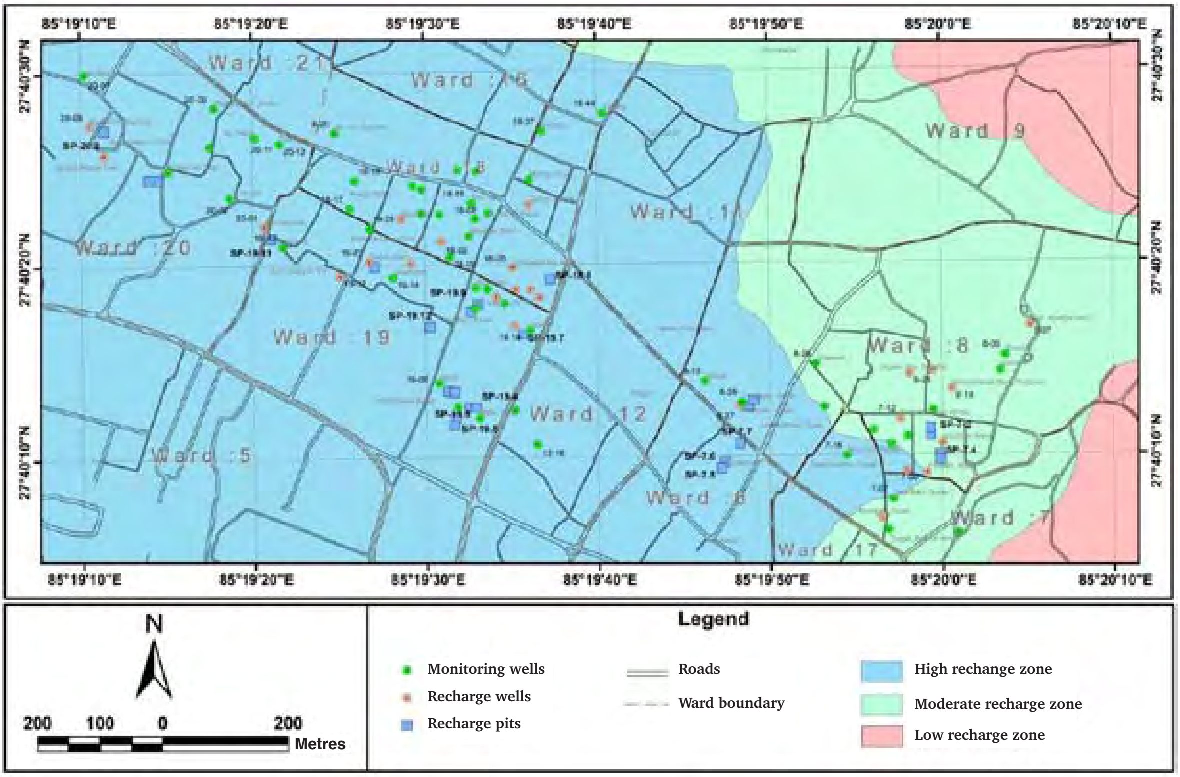


Figure 6.5
Map showing location of low, moderate and high recharge potential zones in Patan City, Nepal (Credit: Kabir Das Rajbhandari, WaterAid in Nepal).

Once hydrological data had been collected for a period of three consecutive years, the data were used to produce a map showing the potential for recharge across the area. As shown by the map in Figure 6.5, three different zones were identified: high recharge potential zones, moderate recharge potential zones and low recharge potential zones.

In order to achieve maximum benefit from the project, the communities will need to continue monitoring water levels and infiltration rates into the long-term future; this will allow the full impact of rainwater harvesting on groundwater recharge to be accurately quantified.

In the future, the project may be improved by combining the monitoring of infiltration and groundwater levels with the monitoring of groundwater abstraction; this will provide an indication of whether the additional recharge gained is sufficient for groundwater demands to be sustainably met. Demand control measures may also need to be considered if recharge interventions are found to be insufficient to maintain adequate water supply levels to the community.

CHAPTER.06

Experiences from Oxfam and WaterAid field programmes

WATER USE MANAGEMENT PLANS

The Water Use Management Plan is a planning tool devised by the Swiss development organisation, Helvetas[39]. WaterAid is implementing the Water Use Management Plan in Ghyachowk village in Nepal. Water Use Management Plans can be used at community level to assess available water resources and plan equitable and sustainable water allocation for different purposes. In times of scarcity, drinking and household water uses can be prioritised. All water users, including farmers, small businesses, hydropower generators and householders, are involved in the planning process, which helps to reduce conflict over water resources and optimise the use of available resources within the community.

WaterAid in Nepal is using the Water Use Management Plan to place communities at the centre of water resource planning and management (see Figure 6.6), together with the local government which facilitates the process. Once the Water Use Management Plan is complete, communities advocate for their plan to be enforced by local government among relevant water providers and users.

The development and implementation of a Water Use Management Plan comprises eight distinct steps grouped within three phases that run in a continuous cycle, as shown in Figure 6.4, p65. This means that the effectiveness of the plan is continually assessed and improved where necessary. Box 6.2, p66, outlines more details of the specific steps involved in developing a Water Use Management Plan.

Figure 6.6 *(Below) Water resource management committee members at a water use planning meeting, Ghyachowk village, Nepal (Credit: Kabir Das Rajbhandari, WaterAid in Nepal).*

WATERAID'S EXPERIENCES IN INDIA

Water security planning

In the Bundlekhand region of India, groundwater demand, both for domestic and irrigation needs has increased dramatically in recent years. This increase in demand, coupled with successive years of drought has resulted in an alarming downward trend in groundwater levels. The resulting water stress at village level has impacted negatively on health and school attendance. It has increased the hardship experienced by women who have to walk longer distances to collect water. The poor and marginalised members of society are hardest hit by reductions in availability of water resources.

> ‘Understanding local context will be a defining factor in scaling-up CBWRM.’

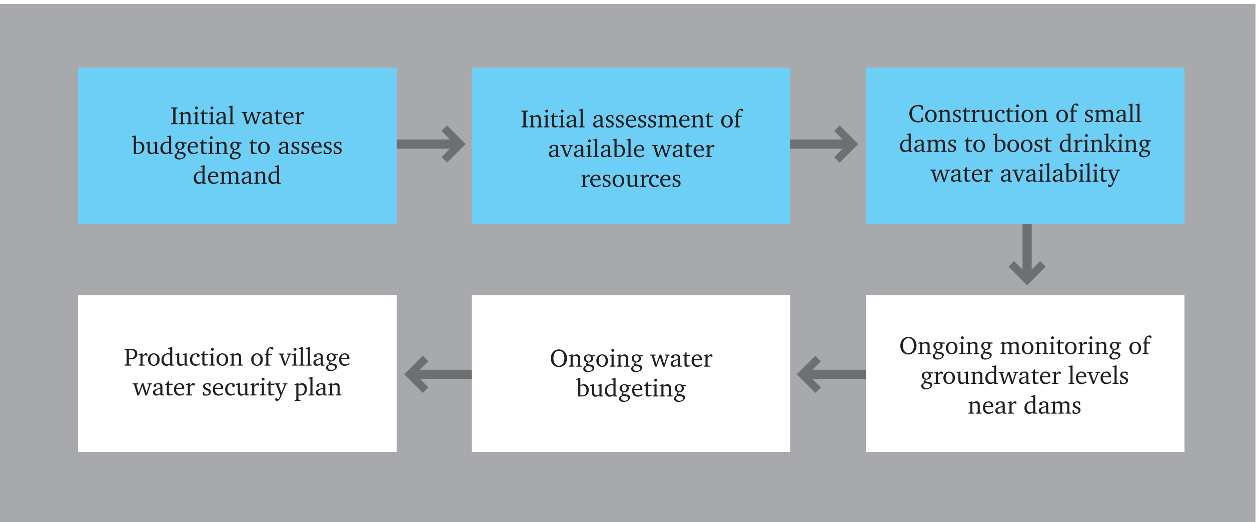


Figure 6.7
The approach used to initiate water security planning in Bundlekhand[40].

WaterAid in India is working together with local NGO HARITIKA to empower local communities to develop water security plans that aim to reduce the risk of groundwater depletion, ensure reliable drinking water supplies throughout the year and encourage equitable sharing of water for domestic and irrigation needs. This is achieved using a three tier water resource management approach which involves facilitating a water budgeting exercise with all water users, establishing demand for water and the availability of water resources to meet those demands, boosting the amount of available water by harnessing monsoon rainfall through a series of small dams, and building community capacity to manage drinking water supply assets. The approach links water supply asset management to the management of water resources[41].

This water security planning targets a number of villages within a sub-catchment and accounts for water availability at sub-catchment level; it was felt that it was more realistic for WaterAid to have an impact at this scale, rather than at the basin level. As a result of this combined intervention involving water budgeting, water conservation, increased storage and capacity building on WASH asset planning and management, 13,000 people in 14 villages now have more reliable drinking water supplies.

The role of agricultural water users in creating water scarcity in this area is highly significant. Agriculture consumes the vast majority of water resources and is the main driver of depletion. Hence, improving irrigation efficiency and self regulatory norms for water use is key to achieving water security as a whole. One of the major challenges in this project has been to encourage farmers to self-regulate water use and opt for lower water use crops in low rainfall years as part of the system. Therefore, attempts are being made to introduce the ongoing monitoring of agricultural wells so that the community can understand the demand and supply side of water management. Monitoring wells have been set up to provide information about groundwater availability for drinking water supplies near the small dams. The information collected from ongoing monitoring can be used to assess the risk that groundwater supplies will be depleted, enabling villagers to produce a water security plan outlining water use priorities and allocations.

SCALING-UP CBWRM

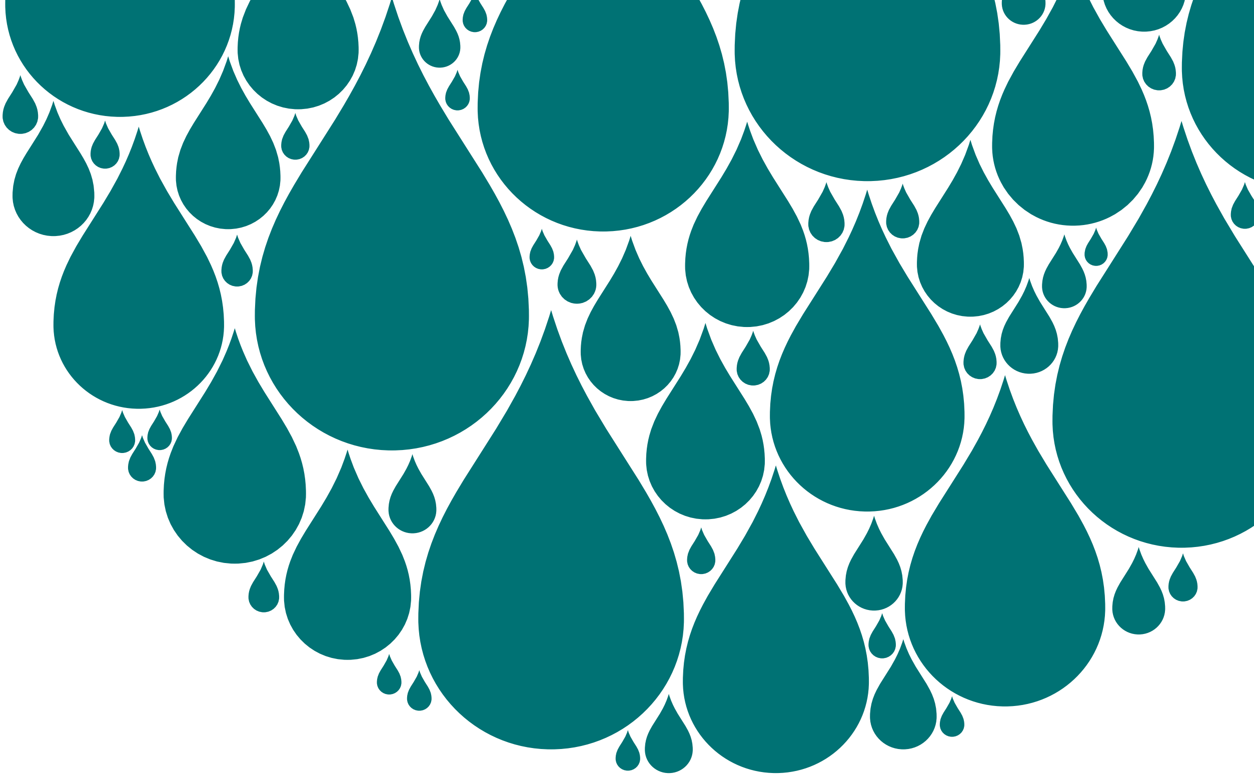
The examples from both Oxfam and WaterAid field programmes presented here demonstrate the ability of communities to participate in and take ownership of water resource management. Field experience also demonstrates that CBWRM combined with Integrated Water Resource Management (IWRM) principles may provide the most realistic option for putting effective water resource management policies into practice in developing regions, and helping to optimise the use of often limited financial resources allocated to water-related issues.

However, community projects cannot remain in isolation and pockets or islands of good practice need to be scaled-up and linked. Local level field programmes may have a limited impact on any national water resources scheme; therefore, it is important for NGOs and WASH agencies that work at the local level to help communities engage effectively with those at district, regional and national levels and advocate for their government to recognise and enforce community schemes.

A lack of coordination between separate programmes may present a challenge to the success of CBWRM and collective action by the WASH sector will lead to more targeted field interventions that will have a greater impact at larger geographic scales. Understanding local context will be a defining factor in scaling-up CBWRM and will determine the roles of different actors in the process; communities will require different methods to ensure they can successfully cope with water scarcity and improve water security.

Community-based initiatives will require sustained financial input and capacity building, and a process of action research or 'learning by doing'. Engagement with communities as well as regulating water authorities at local, district or regional level is required.

Figure 6.8 *Water level monitoring in a dug well used for irrigation. Bundlekhand, India. (Credit: Vincent Casey/ WaterAid).*



CHAPTER.07

Aligning national water policy to field realities

Overview: National and regional water policies often do not take account of or incorporate successful operational practices at the local level; the bridges between science, policy and practice are weak. Local institutions and water users must be more involved in decision-making processes, so that water policy is more accurately aligned to field realities.

CHAPTER.07

Aligning national water policy to field realities

A policy is a principle or rule to guide decisions and reach a goal. Every actor involved in managing water, from the state to farmers, has a policy, although it might remain oral and informal; this policy is reflected in each actor's practices. Many formal methods used in the development and implementation of national and regional water resource policies in developing countries do not recognise and take into consideration the range of policies and practices that different water users may have, particularly those at the local level. The formal methods used tend to be rooted in theories and approaches that are often developed in northern Europe and North America and are inappropriate for the environmental, political and social complexity of other regions.

Such inappropriate approaches include rational choice theory, which assumes individuals and groups always act to maximise their economic benefits and profit, and commensuration, which measures a variety of elements from one point of view and often misrepresents the values of some actors.

Closer examination of environmental, social and political systems in northern Europe and sub-Saharan Africa clearly demonstrates the inappropriateness of methods of policy development used. Unlike northern Europe, the environment in sub-Saharan Africa is highly variable (Chapters 2 and 5) and conditions can fluctuate from flood to drought within periods as short as a few months, or as great as a few years[40]. Furthermore, sub-Saharan Africa does not possess the highly engineered infrastructure needed to transfer, distribute, treat and store water that is found in northern Europe. River basins located within these sub-Saharan environments can be characterised as pulse driven non-equilibrium basins (Box 7.1). The key challenge of water resource management and allocation in sub-Saharan Africa is to determine how best to deal with the complex and highly variable conditions across the region. This climatic uncertainty is also often coupled with a lack of administrative reach and fiscal constraints which can slow down attempts to improve management.

USERS IN WATER POLICY

In order to solve the issues outlined above, there are two key improvements that need to be made to methods for developing water policy:

- Programmes involving the development of infrastructure, such as irrigation rehabilitation, should make more use of the skills of local artisanal engineers, yet with support from qualified professionals.

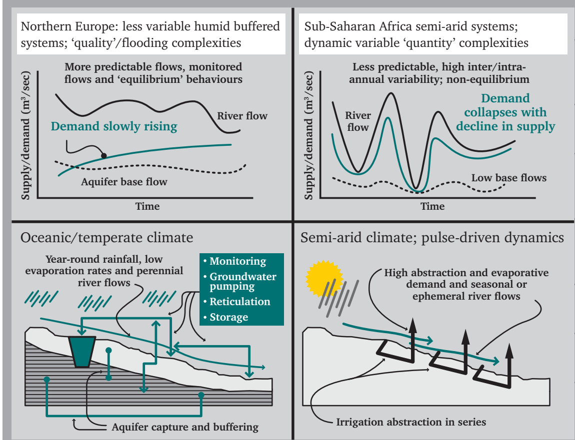
- Local group practices and responsibilities regarding the sharing of water and water scarcity must be recognised and supported (Chapters 5 and 6).

‘Every actor involved in managing water, from the state to farmers, has a policy.’

Credit: Bruce Lankford, UEA.

Box 7.1

Comparison of typical environments within northern Europe and sub-Saharan Africa



	Equilibrium	Non-equilibrium
Observation	Irrigation area and demand for water are fixed within limitations	Irrigation area and demand for water vary widely with supply
Inter-annual irrigation area	Fluctuates <100%	Fluctuates <1,000%
Climate	Tends to be temperate tropical oceanic which reduces water availability	Tends to be semi-arid with a high coefficient of variation of rainfall
Irrigation planning	FAO-type methodology for determining fixed/adjustable peak irrigation demand	Requires a river-centred approach allowing for proportional intakes
Water rights and permits	Defined by quanta (eg l/s)	Defined by proportions of river flow (%)
Basin development curve	S-shaped rising to a stable plateau	S-shaped to high variable supply/demand curve
River basin governance	Suggests normative forms of regulatory management	Suggests modular and localised models to meet local apportionment

It is argued that water management needs to be centred on water users and local engineers for five key reasons:

- Plans for investment in food security in many developing regions, including sub-Saharan Africa, which focus on the expansion and rehabilitation of irrigation (see Chapter 3), particularly at the smallholder level, will require significant user input.
- Formal water regulation approaches, based on predictable flows, are inappropriate for river basins in regions such as sub-Saharan Africa that have highly varying flows; a more dynamic, transparent and flexible approach is needed.
- Decentralising water resource management to the lowest practical level is the most appropriate strategy to adopt due to the size, remoteness and complex nature of river basins in many developing regions.
- Current costs of water policy development and irrigation programmes are high as they depend on the involvement of foreign experts.
- Water allocation systems, such as those controlled by irrigation headworks, cope poorly with the large variations in water availability characteristic of many developing regions; this often results in inequity between upstream and downstream users.

CHAPTER.07

Aligning national water policy to field realities

POTENTIAL IMPROVEMENTS

There are many alternatives to common Western scientific approaches to water resource management that could be used instead; for example, the entitlements approach[42], which concentrates on the important difference between the availability of and access to a resource, or the recognition of social capital and the ability that individuals have to define and enforce rules among themselves. There are several practical steps that can be taken to better incorporate the different social and political interactions related to water resource management that take place in different regions, countries and localities.

SCALE AND LOCALISATION

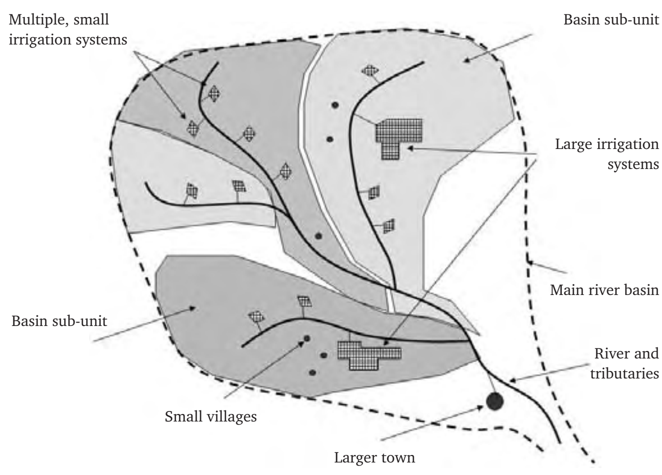
Challenges to water management created by analysing issues only at the basin level may be overcome by encouraging decentralisation and sub-dividing basins into smaller management units[43], as shown in Figure 7.1. Within each unit, specific byelaws could be devised to abstract and distribute water equitably. Measures could also be taken to ensure that the flow entering each sub-unit is enough to meet the needs of all water users in that area and that upstream users are not using more than their fair share of water. The autonomy given to each unit enables farmers to work to their own specific water policies (supported by engineers and other services) and allows more tailored policies suitable for each specific area to be developed.

USE OF LOCAL ENGINEERS AND ARTISANS

The current tendency among development organisations is to build highly engineered 'modern' approaches to water infrastructure, such as irrigation intakes[44]. These structures are often unable to cope with the varying flow and runoff levels experienced in developing regions, especially the semi-arid environments of sub-Saharan Africa. As a result, downstream users can be deprived of their water allocation, either in part or in full. Structures designed by local engineers and artisans may be able to better cope with characteristic climatic conditions, as well as costing significantly less than those requiring the input of international engineers (Box 7.2).

Figure 7.1 *Forms of polycentrism require the division of river basins into modular units[42].*

Division of basins into smaller management units



> ‘Challenges to water management may be overcome by encouraging decentralisation and sub-dividing river basins into smaller units.’

Box 7.2

Irrigation rehabilitation in the Usangu basin, southern Tanzania

River runoff from the Usangu escarpment, used for irrigation by smallholder farmers situated on the plains beneath, was inequitably shared between several sectors: upstream – irrigated lands; downstream – ecosystems and livelihoods in Ihefu wetland, ecosystems in the Ruaha National Park and two hydropower dams[45]. Research by two Department for International Development-funded projects (SMUWC and RIPARWIN) in the Usangu basin demonstrates how irrigation rehabilitation, expansion and Integrated Water Resource Management (IWRM) can be successfully improved with the help of local water users, engineers and artisans.

In the Usangu basin, highly engineered irrigation intakes were often unable to cope with the varying flow levels experienced in the river (Figure 7.2). The formally engineered structures effectively allocated water by limiting abstraction for irrigation during the wet season, when flows and abstractions in the system were at a maximum[46]. However, during the dry season when river flows were much lower, these structures were often unable to adapt in order to provide proportional abstraction at levels below the maximum allocation limit.

Figure 7.2 Example of an improved modernised irrigation intake in Usangu, Tanzania (Credit: Bruce Lankford, UEA).

To increase the involvement of local water users in the decision-making processes in the Usangu basin, the river basin game was used. Farmers from different parts of the basin system worked together to explore their ideas and perceptions of the volume of water used by different farmers in their local area[47]. Following the game, they discussed their experiences of water management at both the upstream and downstream end of the system, and shared ideas on how water could be shared more equitably between them.

The ideas for improved water management generated using the river basin game, together with the facilitation of basic hydraulic training, allowed local engineers and artisans to successfully design proportional concrete structures that provide a maximum limit on abstraction as well as proportional abstraction for the full range of flows below the maximum. The inclusion of local artisans in the rehabilitation and expansion of water infrastructure in the Usangu basin also helped to reduce the cost of schemes.

CHAPTER.07

Aligning national water policy to field realities

APPROACHES TO ENGAGE LOCAL WATER USERS

Methods for placing water users at the centre of water allocation and irrigation policy may help define customary arrangements or new byelaws that hold validity in their locality (Chapter 6). The use of games or simulations may help achieve this. One example of such a game is the 'river basin game' (Figure 7.3), which has been extremely well received by farmers that have used it (Box 7.2, previous page) and is an example of a participatory tool that can transform relations between top-end and tail-end water users, and between water users and external support services offered by engineers and other specialists. This user to user knowledge sharing may be much more productive than conventional training programmes delivered by soil and water experts who see farmers as 'water wasters' in need of further teaching.

ACKNOWLEDGING LOCAL LEVEL INSTITUTIONS

A key improvement to current water resource management approaches would be to recognise the role of local water institutions managing communal resources, and to ensure their inclusion in national and regional institutional frameworks.

However, the incorporation of local level institutions in water resource management frameworks is challenging. Policy-makers cannot assume that traditional and community-based management strategies (Chapter 5) represent the best way to manage water resources at the basin scale simply because they remain resilient to climate change and function at the local level. The advantages and disadvantages of such systems from the perspective of all water users involved must be considered, as opinions and values will vary from user to user. The priorities and values of each water user are also likely to change over time and local management systems have to be able to adapt to this as well. The resilience of community-based systems is largely due to their robustness and capacity to evolve

Figure 7.3
Farmers in Usangu, Tanzania, playing the river basin game (Credit: Bruce Lankford, UEA).

'A key improvement would be to recognise the role of local water institutions.'

over time (Chapter 5). Therefore, the integration of community and local-level practices into an overall, basin or even transboundary institutional framework needs to allow for mediation, negotiation with and evolution of local level institutions if water resource management and use is to remain sustainable.

SUMMARY

Linking policy and practice in water resource management introduces many challenges, but it is highly important. The environmental, political and social complexity of situations in developing countries must be recognised if the effectiveness of water resource management is to be improved. At present, issues of water allocation at the local and basin levels and problems caused by increasing competition for limited water resources remain unaddressed.

The major challenge to the creation of effective water resource management schemes in developing regions over the next five to ten years will be the development of strategies that successfully embed water management, infrastructure maintenance and improvement within local communities, while maintaining food security from irrigation. Overcoming this challenge will require the acknowledgement of local level practices and institutions.

Reform of institutional frameworks to allow for the correct balance between local ownership and the involvement of specialists and engineers in all types and sizes of water systems is needed. In order to help make this possible, it might be advantageous to divide river basins up into smaller units to increase ownership, with operation, design and consultation engineers providing support. The role of games and other participatory tools may play a key part in empowering local users and bringing them together with support services and technicians to discuss how to meet these challenges sustainably.

Governments have an obligation to link national policy to field reality. They must also ensure water laws and regulations are complementary and synergised across multiple ministries. To do this effectively, during policy formation they must undertake widespread stakeholder consultations to elicit the true nature of local water resource management. Domestic water supply needs to be safeguarded alongside productive water usage requirements, and traditional water management practices need to be incorporated into national water law. Civil society must have a voice during consultations to influence policy-makers.

CHAPTER 08

Conclusions on Community-Based Water Resource Management

Overview: Collaboration between local institutions and communities, and water sector practitioners and policy-makers, can dramatically improve water resource management. The role of community-based institutions in monitoring and planning the supply and demand of water resources can complement broader water resource management frameworks, where they exist.

CHAPTER.08

Conclusions on Community-Based Water Resource Management

Looking ahead, population growth, urbanisation, an increase in water demand for food security and energy production, existing climatic variability as well as land and soil degradation are just some of the reasons why improved water resource management is needed. These pressures will occur even in the absence of climate change caused by human activity.

The philosophy of Integrated Water Resource Management (IWRM) has become increasingly fashionable over the last two decades. Yet, managing water resources at a global or state level is often over-ambitious and unrealistic, particularly when many developing countries have weak regulating institutions and limited technical and financial capacity. Furthermore, governments attempting to put IWRM into practice in low-income countries have very few good examples of IWRM that they can learn from and build upon. New options for managing water resources locally are required.

Today, although community management is a standard strategy used for the operation and maintenance of water supply systems in rural Africa, these mechanisms often focus only on management of the infrastructure itself. Many international development organisations who work in the WASH sector have committed to the IWRM theory, but few have put IWRM into practice and implemented activities in the field to prove that the theory works.

Regardless of IWRM and the generally unsuccessful attempts by national governments to put the theory into practice, there are many resilient communities that have continued to sustain their livelihoods in extreme environments by using traditional community-based methods to manage their water resources (Figure 8.1). In order for state water resource management policies to be more effective, these traditional community-based practices need to be identified and built upon, so that governmental water policies more accurately reflect practices at the local level. The best way for this to be achieved is for river basins to be divided into smaller sub-catchments, which will allow grassroots practitioners to work directly with local institutions and water user groups.

CBWRM is not a replacement for national water resource management plans. The philosophy outlined in this publication is that there is no reason

Figure 8.1 *Nomadic pastoralists, Kebkabiya, North Darfur, Sudan (Credit: St John Day, Oxfam GB).*

Box 8.1

Key questions about Community-Based Water Resource Management (CBWRM)

Is there a water resource management blueprint that can be followed?
Many of the current water laws in developing countries are based on a blueprint of IWRM that fails to recognise local law, local customs and local practice, and are often devised by independent external parties. However, any successful framework for IWRM will not be a 'one size fits all' policy and must take due consideration of the contextual issues in the country it is to be implemented in.

How can the involvement of communities be increased?
Effective CBWRM requires the integration of all institutions, from central government to community level, combining both technical expertise and local knowledge. However, care needs to be taken in the manner in which these traditional water rights systems and institutions are incorporated to ensure their form and function, in particular the adaptive capacity they provide, is accurately preserved.

How can the resilience of water resource management be improved?
An allowance for mediation and negotiation with communities in any formal water resource management framework will ensure systems remain flexible and adaptive. Devising a system of priorities is also crucial, and constructing negotiations and mediations along these set priorities will provide agreement between all users as to what approach is workable in an area. The optimum institutional framework will encompass management at regional, national and local level, and allow for effective negotiation between actors at each of these levels.

Why should communities in developing countries be involved in water resource management?
There are many examples in dry environments across the world, such as Australia and the western United States of America, where, in the past, water has been successfully provided through top-down mechanisms by the state, to the satisfaction of communities. However, communities in the developed world are now more active and engaged in water resource management than previously, on issues not just related to water supply, but also pollution and environmental ecosystems. The role of communities and the state, plus their

Continued...

Continued from previous page...
interaction with each other, is adjusting on a global level as competition for water increases and management becomes more contentious. National governments are ultimately responsible for safeguarding water resources; however, roles and responsibilities of central and local governments and community-based institutions need to be defined. In particular, local governments should facilitate dialogue through consultative committees, where there are competing demands for water usage.

Do developing countries possess the resources needed for CBWRM?
Some argue that poor households may not have the spare capacity to participate in water resource management due to the large demands securing their livelihood places on them. However, many communities already manage their resources communally and the process of CBWRM will merely represent a formalisation or improvement on current schemes. At national and local government level, community-based management is also likely to reduce project costs for water management schemes, as the cost of providing money or other allowances to community members for participating in meetings or other management tasks will be relatively low compared to the cost of hiring foreign experts to develop and implement schemes.

(Credit: IWRM Series Event 4, panel discussion).

why CBWRM and IWRM methodologies cannot both exist together. CBWRM is rooted in water user practices and the approach recognises existing communal water management techniques. CBWRM is therefore a strategy capable of ensuring water resource management activities are relevant to water users, and provides a platform for WASH agencies to engage in local level water resource management. Indeed, CBWRM aims to provide WASH agencies with a very practical implementation strategy that recognises and respects the role of social groups, and is in line with the main principles of IWRM.

The challenge for water sector experts is how to engage with local institutions on issues of water resource management using flexible and adaptive support mechanisms that can be adapted to different contexts; there is no blueprint for water resource management. This process will require WASH agencies to collaborate meaningfully with multiple stakeholders and to not be afraid of taking risks and learning by doing. This approach will be creative not wasteful if field experiences are effectively monitored and evaluated so that lessons learned can be documented.

As development organisations move beyond their traditional WASH service delivery functions towards the management of water resources, they will need to:

- Find out people's priorities – identify whether local conditions and community characteristics make it feasible for people to engage in water resource management.
- Adopt a 'bottom up', rather than 'top down', approach, recognising and respecting traditional water management approaches, and using these as a basis for governmental management strategies.
- Build and strengthen people's capacity so they can find things out for themselves – this implies that practitioners need to facilitate community discussions and decision-making, rather than implementing changes directly.
- Undertake local level hydrological monitoring – so people have access to information that can then be used to make more informed collective decisions.
- Encourage the growth of local institutions responsible for water management – supporting people to take collective action and establish operating principles for water usage.
- Ensure that community-based institutions have continuous support from local government and implementing agencies.
- Support groups in society to have access to and influence on decision-makers – people need a 'seat at the table' where decisions are made.
- Identify how innovative approaches at a local level can complement national planning and assist larger service providers.

In conclusion, global problems require global solutions, but these solutions must also make the transition from water policy to practical applications that reflect the realities on the ground; there are far too many examples of community water supply projects that have inadvertently failed or fallen into a state of disrepair. Above all, we must recognise the skills and indigenous knowledge that people possess. Alternative options for water resource management must recognise the need for bottom up, community-based and community-managed approaches, coupled with continuous support from local and central governments.

Many WASH organisations, like Oxfam and WaterAid, pride themselves on being learning organisations during their service delivery work in extending water supply services. Given the multiple demand side pressures on water resources (Chapter 3), the WASH sector can play an important role in supporting national water security, particularly at local level. An immediate priority is to work collaboratively with governments to strengthen systems for hydrological monitoring, data collection and greater commitment to sustainability of infrastructure and resources.

APPENDIX 1

Identified attributes for engaging in Community-Based Water Resource Management

Attributes needed for start up – defining an entry point

- Improvements in water resource management must address real need.
- Risk of water scarcity and threat to livelihoods.
- Dependence on water as a productive input to livelihoods.
- A sense of ownership over local water resources.
- A willingness and feeling that it is possible to have increased influence in water management.
- A small number of key individuals who have the motivation to engage in water resource management.
- Interest or anecdotal evidence of collective action.
- Sufficient trust or common interest to form or develop a water user group.

Attributes important for a water user group to evolve

- Continued interest in water resource management amongst local users.
- People have the autonomy to devise their own rules and institutions.
- Avoidance of external agencies trying to 'train' local users on water resource management.
- Establishment or strengthening of rules and regulations for water resource management.
- Improving openness and transparency between water users, but also local water authorities and external agencies.
- Increased knowledge of local water balance.
- Improved information sharing.
- Engagement in local level monitoring – data sharing with local users and district authorities.
- Benefits to local users becoming increasingly evident and in proportion with costs imposed on them.
- Development or contingency plans and scenario plans – alongside local authorities.

Attributes for successful water resource management by local users

- Adequate monitoring of water resources and appropriate decision-making by local users and district authorities.
- Evolving risk identification, risk management and rule modification.
- Graduated sanctions for rule violations depending on the seriousness of the offence.
- Rules relevant to local context.
- Ongoing conflict resolution mechanisms.
- Local users have access to decision-makers and engage in consultative committees.
- Culture of openness, trust and cooperation between local users and district authorities.
- Water policy reflects local practices – local users have a seat at the table where decisions are made.
- Established and operational contingency plans.
- Long-term back stop support (facilitation) by external agencies.

APPENDIX.2

Basic monitoring of rainfall and groundwater levels

Chapter 6 refers to local level monitoring of rainfall and groundwater levels. Monitoring is a crucial component of Community-Based Water Resource Management (CBWRM) as it provides information about the relationship between rainfall and water availability, which, as Chapter 3 explains, may not be intuitive. The influence of land use, irrigation and the functional condition of water sources can all influence water availability.

Monitoring of rainfall and groundwater levels provides communities with the information that they require for risk-based planning. If groundwater levels show a progressive downward trend year on year, action can be taken to manage the situation before a water source completely fails. The cause of the downward trend can be investigated in detail.

This appendix outlines some simple monitoring techniques that can be adopted as part of CBWRM.

RAINFALL MONITORING

Simple rain gauges such as the ones shown in Figures A1 and A2 can be used to take daily readings of rainfall. These readings can be recorded in water user management committee logbooks. This simple graded flask-based rain gauge must be emptied by hand daily.

Self-emptying rain gauges can also be obtained cheaply. These can be set to record monthly rainfall readings and pass the information to a wireless rain monitor. This device might be best placed at local government or local partner offices.

Rain gauges must be properly sited if accurate rainfall readings are to be obtained. They should not be located in close proximity to obstructions such as buildings or trees, which may shield them from wind driven rain. They should not be located in wide open exposed locations such as on top of buildings or in wide open plains as turbulence may also interfere with accurate readings. Rain gauges are ideally located in clearings surrounded by trees or buildings. The distance from the nearest object should be twice the height of that object.

MONITORING OF GROUNDWATER LEVELS

Monthly readings of static water levels can be taken from wells and boreholes using very basic water level dipping tools such as the whistle-based dipper shown in Figure A3. This is attached to a measuring tape and can be lowered into a well or borehole to take a water level reading. It makes a whistle sound when it strikes the water table.

Figure A1
A simple rain gauge (Credit: www.Weather WeatherWeather. co.uk).

Figure A2
A self-emptying rainfall gauge (Credit: www.Weather WeatherWeather. co.uk).

Figure A3
A whistle-based dipper (Credit: Geotech).

Another more expensive technique involves using an electronic dip meter such as the one shown in Figure A4. This beeps when the probe comes into contact with the water table.

Another technique involves the use of submersible level loggers such as those shown in Figure A5. These can be hung inside a borehole, alongside the rising main of a pump, below the water surface, and programmed to take water level readings at any time interval. They can not only shed light on static water level trends but can be used to gather information about peak demand on a water source and longer-term recharge patterns.

Figure A4
An electronic dipper (Credit: Waterra (UK) Limited – an In-Situ Inc Company).

MODIFICATION OF WATER SUPPLY WELLS TO ACCOMMODATE WATER LEVEL MONITORING

In order to avoid removing the pump head or borehole cap every time a water level reading has to be taken, it is useful to modify either the pump pedestal or the borehole cap (in the case of motorised wells) to facilitate monitoring.

Certain handpumps such as the Ghana Modified India MKII handpump come with a monitoring hatch fitted to the pump pedestal (Figure A6, overleaf). Other handpump models may require modification to enable access for dip meter probes.

Figure A5 *Submersible level loggers (Credit: Waterra (UK) Limited – an In-Situ Inc Company).*

APPENDIX.2

Basic monitoring of rainfall and groundwater levels

MONITORING WATER ABSTRACTION

Community level monitoring should include water abstractions as these may alter seasonally or over time. Measurements of water abstractions are important because they may be a strong determinant of groundwater recharge and they enable water users to correlate queuing and collection times with groundwater fluctuations. In turn this can inform community decision-making around water prioritisation, equity and transparency for usage. There are multiple examples where communities can monitor abstraction using simple techniques, such as the time required to fill a water container of known volume, or the number of handpump strokes required to fill a container. Sphere minimum standards, for example, recommends a maximum filling time of three minutes for a 20 litre water container or jerry can[48].

Figure A6
An India MarkII handpump with modified pedestal to facilitate manual water level monitoring in Burkina Faso. (Credit: Vincent Casey/WaterAid).

In situations where large-scale human displacement results in the formation of large camps or informal settlements, WASH organisations may also be required to install flow meters on submersible pumping systems to help monitor and regulate supply and demand. If this information is disseminated to communities in an appropriate manner, communities can collectively agree quotas which ensure that users receive a fair allocation of water.

Figure A7
Installation of a water level logger inside a borehole in Burkina Faso. (Credit: Vincent Casey/WaterAid).

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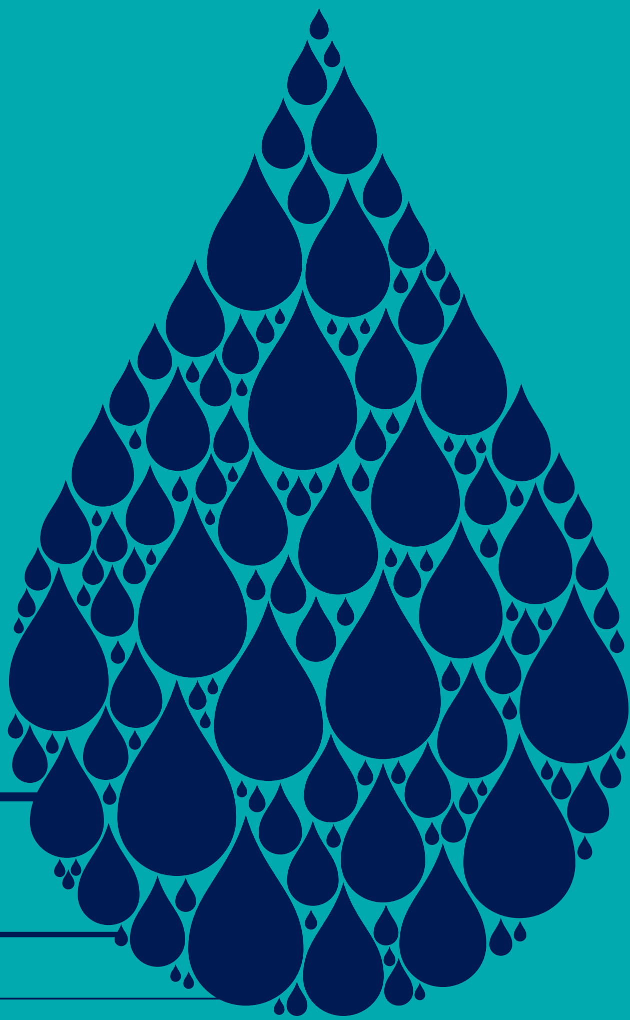

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