Framework

Water security framework

This document sets out a framework for community-level water security. It reflects WaterAid's focus on water for basic human needs in low-income countries while acknowledging the importance of other water uses. It provides a generic set of concepts, approaches and commitments that our country programmes can modify to fit their national contexts. It is also intended to inform supporters and donors about our efforts to safeguard the water supplies of poor and marginalised communities. This framework should be used as part of an integrated approach to improving water, sanitation and hygiene.

The framework was drafted by Vincent Casey, Richard Carter and Daniel Yeo. Many staff in WaterAid's country programmes and regional teams have made valuable inputs and shared their experiences, including Andersen Rabeson (and the WaterAid team in Madagascar), Asad Umar, Bethlehem Mengistu, Ephraim Tonya, Francis Musinguzi, Gossa Wolde, Indira Khurana, Jesse Kofi Danku, Jyoti Bhushan, Kabir Das Rajbhandari, Lucien Damiba, Nshuti Rugerinyange, Paritosh Chandra Sarkar, Rebecca Alowo, Sohail Nazir, Suresh Jaiswal and Takele Kassa.

Colleagues in the UK and Australia have helped to shape and greatly improve the document, including Girish Menon, Cristian Anton, Joseph Pearce, Louisa Gosling, Nick Bundle, Peter Dwan, Richard Steele, Sue Cavill and Ray Heslop. Thanks to Jen Smith and DEWPOINT for a preliminary literature review. External peer reviewers Alan Macdonald (BGS), Mark Zeitoun (UEA) and St John Day have strengthened the document considerably. Thanks also to Professor Tony Allan and Chris Perry for guidance. Department for International Development (DFID) funded research carried out by the British Geological Survey (BGS), the Overseas Development Institute (ODI) and the RIPPLE programme is acknowledged as are evaluations carried out by Hafren Water, Joe Gomme and Nancy Proudfoot.

The document should be cited as WaterAid (2012) *Water security framework*. WaterAid, London.

It can be found in the documents section of WaterAid's website – **www.wateraid.org/publications**

Cover photo: WaterAid/Marco Betti

People queue at a water point in Asegeda, Tigray, Ethiopia, for water for domestic use and livestock watering.

Contents

Part 1

Introduction and background

WaterAid's current Global Strategy (2009-2015)[1] sets out ambitious targets for extending water supply and sanitation services. Various contextual factors will have an impact on the sustainability of these services – including rapid urbanisation, increasingly stressed water resources, a changing and unpredictable climate, and economic and political instability. Conversely, extending water supply and sanitation services will have some impact on water resources.

Water sources and water resources

The terms 'water source' and 'water resource' are often used interchangeably. However, they are not the same thing. In this document the following definitions will be used:

Water source

A water source (or water point) is the point at which water can be accessed. Sources considered to be 'improved' have been protected from contamination and include boreholes or dug wells capped with handpumps, protected springs, rainwater storage tanks, public tapstands or standpipes[2]. Sources considered to be 'unimproved' include unprotected dug wells, unprotected springs, and surface water abstraction points on rivers, dams, lakes, streams, canals and irrigation channels.


WaterAid/Jon Spaull

A handpump – an improved water source

Water resource

A water resource is the wider body of water upon which a water source depends. This could be rainwater, surface water (eg rivers, streams, lakes) or groundwater within an aquifer.


WaterAid/Vincent Casey

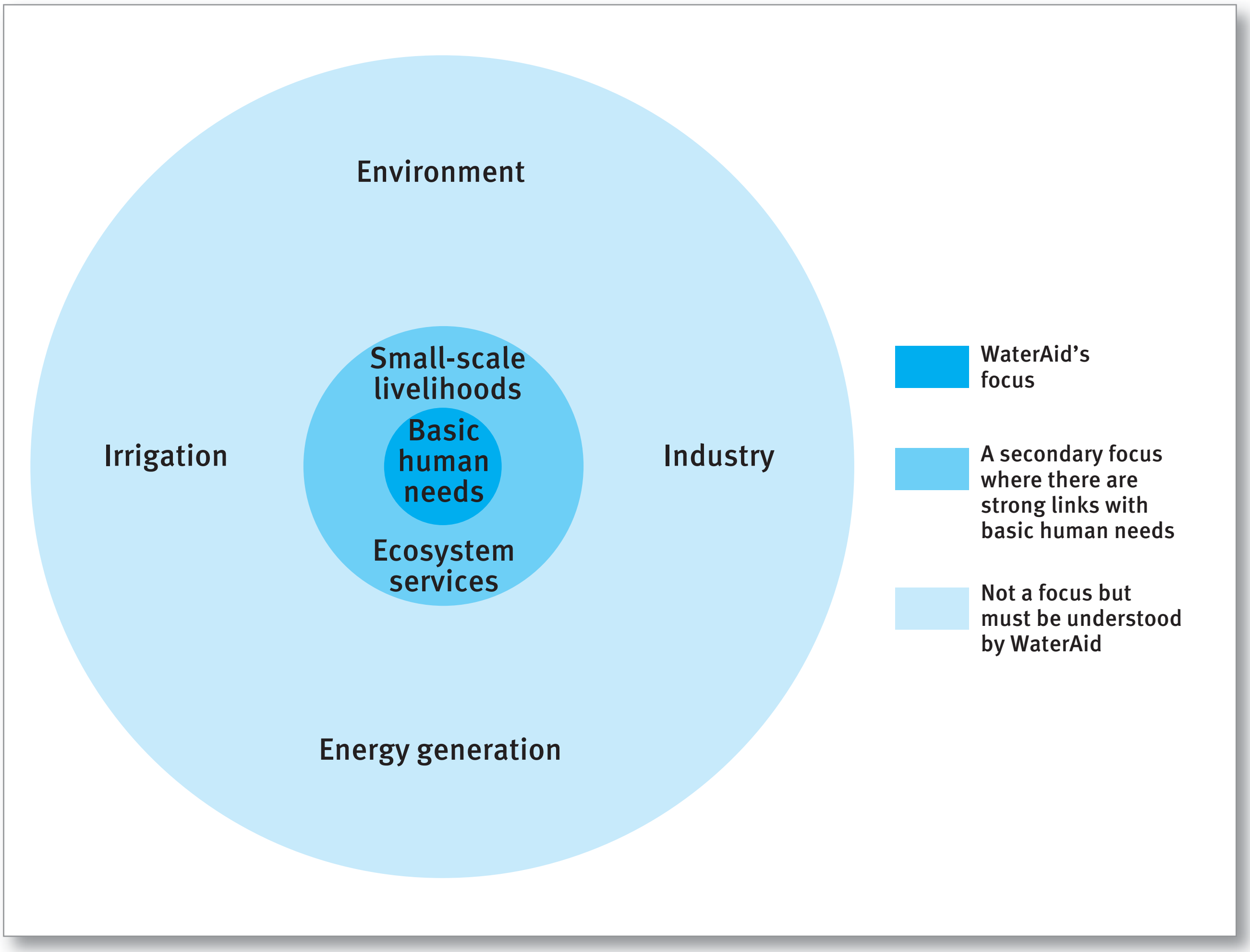
The River Nile – a water resource.

WaterAid's focus

WaterAid's focus is on improving access to water for the basic human needs of the poorest people. These needs include drinking, cooking, bathing, sanitation and hygiene.

This is not a water security framework for all water users. For example, it does not focus on the needs of large-scale irrigation farmers or the energy sector. Neither is it a comprehensive framework for the water security of a nation, which would need to consider all water uses. Instead, it is centred on the provision of water for basic human needs while acknowledging that other water uses (eg agriculture, industry, livelihoods, ecosystem services and the environment[3]) are important and closely interlinked.

Figure 1 – Water use and WaterAid's focus



WaterAid's definition of water security

There is no single, widely accepted definition of 'water security'. A literature review carried out by Cook and Bakker in 2010[4] highlighted that 'water security has multiple definitions depending on the definition of need (human and/or environmental)'. A literature review by WaterAid found that definitions primarily relate to food security, ie do we have enough water to grow the food we need? There is a selection of published definitions of water security in the Appendix on page 52.

These are all useful, but do not adequately capture the context in which we work. WaterAid defines water security as:

> **'Reliable access to water of sufficient quantity and quality for basic human needs, small-scale livelihoods and local ecosystem services, coupled with a well managed risk of water-related disasters.'**

Water security is an outcome that we aim to achieve in a way that is affordable to users without imposing an unrealistic management burden on communities.

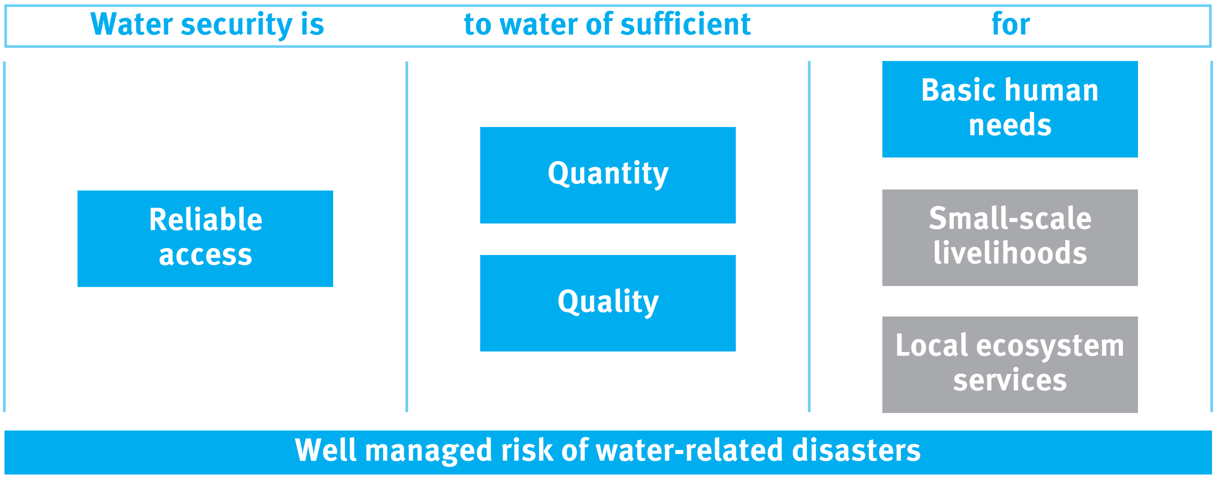
There are strong relationships between water for basic human needs and water for livelihoods:

- Large-scale livelihood water uses can impact on the quantity and quality of water available for basic human needs, for example where uncontrolled irrigation is practised or where return flows from productive water uses are polluted.
- If water sources provide for both domestic and small-scale productive uses, for example cattle watering, there can be competition between users for access.
- If people do not have ready access to clean water, the time and energy required to fetch water, coupled with the negative health impacts of water-related diseases, affects their ability to farm and work.
- Revenue generated from livelihoods can help to fund the ongoing maintenance of water sources, ensuring continued access to the resource.

People are dependent on water-related services provided by ecosystems, for example, the purification of water by wetlands or forest zones. Access to water is also affected by disaster events.

For this reason, livelihoods, ecosystems and disaster risk feature in WaterAid's overall definition of water security. These areas are not part of our core focus but we aim to understand them and where relevant, factor them into water, sanitation and hygiene programming, through partnerships.

Figure 2 – Components of WaterAid's water security definition



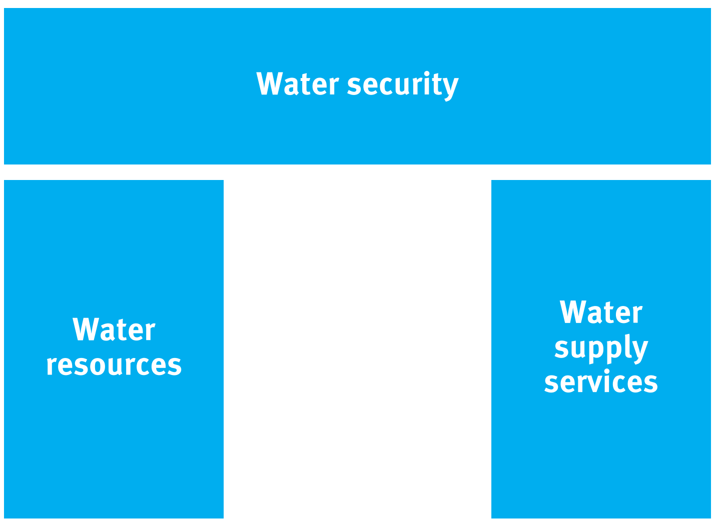
Primary focus areas are coloured blue, and secondary focus areas are coloured grey. Irrigation, industry and energy water uses do not feature in the definition. This does not mean that they are not important. It simply means they are not primary or secondary focus areas for WaterAid interventions. However, they must be taken into consideration where they occur.

The dimensions of this definition are further explained in Part 3 on page 28.

Water security and WaterAid's framework documents

We believe two factors are required to deliver community-level water security. These are well managed and financed water supply services, and well managed, sufficient and good quality water resources.

Figure 3 – The two pillars that support water security

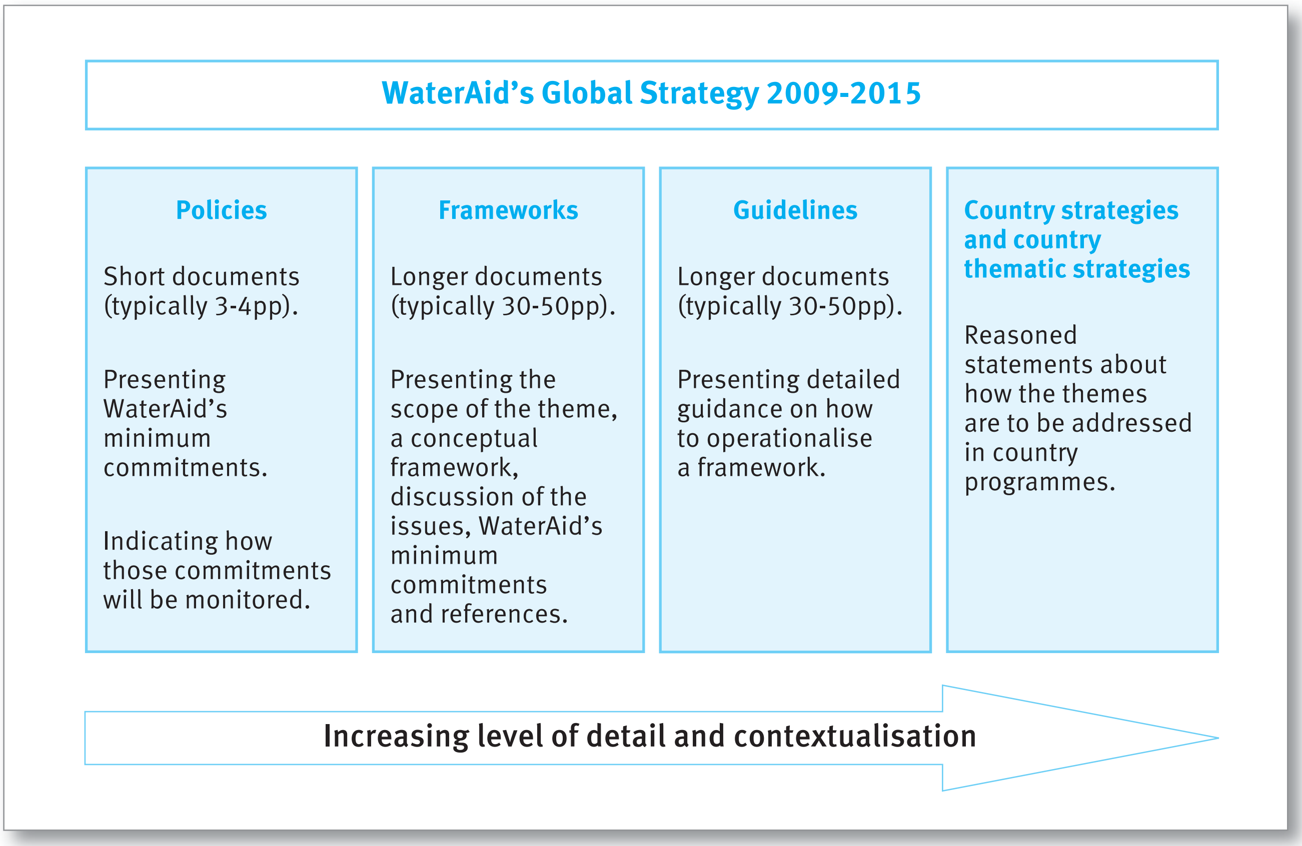


WaterAid's *Sustainability framework*[5] sets out the necessary components for sustainable water supply services, which make up the right-hand pillar of Figure 3.

This framework sets out the necessary components for water security, focusing specifically on water resources, their development and ongoing management.

Our *Disaster management framework*[6] sets out issues relating to disaster risk, some of which are touched upon in this document.

Figure 4 – How framework documents are situated beneath WaterAid's Global Strategy



This framework should be used in conjunction with the following WaterAid publications:

- *Global Strategy*[1]
- *Sustainability framework*[5]
- *Urban framework*[7]
- *Sanitation framework*[8]
- *Hygiene framework*[9]
- *Equity and inclusion framework*[10]
- *Disaster management framework*[6]
- *Counting users and post-implementation monitoring guidance*[11]

This framework supersedes WaterAid's *Water resource management policy and guidelines*.

The nature of the global water crisis

In the various discourses on water security the global water crisis is framed in a variety of ways. It is sometimes portrayed as an absolute scarcity, where fresh water is running out, where there is only so much water per person, and where the water needs of a population cannot be met with available supplies. This sometimes misleading depiction often triggers dire warnings of countries going to war over water[12].

The reality in areas where WaterAid works is that poor communities cannot get access to sufficient quantities of good quality water locally, even though water itself may not be scarce on a national scale. This is because water supply services, which are required to access, store and convey available water to communities, are unequally distributed and water resources largely go unmanaged. This is not a technical problem that can be solved with a technical solution alone. It is a problem that relates to the way that water resources and water supply services are governed.

Credit: Charlie Bibby, Financial Times

Slum housing as seen from the polluted Lake Gulshan, which separates the Korail slum from the affluent area of Gulshan, Dhaka, Bangladesh.

Water scarcity and water stress

These terms are frequently used to describe situations where a water crisis exists. But what do they actually mean? Len Abrams provides some useful definitions which are summarised below[13]:

Water scarcity

This term is used to describe the relationship between demand for water and its availability. There are two types of water scarcity. A **physical scarcity** exists when demand for water outstrips supply. This occurs when water resources are over-exploited. A **socio-economic water scarcity** exists when insufficient investment, skills or political will exist to keep up with growing demands for water, preventing access to the resource. Both forms of scarcity are derived from poor governance of water resources rather than absolute availability. In many countries where WaterAid works, a socio-economic water scarcity exists; water is available but poor communities lack access to it.

Water stress

Water stress is the outcome of water scarcity and may manifest itself as drinking water insecurity, poor access, poor health, conflict over water resources, crop failure, food insecurity and/or energy insecurity.

It is important that these terms are used accurately and with caution. The term 'water scarcity' does not necessarily mean there are inadequate water resources in a particular place.

Even though this water supply pipeline runs directly through an urban slum in Dar Es Salaam, Tanzania, very few households are connected to the main town water supply. Poor communities may not have access to water, even though it may be present.

WaterAid/Richard Carter

Why are people water insecure?

For many of the 783 million people worldwide who lack access to safe water, the primary problem is rarely one of physical scarcity, in which demand outstrips available supply, but rather of socio-economic water scarcity. There may be:

- Insufficient political will to improve water supply services and management of water resources.
- Insufficient investment in water supply services and management of water resources.
- Insufficient skills to manage water supply services and water resources.
- Insufficient human capital to manage water supply services and water resources.
- Exclusion of certain groups, because of inability to pay, political affiliation, disability, race, caste, gender, age or social status.

In many parts of Sub-Saharan Africa, South Asia, Latin America and Oceania, water resources may be present but not **where** or **when** they are needed most; they may be contaminated, located a great distance from households or inaccessible because of difficult terrain; or they may have been depleted by uncontrolled abstraction[14].

Poor, or socially or politically excluded groups may be ignored when investment is made in water supply service extension. They may also be prevented from using existing services.

The result is that millions of people lack access to a water supply that is safe, close to the home and available all year round. People frequently travel long distances to unprotected, contaminated and seasonally unreliable water sources in order to meet their daily needs. Those living in crowded, informal urban settlements often depend on water vendors and trucked water of dubious quality sold at a relatively high price. Both children and adults suffer high morbidity and mortality rates as a result of drinking contaminated water or having insufficient water for basic hygiene. These problems exacerbate poverty, stifle human development, leave people exposed to pressures on their health and livelihoods, increase the workload of women, lead to migration[15] and prevent people from living with dignity.

Water resource scarcity can be managed

Wealthy nations with very little renewable fresh water (such as Singapore) can offset low water availability by investing in coastal desalination, inter-basin water transfers, wastewater reuse, food imports, tariff adjustments to regulate demand, and cutting the amount of water allocated to ‘thirsty’ agricultural practices. There is high institutional capacity to manage available resources.

Such options can be too expensive or too difficult to apply in low-income countries due to the inability of institutions to manage them or the scale at which they would have to be implemented to reach remote rural populations. The State of California uses 19% of its total energy budget to move water over long distances to meet the household water demands of its population[16]. This high energy commitment to move water around is not practical in many countries where WaterAid works.

A high-tech reverse osmosis water purification plant in Florida, USA. Solutions like this are expensive and require substantial energy input.

Measuring water insecurity

Measuring water insecurity is not straightforward and many of the tools devised to characterise scarcity produce misleading results. Such tools tend to frame the water crisis as one of absolute quantities available, ironically, without taking into account all water available.

For example, the Falkenmark Water Stress Indicator assesses a nation’s annual renewable fresh water availability per person and classifies countries with less than 1,000m^3/person as suffering from water scarcity. This simplistic indicator dates back to 1989 but is still widely used today. However, it has many shortcomings. It overlooks a country's ability to make use of available water resources[17]. It does not acknowledge that water may only be present in certain locations or at certain times of the year. It only accounts for renewable blue water (surface and groundwater flows) and omits blue water storage in aquifers, which, although not renewable, may be a substantial buffer. It also omits green water (soil moisture available for plant growth) which again may be substantial. It takes no account of varying demand from place to place or of water quality issues. Falkenmark has since introduced the concept of green water[18] which has significantly advanced methods for assessment of water scarcity.

Water availability

When rain falls onto land it can be evaporated back into the atmosphere or pass into rivers, streams, lakes, the soil and aquifers. These water resources can be classified into two broad groups:

Green water enters the soil, is temporarily stored there and flows out by evapotranspiration. It is essential for plant growth and may exist in large quantities but is often overlooked when assessments of available water resources are made.

Blue water consists of rivers, streams, lakes and groundwater[18].

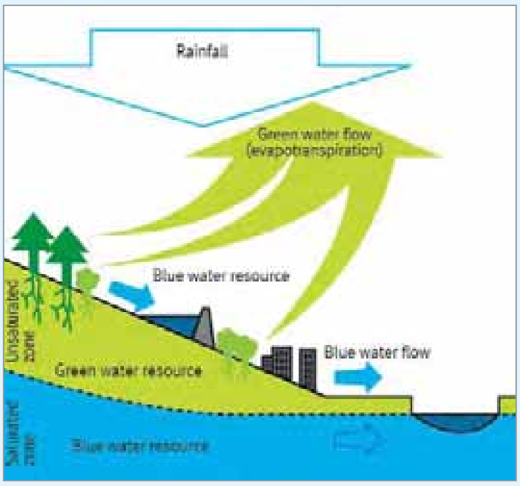


Figure 5 – Green and blue water in the environment[18]

Consumptive and non-consumptive uses of water[17,19]

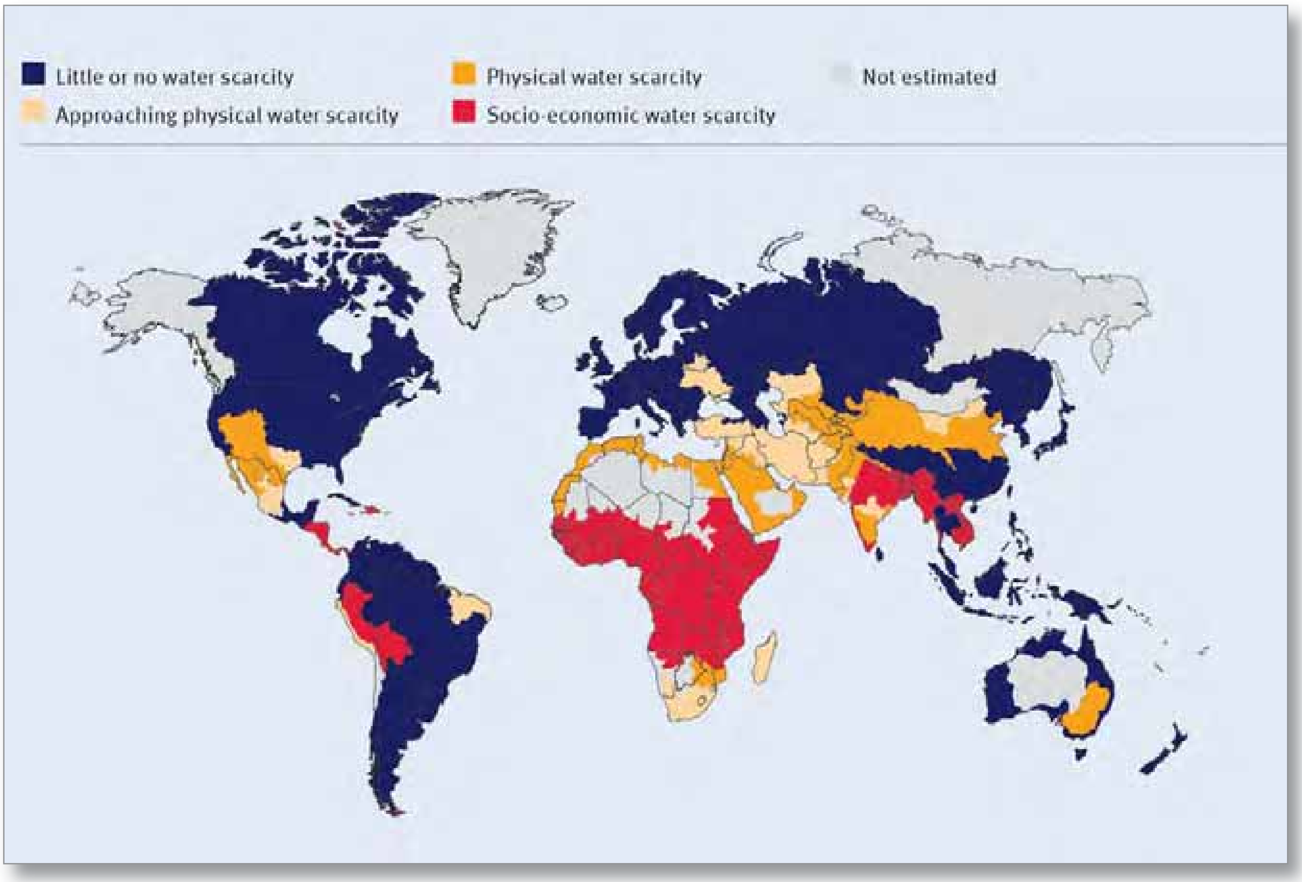
When looking at water availability, it is important to distinguish between consumptive and non-consumptive use:

- **Consumptive use of water**
  Water that has been put beyond further short-term use because it has evaporated, transpired, been incorporated into products and crops, or been consumed by humans or livestock.
- **Non-consumptive use**
  Water that has flowed back into the environment after being used as part of a process such as inefficient irrigation, industrial washing or cooling processes, and hydro-power generation. This water may be polluted, but it has been returned to the environment and may be available as wastewater for other uses.

The Water Poverty Index[20] attempts to accommodate the social and economic factors that have an impact on water scarcity, producing a national rating based on resources, access, use, capacity and environment. The drawback of this measurement tool is that each aspect is equally weighted in importance, which may not hold true in different communities, economies, cultures and ecosystems.

There have been attempts to map water scarcity. Figure 6 is a world map showing areas where physical and socio-economic water scarcity exists, based on a map produced by the International Water Management Institute. For clarity we have adapted the key to refer to 'socio-economic' water scarcity rather than 'economic' water scarcity which featured in the original map. Areas where water withdrawals are above 75% of total river flow are classified as suffering from physical water scarcity. Areas where water withdrawals are less than 25% of river flow but where malnutrition exists are classified as suffering from socio-economic water scarcity.

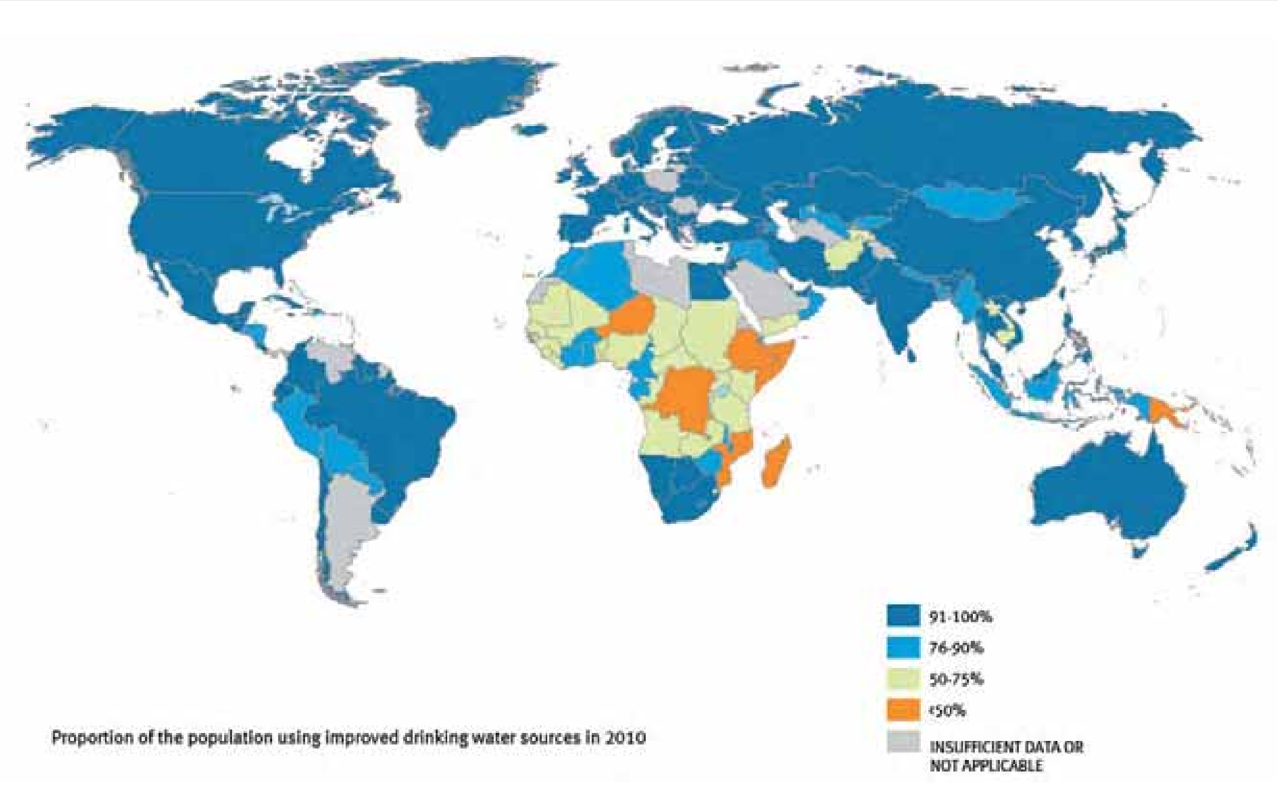
Figure 6 – The distribution of physical and socio-economic water scarcity[21]



It is important to note that this map does not illustrate the distribution of renewable fresh water resources. Areas showing a scarcity may still receive high rainfall or may have substantial groundwater reserves.

The picture of where drinking water scarcity exists becomes clearer when Figure 6 is looked at together with Figure 7 (overleaf), which shows the extent of improved drinking water supply coverage.

Figure 7 – Proportion of population using improved drinking water sources in 2010[22]



The aim is to improve access and increase the amount of water available to people

When water shortages arise in high-income countries, where people use up to 400 litres or more per capita per day at household level, or in countries where large quantities of water are used for food production, there tends to be a focus on demand management aimed at using less water. In low-income countries, such as those in which WaterAid works, where people sometimes get by on less than five litres per day, the focus is very much on improving water supply services to make more clean water available to people.

Summary

In South Asia, Sub-Saharan Africa, Latin America and Oceania, water insecurity is largely a problem of social and physical barriers preventing equitable access to water. Water resources largely go unmanaged and water supply services required to access water struggle to keep up with growing demand. Inadequate management capacity has an impact on the longevity of water supply services. Consequently, the quantity and quality of water supplies accessible to people are insufficient to meet basic human needs. While the Millennium Development Goal water supply target to 'halve, by 2015 the proportion of the population without sustainable access to safe drinking water' relative to 1990 has been met globally, the target will not be met in parts of Sub-Saharan Africa, parts of South Asia and parts of Oceania[22]. The various methods available for assessing water scarcity and water insecurity have flaws and should be used carefully.

Credit: WaterAid/Tom Van Cakenberghe

Women collect water from the river, Sindhuli district, Nepal.

Part 2

Threats to water security

Even when access to an improved water supply has been achieved, it cannot be taken for granted. Water availability and quality fluctuate over time, demands for water change and water sources must be managed effectively if they are to remain in operation. Part 1 touched upon some of the reasons why communities in WaterAid's countries of operation lack water security. This part explores some of the causes of water insecurity in more detail. As these causes are interlinked, with complex relationships between them, they should be considered together rather than in isolation.

Weak political will and low institutional capacity to manage water resources and water supply services

Poor governance and/or weak political will to commit the necessary financial and human resources to water supply development and water resource management stifles progress. Even where sufficient financial resources are allocated, serious and widespread capacity constraints undermine effective implementation and equitable targeting of services[23].

Responsibility for management of rural water services is often delegated to communities. However, it is a myth that all communities can manage their water supply services sustainably in the absence of external technical, managerial and financial support from local public or private sector institutions. For example, many will require external support when major repairs are necessary. This issue is explored further in WaterAid's *Sustainability framework*[5].

Where investment is made in institutions tasked with integrated water resource management (IWRM), communication and enforcement of legislation and regulations can be a slow process, and there can be confusion over responsibilities at the local level. National-level integrated water resource management (IWRM) policies can sometimes be developed without consideration of existing informal and traditional institutions tasked with allocation of water resources and resolution of water use disputes, meaning they lack relevance at the local level[24].

Social and political exclusion

Many people lack water security because of their political affiliation, disability, race, caste, gender, age or social status.

In 2010, the United Nations General Assembly adopted a resolution recognising that access to safe water and sanitation is a human right, essential for the full enjoyment of life. This is yet to be translated into specific obligations at international and national levels and operating principles that will assure water security. In some instances, communities may be unaware of their rights to improved service provision and may not demand improved services, contributing to further exclusion.

In some drought-prone environments, such as Konso in southern Ethiopia, communities with access to reliable water supplies may share water with neighbouring communities but only after they have watered all of their livestock and collected water for household use first. In some situations, communities that do not support ruling political parties are not prioritised for service provision.

Improved water sources may not be accessible to people with certain disabilities or chronic illnesses unless inclusive design principles have been observed. WaterAid's *Equity and inclusion framework*[10] tackles the issue of exclusion in detail.

Poverty

In WaterAid's experience, even where communities have access to improved services, individuals with no ability to pay for water can be excluded from reaping the benefits unless mechanisms for cross subsidy are in place.

Research carried out by the ODI and the BGS in Ethiopia[25] looking into links between wealth and access, highlights that wealthy households use more water than poor households, especially during drought periods. Wealthy households can mobilise more labour to collect water. They may have more jerry cans and donkeys than poor households. Wealthy households are therefore more water secure by virtue of the financial resources at their disposal. Lasting improvements in water supply, sanitation and hygiene come with overall economic development. Income is required to pay for services, and productive, sustainable livelihood options are necessary.

Low community resilience to cope with stresses on water supplies

Communities with fragile livelihoods, fragile coping strategies, limited financial resources, and limited technical and adaptive capacity are more vulnerable to stresses on their water supplies. They may lack secure water supply infrastructure, services and management capacity.

Poor hygiene and sanitation

The overall effectiveness of water supply interventions aimed at boosting water security is undermined if poor hygiene and inadequate sanitation prevail. Relatively clean water collected from a water source can be heavily contaminated by dirty collection vessels and unwashed hands. Disposal of human faecal material in the open environment increases the risk of human contact with dangerous pathogens. Poorly sited latrines or water sources also have an impact on water quality.

Rapid population growth and urbanisation

The population of Africa is projected to almost double by 2050, from 1.03 billion people in 2010 to two billion, according to United Nations population projections[26]. As an example of the rapid population growth predicted in Africa, the population of Ethiopia is projected to increase from 85 million people in 2010 to 173.8 million in 2050[23]. Rapid urbanisation is also taking place, with populations in African cities growing by an average of 3.4% per year. The urban population of Africa is set to increase from 40% to 50% by 2030[27] (although not in every country).

Likewise, the population of South Asia is projected to increase by almost another billion people by 2050. In this region, urban populations are growing by approximately 2.4% per year.

The implications of these rapid population rises and demographic changes for water security are sixfold:

- **Keeping pace with demand for services**
  Firstly, governments and service providers are already struggling to keep pace with rapidly increasing demand in both rural and urban areas, and large numbers of people remain unserved. A growing population will exacerbate the problem unless political action is taken to commit greater financial and human resources to improving water supply service provision.

- **Keeping pace with domestic demand for water resources**
  Domestic per capita water consumption is higher in urban areas than rural areas[28]. As the populations of both major cities and small towns grow, domestic water consumption increases and it may be difficult to meet demand using nearby water resources. Some African and South Asian cities already depend upon surface and groundwater conveyed from distant sources to meet demand[29]. High leakage rates and unaccounted for water from existing infrastructure will need to be reduced and storage capacity will need to be increased. High leakage rates can increase local groundwater availability in some circumstances but the benefits of this are often offset by pollution with heavy contaminant loads, discharged by on-site sanitation and urban industry[30].

- **Increased agricultural production and knock-on impacts on water resources**
  Growing populations place increased pressure on land, agriculture and water resources to meet food needs[31]. Economic growth increases demand for water resources through changes in diet and lifestyle. As people become wealthier, they typically consume more water-intensive foods and products. Unless well managed, intensification of agriculture and cultivation of marginal lands result in environmental degradation. Changes to land use have significant knock-on impacts on the quality, quantity and reliability of water resources. Overgrazing is a major cause of environmental degradation, in some situations causing soil compaction and erosion, reducing water infiltration and storage[32]. Clearance of indigenous vegetation to make way for agriculture can increase as well as decrease blue water availability[33].

  Intensive irrigation using groundwater is well established in some parts of South Asia, depleting aquifers where unregulated abstraction and natural discharge exceed recharge[34]. India, the largest user of groundwater in the world, is facing serious problems in certain states as aquifers have reached the limit to which they can sustainably be exploited[35]. Environmental non-governmental organisation, Friends of the Earth points out that there is a growing interest in the production of crops for fuel (biofuels)[36]. According to the World Bank's 2011 assessment of agricultural and rural development[37], a 2008 commodity boom dramatically increased interest in agricultural land as a potential investment, especially in Sub-Saharan Africa. Friends of the Earth has documented instances of 'land grabs' in Africa, 'where land traditionally used by local communities is leased or sold to outside investors (from corporations and from governments)'[36].

- **Pollution and water quality problems**
  Intensive farming can have negative effects on water quality, for example in areas where nitrate-based fertilisers are used. High soil and groundwater salinity caused in part by the activities of shrimp farmers and the upstream damming of rivers is prevalent in south-western Bangladesh[38]. On-site sanitation (septic tanks, soakaways, cesspits and pit latrines) can be a major source of widespread microbiological and nitrate groundwater pollution in densely populated areas as well as sparsely populated areas if they are sited too near water sources. Untreated industrial effluents containing high concentrations of hazardous substances pollute surface and groundwater resources where uncontrolled discharge takes place.

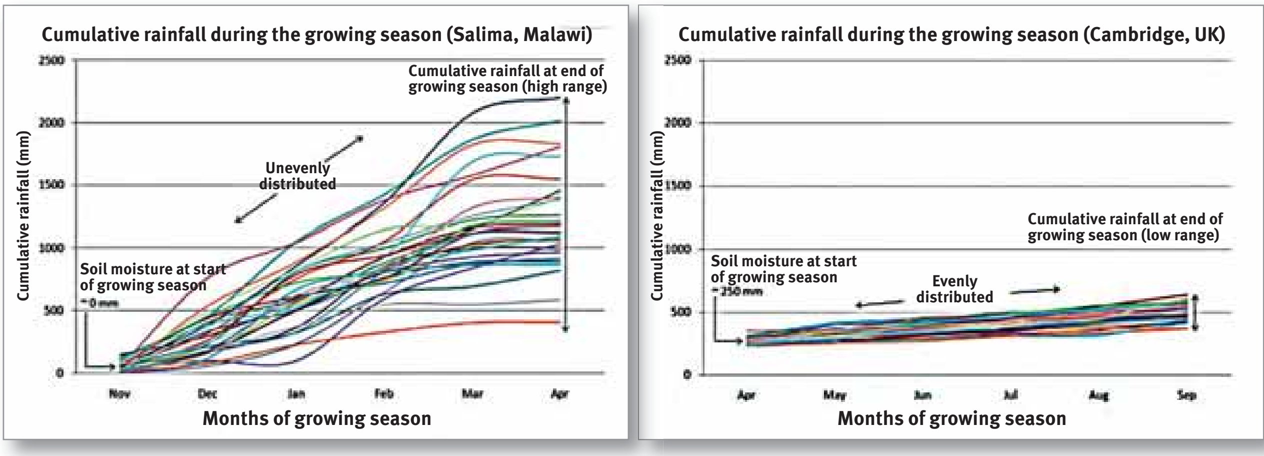
- **Settlement of marginal land and increased disaster risk**
  As populations grow, more marginal, flood and landslide-prone land such as flood plains, areas with high water tables and unstable slopes are built upon, especially around urban centres, increasing exposure to disasters[39]. In rural locations, poor communities often occupy the most drought-prone areas[40]. United Nations Development Programme (UNDP)'s 2011 report on reducing disaster risk points out that cultivation of marginal land can itself create risk, giving the example of deforestation to make way for agricultural production, leading to soil erosion and new patterns of flood, drought, fire and landslide hazard[41].

- **Increased competition for water**
  While military conflict between states over water looks unlikely in the next decade, competition for access to water resources manifesting in localised conflict is a reality in water scarce areas such as the Sahel in Africa. Growing populations are likely to increase the level of competition and conflict unless competing demands can be managed.

Climate variability

The natural variability of the climate presents a major challenge to the water and food security of rural people who make a living from the land and its natural resources. In most of the low latitude African and Asian countries where WaterAid works, annual rainfall is highly variable and the start and end date of the rains varies greatly. This variability is a major contributor to the continuing poverty of farmers and pastoralists who rely on rainfall for crop production and grazing, and who use the natural vegetation in their immediate environment.

Figure 8 – The difference in annual rainfall variability between Salima in Malawi (a low latitude tropical zone) and Cambridgeshire in the UK (a higher latitude temperate zone)



The starting point for each graph is the beginning of the growing season[42]. Each coloured line represents one year's rainfall. The graphs show that annual rainfall in Cambridgeshire is far more predictable than annual rainfall in Salima.

Droughts are normal, recurring extensions of seasonal water shortages rather than abnormal events[41]. Weak local institutions lack the capacity to plan for and respond to drought events[43], which greatly exacerbates their impact, perpetuating poverty and stifling human development in rural areas.

When drought strikes and rains fail, crops fail, food supplies dwindle, a food security crisis emerges and people go hungry[44]. Research in East and Southern Africa carried out by ODI and BGS in 2002[45] points out that in addition to food security, drinking water security is a casualty of droughts in three ways:

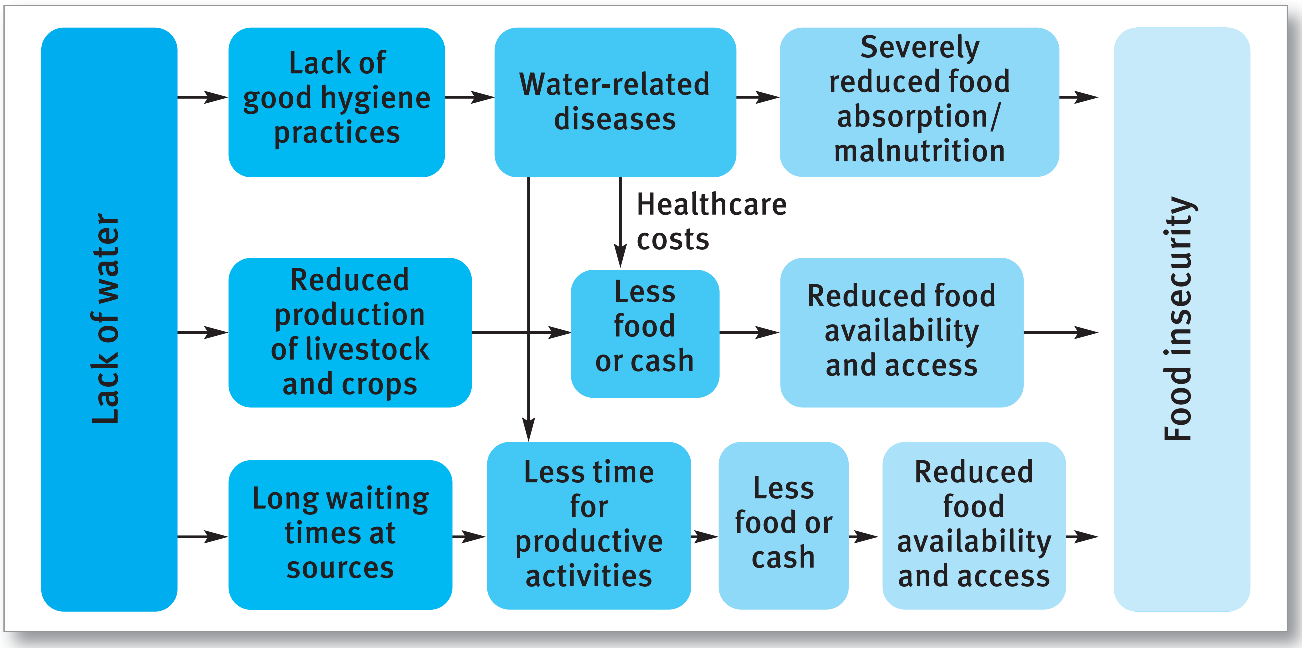
1 Groundwater levels may fall below the base of constructed wells and boreholes, causing well failure.

2 When crops fail, rural households dependent on crop trading lose their income and they may have to spend any money they have on food, meaning there is little left to pay for the upkeep of water points. As a result, water points fall into disrepair and fail to yield safe drinking water.

3 Unprotected surface water sources may dry up, placing greater demands on any handpumps that remain in service to meet both domestic and livestock needs. This puts strain on the pump mechanism and leads to breakdowns. Such situations force people to walk to distant sources which may be unprotected, increasing exposure to potentially fatal diseases.

Research carried out by the RIPPLE programme in Ethiopia highlights the links between water availability and food security[46].

Figure 9 – The links between water and food security from RIPPLE research carried out in Ethiopia



Flooding is another consequence of the intense climate variability experienced at low latitudes, with devastating consequences in many of the countries where WaterAid works[47].

Climate change

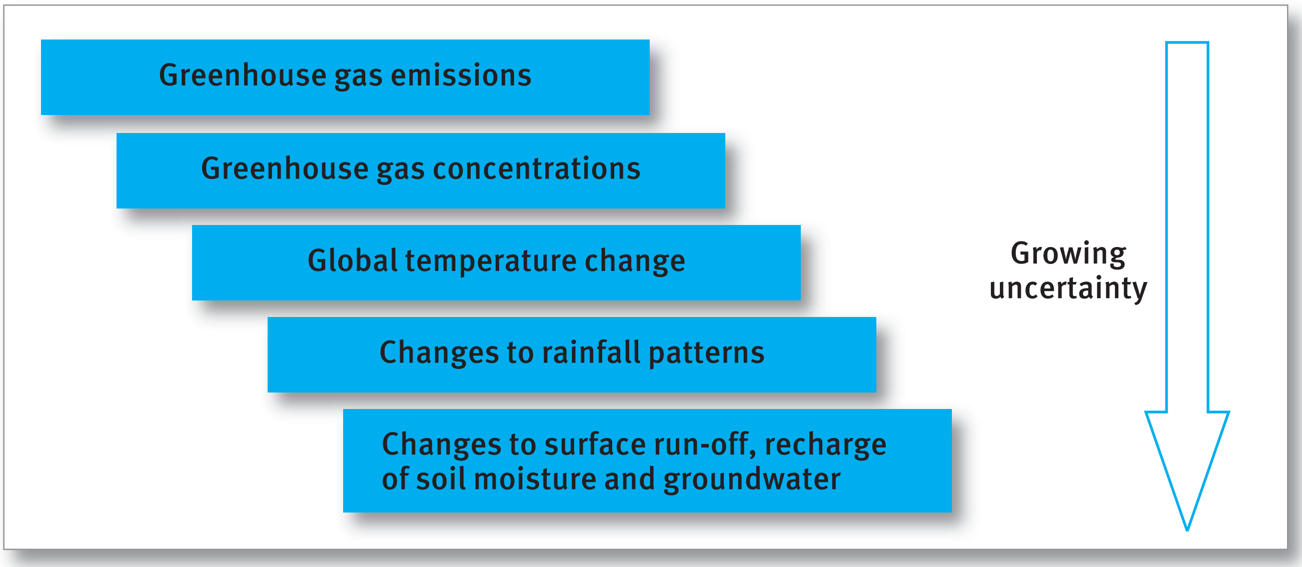
Changes in the earth's climate occur naturally over time. Alongside these natural climatic shifts, it is now accepted that human activity is contributing to rises in global temperatures. These changes are expected to add to the challenges faced by the world's poorest people.

While there is a high degree of certainty relating to temperature increases due to greenhouse gas emissions, there is very little certainty about the local- and national-level impacts. Global circulation models can be used to investigate possible future climate changes, but these have significant limitations and are of little use for local-level planning. While global temperature increases have been observed, mean annual rainfall is likely to increase or decrease depending on location according to the Intergovernmental Panel on Climate Change (IPCC)[48] with a great deal of uncertainty around these projections in WaterAid's countries of operation. In countries that rely on snowmelt for part of their water supplies, any recession of mountain snows and glaciers will affect the seasonality of river flows. Sea level rise will affect low-lying coastal areas. Extreme weather events are likely to become more frequent according to the IPCC but are not going to be the only factor contributing to increased disaster risk.

Climate change is an important long-term risk, but it is vital to understand two things: firstly, attributing local events to climate change is very difficult and in some cases impossible; secondly, many other factors affect the availability of water resources. Climate change must be seen in the context of existing high levels of climate variability at low latitudes, population growth, increased demand for water resources, political obstacles, increased disaster exposure due to settlement of hazard-prone areas, and environmental degradation. While climate change is topical, it is not the only driver of water stress.

Climate change is about uncertainty. The communities in which we work have lived with climatic variability for a long time. This uncertainty does not mean inaction is acceptable; we know that climate change could have severe impacts, so we must adopt a no regrets approach that takes account of the uncertainty. Many strategies aimed at coping with current levels of seasonality provide a good basis for coping with climate change[49].

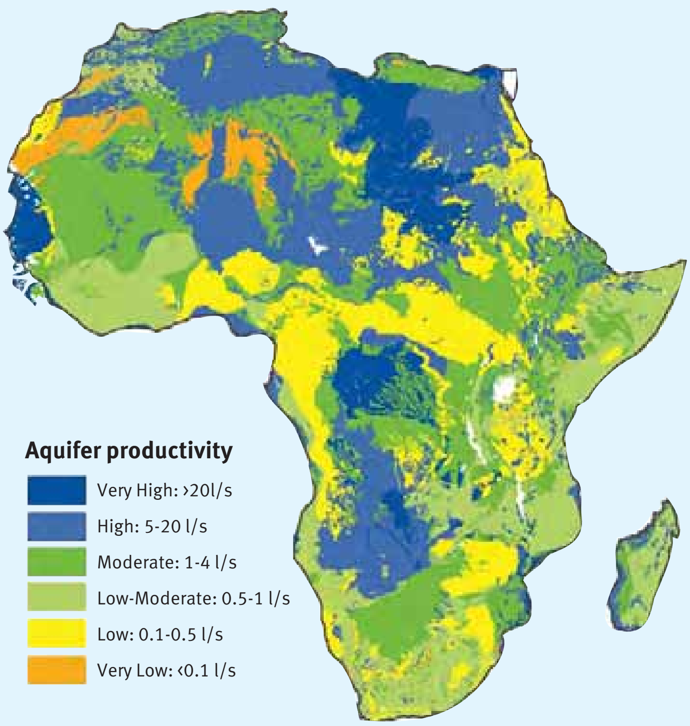
Figure 10 – The cascade of uncertainty[50]



Groundwater and climate change

Figure 11 – Aquifer productivity in Africa[25]

Recent ODI and BGS research[25] investigating the potential impact of climate change on groundwater supplies in Africa highlights that 'people relying on unimproved water sources (surface sources and open shallow wells) are likely to be most affected by climate change' because these are more vulnerable to seasonal drying and contamination.



The research also highlights that, 'Climate change is unlikely to lead to a continent-wide failure of improved rural water sources that access deeper groundwater (generally over 20 metres below ground surface) through boreholes or deep wells. However, a significant minority of people could be affected if the frequency and length of drought increases – particularly those in areas with limited groundwater storage.'

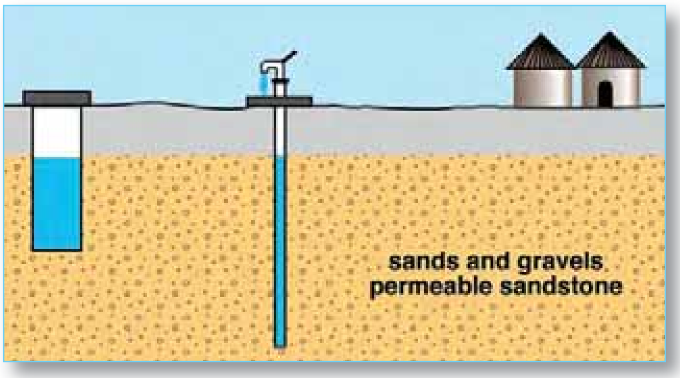
Complex hydrogeology and challenging terrain

Complex hydrogeology and challenging terrain make development of water resources difficult. Good supplies of groundwater cannot be found everywhere, its occurrence being very much dependent on local hydrogeology. Borehole drilling will not always locate groundwater and drilling success rates vary from place to place.

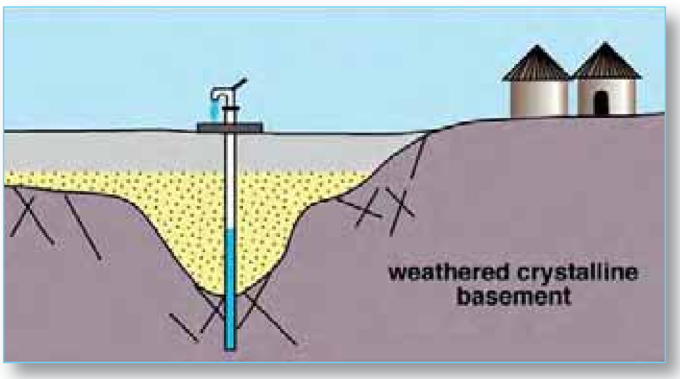
The BGS has identified three broad hydrogeological environments based on how easy it is to locate sources of groundwater[51].

Figure 12 – Different hydrogeological scenarios and different levels of complexity involved with locating groundwater[52]

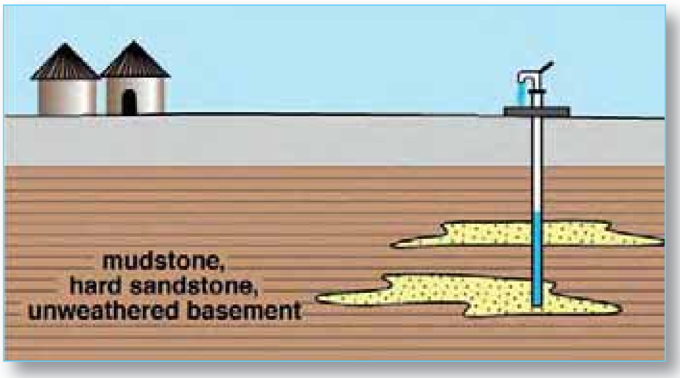
Scenario 1: Easy to find groundwater:
boreholes and wells can be sited anywhere



Scenario 2: Hydrology generally understood:
geophysics, interpreted using simple rules, can be used to site a borehole

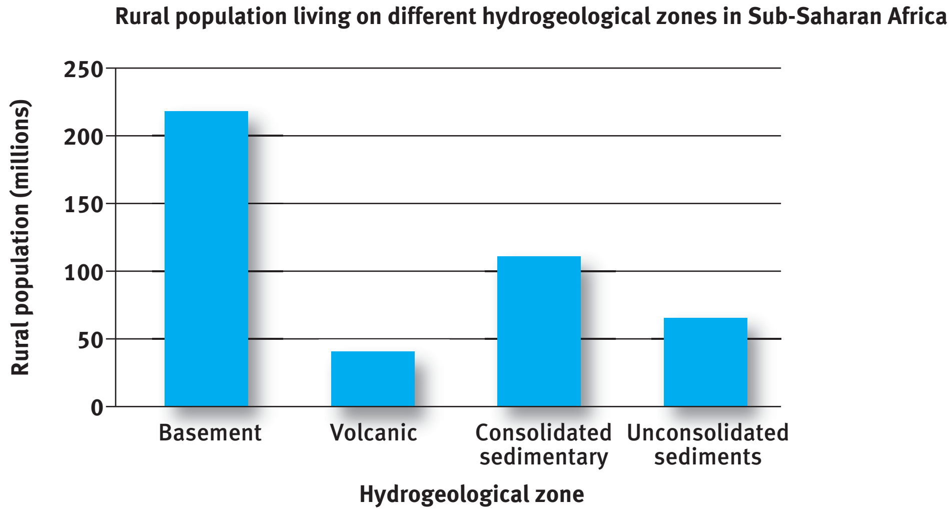


Scenario 3: Hydrogeology complex:
successful boreholes and wells difficult to locate using simple rules.
Detailed investigations required



In Sub-Saharan Africa, 50% of the rural population lives on crystalline basement terrain (leftmost column in Figure 13, below) which may or may not have fractures or weathered zones where water is stored[53]. This means the siting of wells is not always straightforward and requires some level of investigation. Volcanic rock formations, where the incidence of groundwater is highly variable, underlie some of the poorest and most drought stricken areas of Africa[25].

Figure 13 – Rural population living on different hydrogeological zones in Sub-Saharan Africa[52]



In mountainous regions, for example in parts of Nepal and parts of the Ethiopian highlands, it can be difficult to access groundwater using wells and boreholes because the terrain constrains drilling rig access. Instead, water supplies from springs can be piped by gravity to users.

The ability of groundwater to meet the demands placed upon it is related to the volume of storage present in the aquifer and the rate at which groundwater can move through the aquifer.

Hazardous levels of naturally occurring arsenic are present in groundwaters in certain areas such as the alluvial and deltaic aquifers of Bangladesh, north-east India and the Indus Valley of Pakistan. Hazardous levels of naturally occurring fluoride are present in groundwaters in parts of India, Ghana and the East African Rift Valley (Kenya, Uganda, Tanzania, Ethiopia).

Hydrogeological and terrain factors combine with hydrochemical aspects to influence the quantity, quality, reliability, manageability and in some cases where drilling success rates are low, affordability of improved water supplies.

Poor siting, design and construction of water sources

A large number of handpumps in Sub-Saharan Africa and South Asia fail because boreholes and wells have not been sited or designed appropriately to make best use of the resource. A lack of qualified supervision representing the client on drilling and construction sites results in poor quality work, wasted money and disappointed users.

The optimal siting of a well or borehole in areas where aquifers are most productive is essential for success and long-term sustainability[52]. If dug wells and boreholes are not constructed deep enough to accommodate seasonal fluctuations in groundwater levels, they may not withstand drought conditions, only yield water for part of the year, or fail completely. If they are constructed at the wrong time of year, for example when groundwater levels are not at their lowest, they may not be built deep enough to accommodate drought conditions. If contractors are not supervised during construction by competent individuals there is the danger that corners will be cut and boreholes may not be drilled as deep as contractors claim. Wells and boreholes sited purely on the basis of meeting user targets without consideration for hydrogeology may perform badly.

The remains of a broken handpump. Handpumps, wells and boreholes may fail for a number of reasons but poor siting, design and construction can be major causes.

Where springs are used, it is crucial to design for some level of fluctuation in dry season flow over time.

The ODI and BGS[41] point out that in the Sub-Saharan African rural water supply context, regional depletion of aquifers is rarely a problem where manually operated handpumps with an abstraction capability of no more than 2-6m^3 per day are used. Handpumps are usually few in number so abstraction does not exceed long-term aquifer recharge from rainfall. Localised depletion around these water sources in low yielding aquifers can certainly be a problem, but overall depletion of the resource due to over abstraction rarely takes place where manual pumping is used.

The abstraction of groundwater is limited by pump output capacity, the rate at which water can move through an aquifer (transmissivity) and the duration of pumping. Where there is no motorised pumping, water source failure is more likely to result from poor water source siting and design, poor construction quality, poor maintenance, localised drawdown because of low transmissivity, or pressure on the resource from drought conditions, rather than depletion of the resource from over-abstraction.

However, where motorised pumping takes place, for example to meet the needs of a small town, refugee camp or irrigation scheme, the potential for widespread depletion of groundwater is increased. Pumping rates are greater and many tens or hundreds of cubic metres may be withdrawn per day. In these situations, an understanding of groundwater storage and recharge rates, coupled with ongoing monitoring of water levels is essential.

If boreholes fitted with manual handpumps are upgraded to motorised pumps without adequate yield and groundwater availability assessment to determine whether they can support higher abstraction rates, they may fail to meet the demands placed on them and could even fail completely.

Poor water source design and poor construction quality can also have an impact on water quality. Poor sanitary seals on wells enable microbiological contaminants to seep into water supplies. Cost-cutting and corruption can sometimes result in procurement of low quality materials that corrode in aggressive groundwaters. Even good quality well materials can corrode in these conditions.

Summary

Communities face multiple threats to their water security. Together, these threats have an impact on access to water supplies of sufficient quantity and quality for basic needs. There are knock-on impacts on health, livelihoods and overall wellbeing. The relationships between these different threats are complex and therefore they should not be considered in isolation. Climate change is sometimes singled out as a major driver of water insecurity but there are other significant and immediate challenges that should also be considered. The most serious near-term challenges include meeting the needs of growing populations, weak political will to ensure that the poorest people are served, low institutional capacity to deliver and manage water supply services, environmental degradation, intense seasonality, inadequate management of water resources, inadequate disaster risk reduction planning, and poor siting, design and construction of water sources. Climate change exacerbates these severe challenges.


WaterAid/Richard Carter

Women draw water from an unprotected well in Niger.

Part 3

Dimensions of water security

This section unpacks the dimensions outlined in WaterAid's definition of water security, drawing upon an extensive literature review and consultations with our country staff.

Reliable access

People are described as having access to water if they can use a functioning facility serving safe water within a reasonable distance of their home, and without exclusion on grounds of race, tribe, religion, disability, gender or other cause[5].

There is no universally accepted measure of what constitutes acceptable access to water but various national standards exist, largely based on distance. *The Sphere Handbook*[54], developed by a cluster of humanitarian agencies for use in emergencies, measures access in terms of distance, queuing time and the number of people served per water source (depending on the water source type). WaterAid country programmes generally follow national standards on access where they exist.

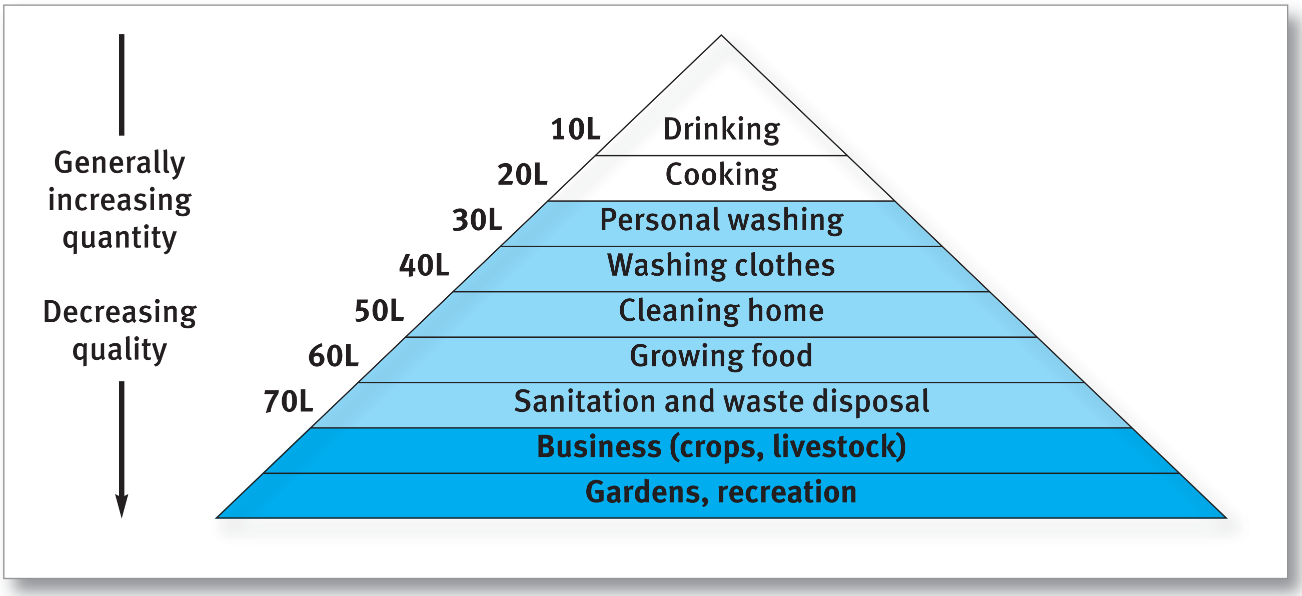
Conditions can change over time. Water security cannot be achieved if water is only available for part of the year or if water quality is impaired at certain times of the year, for example at the beginning of the rainy season. A water supply must provide reliable access to water of sufficient quantity and quality all year round. An unreliable water supply exposes communities to negative impacts on health and livelihoods.

Quantity

The quantity of water resources available in a particular area will be influenced by rainfall, run-off, recharge of soil and groundwater, hydrogeology, land use, and water demands. Improving proximity to water supply services can increase the quantities available to households, especially where household connections are used[55].

In order to meet basic human needs, sufficient quantities of water must be available to prevent dehydration. There must be enough for cooking, bathing, sanitation and hygiene. There are no universally accepted definitions of what constitutes an acceptable quantity of water. Different countries set different national standards. *The Sphere Handbook*[54] recommends that a minimum of 15 litres per person per day must be available to meet basic survival needs in emergencies. Gleick[3] recommends that 50 litres per person per day is necessary to meet basic human needs. The World Health Organisation (WHO) defines optimal quantity for domestic use as 100 litres per person per day[56]. Various studies show that the amount actually collected from improved water sources for domestic use tends to be below these standards[25, 57].

Figure 14 – An outline of different quantities of water for different purposes[58]
(Quantities are in litres per person, per day)



Uses that require greater quantities of water generally require lower quality water[58].

Quality

For drinking water security, the quality of water should be such that no significant health risk arises from its use. It should be acceptable to users in appearance, taste and odour. Contaminant levels should not exceed the broadly accepted water quality standards of the region or the country where it is consumed.

WaterAid/Vincent Casey

A handpump in Dahr, India, that has been marked to show that fluoride concentrations are within safe limits.

WaterAid's *Water quality guidelines*[59] outline three major types of contamination that affect the water security of poor and marginalised communities:

- **Microbiological contaminants**
  Infectious diseases caused by pathogenic bacteria, viruses and parasites are the most dangerous and widespread health risk associated with drinking water. Microbiological contaminants originating from human and animal excreta have the capacity to rapidly incapacitate large sections of a community, causing severe illness and death. Almost 2,000 children die every day from diarrhoea caused by unsafe water, poor hygiene and sanitation[60]. Unprotected surface and groundwater supplies are vulnerable to contamination with human and animal excreta. Sources are especially prone to contamination following flooding or other disaster events that damage water supply infrastructure.

- **Inorganic contaminants**
  Inorganic contaminants such as arsenic, fluoride and nitrate pose a significant danger to health if present at hazardous levels. Elevated concentrations of arsenic and fluoride can be harmful after prolonged consumption.

- **Nuisance contaminants**
  Other inorganic contaminants exist that could be described as 'nuisance contaminants' in that, although they are not directly harmful to health at concentrations normally observed in drinking water, they may impact on aesthetic considerations such as taste, odour and appearance, and cause people to abandon safe sources for unsafe ones. Common nuisance contaminants include iron, manganese and salinity. High water hardness can clog pipes and reduce the design life of water supply schemes.

Dirty water, disease and death

Dirty water is not the only, or necessarily the most important, transmission route for intestinal pathogens that cause diarrhoeal diseases and infant mortality. Infection can also be caused by consuming contaminated food or coming into contact with unwashed hands, flies or contaminated cooking/eating utensils. Improvements in drinking water quality alone only contribute to a partial and relatively small reduction in a given disease burden.

Risk of water-related disasters

Just as drought and having too little water causes problems, too much water in its unmanaged state can cause devastation in the form of floods, landslides and disease outbreaks[61]. It is important to consider ongoing risks associated with too much or too little water in water security planning. Response to flooding will be covered in detail in WaterAid's *Disaster management framework*.

Summary

Reliable access, quantity, quality and risk of water-related disasters are core dimensions of water security.


WaterAid/Richard Carter

Women queue for water at a tap stand in Ethiopia.

Part 4

Improving water security

This section reviews processes aimed at achieving water security from WaterAid's own experience as well as academic and grey literature. These processes alone will not achieve water security without the necessary political will to ensure they are implemented equitably for the benefit of all water users.

Primary objectives for strengthening water security and community resilience include:

- Extending improved water supply services, ensuring sufficient quantities are available to meet health and livelihood needs.
- Sustaining improved water supply services (see *Sustainability framework*[5]).
- Reducing collection times and the burden of water collection.
- Protecting and improving water quality through improved hygiene and sanitation, source protection, safe handling, storage and treatment.
- Increasing water storage capacity.
- Strengthening the monitoring of water availability, water demand and water quality.
- Facilitating community-level risk assessment and risk-based planning.
- Facilitating the formation of community-level operating principles for coordination of equitable access and water use as well as protection of water resources.
- Strengthening the voice of poor communities to call for assistance from responsible authorities when access is threatened.

These aspects are drawn together in the following section within a water resource management framework.

The importance of water resource management

The Global Water Partnership defines **integrated water resource management (IWRM)** as 'a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems'. IWRM is based on sound principles aimed at addressing the fragmented nature of water resource development. However, effective implementation of IWRM is dependent on functional institutions with clear roles and responsibilities at every level, from central government to communities. The reality is that these institutions do not exist or are under-resourced in many poor countries. Generic basin-level IWRM plans are presented as a panacea to water resource problems but guidance on how they can be implemented at the local level in the absence of functional institutions is lacking[62]. Water, sanitation and hygiene (WASH) practitioners struggle to integrate basin-level IWRM concepts into their programme approaches, as considerations must go beyond immediate WASH priorities to agriculture, ecology and industrial water usage[24]. These links are seldom made in WASH programmes. Consequently, some WASH sector-led IWRM initiatives simply focus on water sources rather than water resources[63], with limited impact.

IWRM light has been formulated in recognition of the challenges associated with applying IWRM concepts without functional institutions and clear responsibilities at all levels. It has a more local-level focus than IWRM. It is based on local players from different sectors implementing the principles of IWRM at all stages in the programme cycle[64]. The intention is that if all local institutions implement IWRM principles it will lead to better water management and progress towards achieving broader IWRM.

Community-based water resource management (CBWRM) is a process that aims to achieve water security through a combination of practical activities that water users and local government can engage with. The terms CBWRM and IWRM light are sometimes used interchangeably. Both are based on progressive iterations to the IWRM concept. CBWRM recognises that communities may already have coping strategies and water use rules. Rather than overlooking or replacing these with theoretical top down IWRM concepts, the approach aims to strengthen them where appropriate. CBWRM provides a platform for communities to engage with authorities when assistance is required to tackle threats to water supplies. It provides an ongoing mechanism for risk assessment and risk reduction through adaptation. The aim is to contribute towards national water security and support national water management initiatives through local action.

There is no blueprint for water resource management. This section draws out practical steps that are common to a number of different CBWRM approaches in WaterAid country programmes and a CBWRM framework developed by Day[63]. Country programmes should decide the best method for approaching CBWRM in their local contexts. Some WaterAid programmes already have considerable experience.

Water security plans, implemented by WaterAid in India[65], water user master plans implemented by WaterAid in Nepal[66], water resource management activities implemented by WaterAid in Madagascar, and the CBWRM approach implemented by WaterAid in Burkina Faso, Nigeria and Mali are good examples of community-based water resource management. Rather than using the river basin as the unit of management, the focus of these approaches is on smaller, more manageable sub-catchment units.

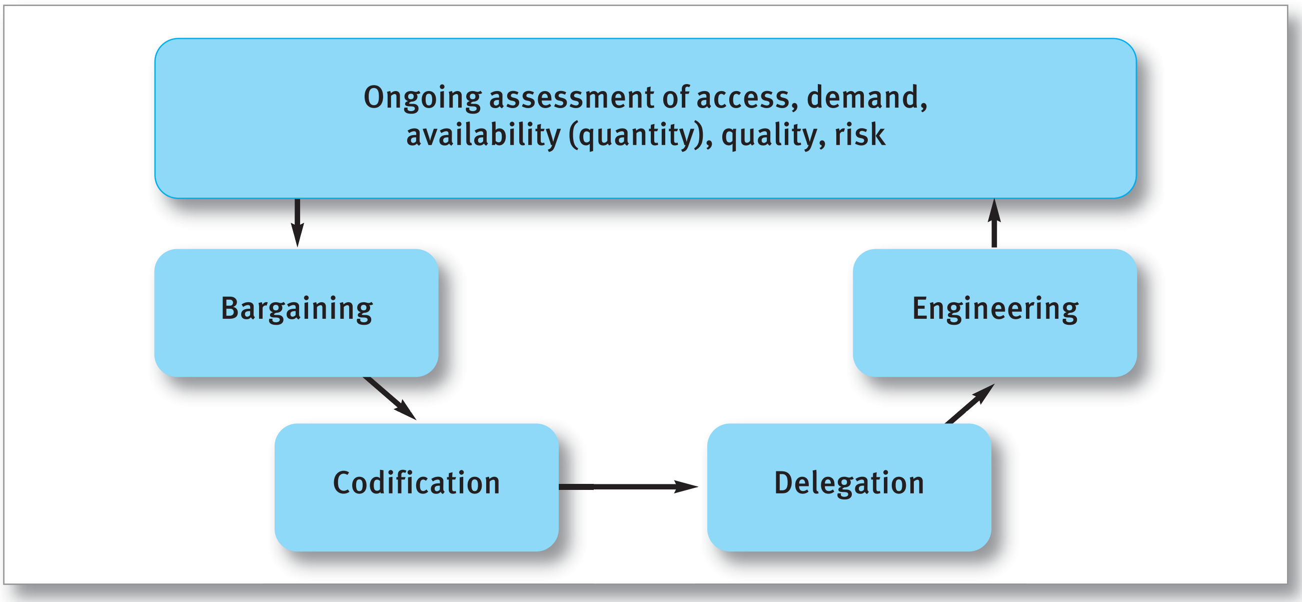
These approaches add value to traditional WASH programming, making the necessary links with health, livelihoods, multiple water uses, adaptation to water supply risk and sound management of water resources.

A framework for classifying components of water resource management is proposed by Perry[67]. Known as the ABCDE approach, each initial stands for an action aimed at managing water resources, reducing water-related risk and improving water supply services:

A = Assessment B = Bargaining C = Codification
D = Delegation E = Engineering

These terms are explained in the following section.

Figure 15 – The sequence of steps in the ABCDE approach



Before carrying out CBWRM, it is important to do three things:

1 Determine if community-based water resource management will add value. Is there a demand for strengthened water use principles and risk-based planning from the community? CBWRM may add value in situations where access is not equitable, where there are competing demands for water, where conflict emerges over access, where availability and quality fluctuate, where disaster events threaten supplies, and where community engagement with local and national institutions responsible for service provision must be strengthened.

2 Define the boundaries of the area where CBWRM will be implemented with communities. This is more likely to be a manageable geographic area of population (eg a group of villages) rather than a hydrological river basin or catchment.

3 Identify all water users.

Assessment

Assessment involves understanding access, water demands, water availability, risks and current coping strategies, not just at the beginning of a project but on an ongoing basis. If water resources are not monitored in order to understand availability and quality on an ongoing basis, it is not possible to manage them.

Angelica Fleischer

A villager holds a water level dipping tool that makes a whistle sound when it strikes water. These dippers are used by communities to measure water levels in boreholes as part of a CBWRM project in Burkina Faso.

A modified India Mark II handpump pedestal which enables water level readings to be taken in boreholes as part of a CBWRM project in Burkina Faso. Submersible level loggers are being used to record long-term trends in water availability.

Table 1 – Practical community-level assessments that can be carried out as part of WASH programming for effective management of water resources

Criteria assessed	Method of assessment	Frequency of assessment
Demand for water at different times of year, including livelihood demands such as cattle watering and agricultural irrigation as these often compete with domestic demands	Water usage survey and participatory community mapping	Annual
Location of access points to the resource; who uses them for what, and whether they are functional in both the wet and dry seasons	Community mapping	One-off unless new access points are installed
Availability of water resources to meet demands (for example, likely annual or inter-annual recharge)	Assisted by a hydrogeologist	One-off
Ongoing availability of groundwater, spring flows and rainfall	Participatory community-based monitoring of groundwater levels, spring flows, rainfall. Information analysis assisted by local institutions	Ongoing
Water quality (taste, appearance, smell)	Participatory community-based monitoring of aesthetic quality	Ongoing
Coping mechanisms and existing rules for water use and management	Focus group discussion	One-off
Threats that have an impact on reliable access, quantity and quality of supplies, including the sustainability of water sources	Focus group discussion	Annual

Assessment should be participatory, involving all water users in a given community, especially women and farmers.

A rain gauge for monitoring rainfall installed in a village in drought-prone Konso, Ethiopia.


WaterAid/Vincent Casey

Pumping demand can be worked out from pump capacity and pumping hours. Calculating the water balance of an area is a complex process but long-term monitoring of water levels in wells or spring flows using manual methods is not. These indicators can highlight if there is any long-term reduction in availability, if threats to water availability are emerging, or if allocations and water use priorities need to change.

Ongoing monitoring of groundwater levels may require handpumps to be modified to facilitate access to water levels.

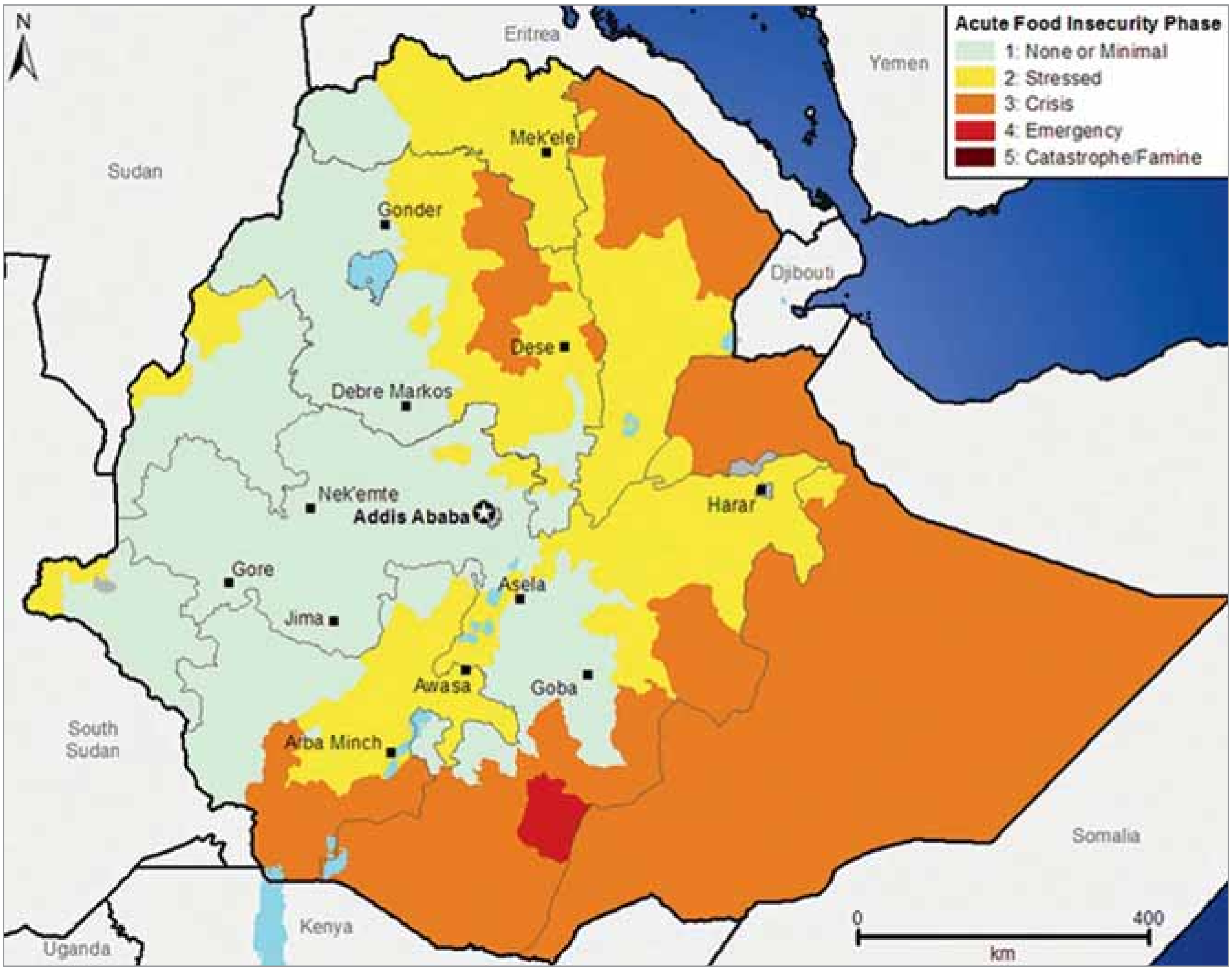
Early warning systems can feed into assessment of risks

A consortium of agencies working to support food security has developed a Famine Early Warning System called FEWS NET. This network regularly reviews threats to food security providing near- and medium-term outlooks on vulnerability in different areas. Low rainfall is one critical risk factor that the network monitors. This early warning system can be used to forecast the onset of drought events. Given the close links between food security and water security, such tools can be used for risk-based planning in areas where WaterAid has programme operations.


WaterAid/Vincent Casey

Community mapping carried out with villagers to highlight differences in access and water use between wet and dry seasons in drought-prone Konso, Ethiopia.

Figure 16 – A map of Ethiopia produced by the Famine Early Warning System highlighting areas facing different degrees of food insecurity in April 2012[68]



Bargaining

Once the availability of the resource is understood and the demands of different water users are known, communities can collectively bargain over allocations for different purposes. Equitable water use priorities can be agreed; for example, irrigation farmers switching between water intensive and low water use crops from year to year depending on changing availability. It is important to ensure that individuals are not ignored or excluded from this process because of their inability to pay for water, political affiliation, race, gender, social status or disability. Water security plans promoted by WaterAid in India and water user master plans promoted by WaterAid in Nepal facilitate this process.

Codification

Codification involves collectively formalising operating principles or byelaws, so that allocations, water use and water resource protection priorities can be formally agreed. This process should acknowledge that existing rules and customs may already exist. Contingency plans that can be put into action when threats to water resources and sources manifest can be developed together with comprehensive WASH plans aimed at improving access and assuring water quality through improved hygiene, sanitation source protection, safe storage, safe handling and treatment where feasible. All aspects can then be drawn together into one comprehensive annual water security plan.

WaterAid/Vincent Casey

Water allocations painted on the wall of a house in a village as part of a WaterAid supported project in Chhatarpur, India. In low rainfall years, farmers can opt for low water use crop types.

WaterAid/Kabir Das Rajbhandari

Community members at a water use planning meeting where allocations are agreed as part of the water user master plan development process, Ghyachowk village, Nepal.

Water safety planning – an example of codification

Looking specifically at water quality, the development of water safety plans is a good example of codification. Water safety plans are promoted by the World Health Organisation as the most effective means of assuring the safety of drinking water. Water safety planning is a preventative management approach aimed at minimising the risks posed to drinking water quality and health from catchment to point of use[69]. They have traditionally been applied to urban water supply systems in developed countries but they have also been adapted and applied to small-scale community-based systems.

The plans are prepared together with community members, who collectively identify contamination hazards at all stages of the water supply chain[70]. Communities agree control measures aimed at minimising the risk of contamination occurring. The control measures are then monitored periodically to ensure that they are working. Control measures may include catchment protection, source protection, ensuring water sources are well maintained, community-level water treatment, ensuring safe transport and storage of water, and household water treatment. WaterAid in Bangladesh has implemented water safety plans extensively and produced useful implementation tools.

More generally, WaterAid programmes promote various activities that align with water safety plans. These are outlined in Table 2 (on the following page).

Table 2 – Comparison of steps in a water safety plan and steps that WaterAid promotes to assure water quality

Water safety plan steps	Steps WaterAid promotes
Establishment of **health-based targets** for microbial and chemical water quality	Country programme water quality policy identifying high-risk contaminants, usually based on national standards informed by health-based targets
A **system assessment** to determine whether the water supply chain from catchment to consumer can deliver safe water at the point of consumption	Sanitary inspection of conditions around water points and in households where water is stored before consumption
Effective operational monitoring of identified control measures within the water supply chain that provide assurance of safety	Sanitary survey of all points in the water supply chain. Risk-based follow up measures and water quality monitoring
Management and communication plans describing actions to be taken during normal operation or incident conditions	Communities trained on source protection, safe household storage of water, and hygiene. Country programme water quality policy outlines steps to take in event of contamination. Frequency of follow-up monitoring is also outlined
Independent public **health surveillance** of water safety	Should be carried out by national institutions

Delegation

Delegation involves the community collectively attributing responsibility for implementation of operating principles, byelaws and plans to an appropriate authority. Some responsibilities may be devolved to community members or farmers, with others being taken up by community leaders or local government authorities. Funding can be sought for the implementation of water security plans.

Delegation may require substantial advocacy to persuade authorities to take on responsibilities and to ensure adequate resources for their implementation. In terms of WaterAid's engagement, forming strong links with communities and local and national government institutions to support the roll out of water security plans and improved services should be an objective. This is in addition to coordination with governments and other agencies working as part of a sector-wide approach. Communities can be empowered to communicate their need for assistance to local authorities when their water security is threatened. Advocacy aimed at ensuring authorities continue to prioritise and provide support to communities over time, should also be an objective.

Engineering

Engineering of additional water supply infrastructure to improve water security can take place once demands, availability, quality and threats are understood. Steps such as boosting storage capacity or increasing access points to the resource can also be undertaken.

Boosting storage capacity

In addition to the natural storage provided by aquifers, construction of artificial storage is a good means of improving community-level water security. Storage forms a buffer between fluctuating supplies and demands.

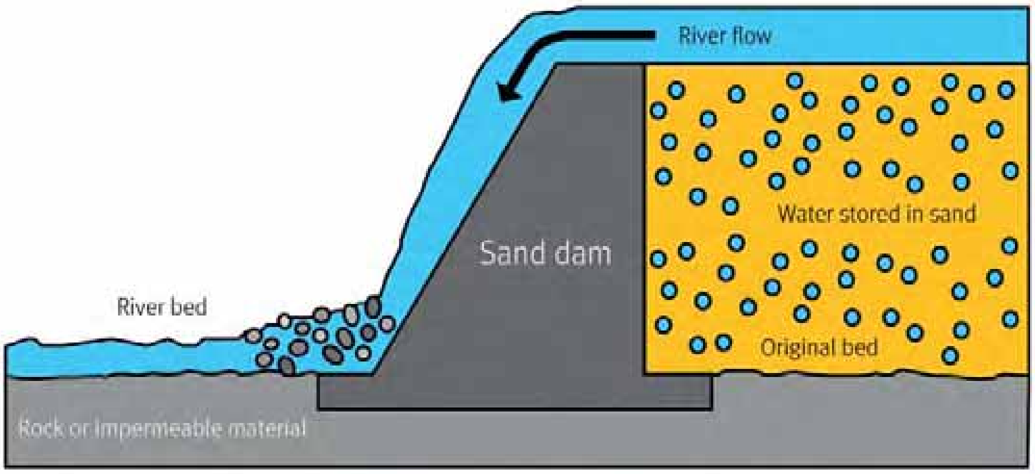
Where groundwater is scarce, difficult to access or has high levels of inorganic contamination, the capture and storage of rainwater offers an alternative source. WaterAid uses several rainwater harvesting techniques, some of which are outlined in our technology note, *Rainwater harvesting*[71].

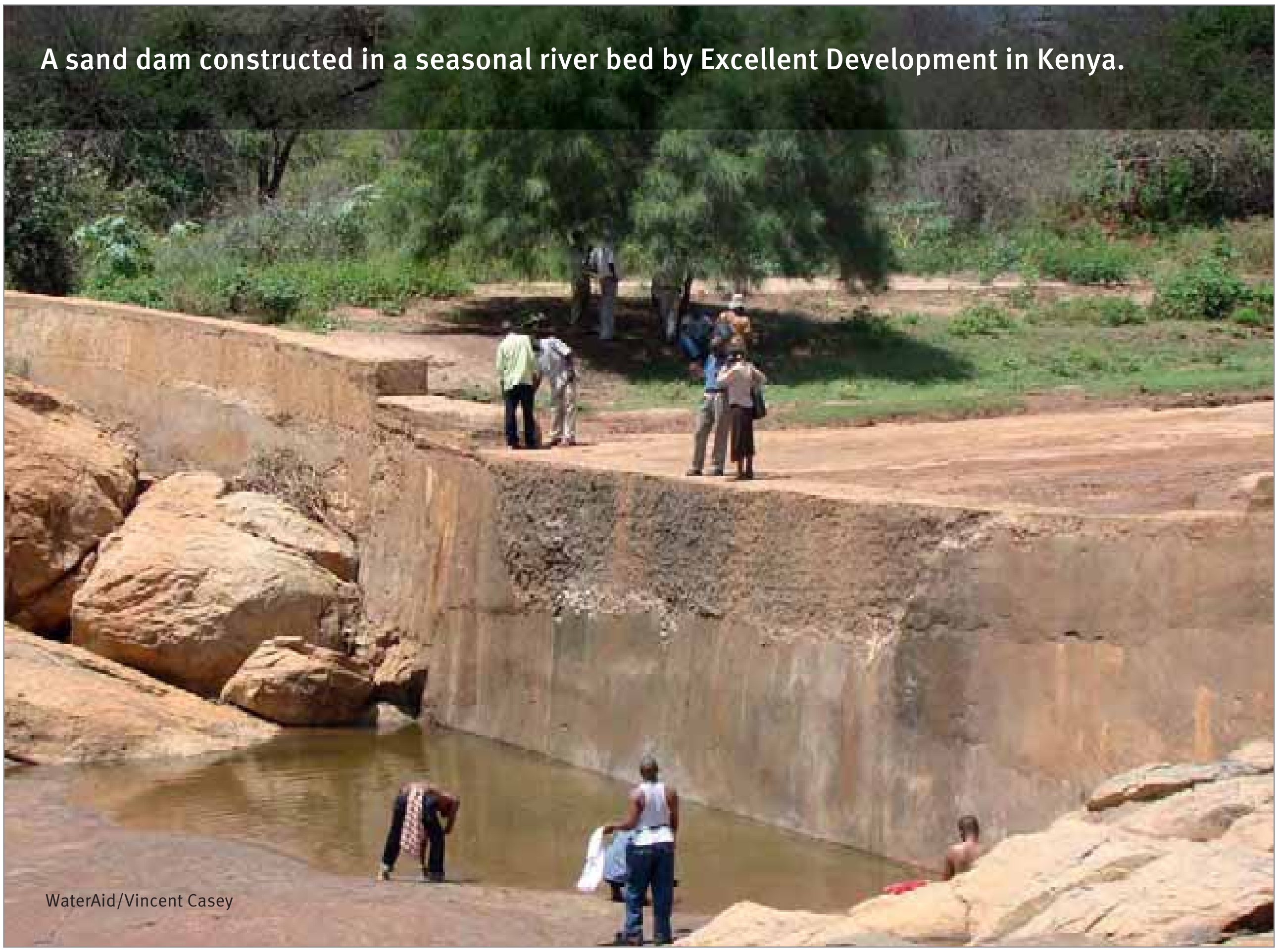
WaterAid/Caroline Irby

Rainwater harvesting provides a means of increasing the amount of drinking water available to households and communities.

In arid and semi-arid areas, sand and gravel deposits associated with streams and rivers can provide water for drinking and irrigation purposes[72]. Infiltration galleries, sand dams, sub-surface dams and earth dams can all be used to tap into these resources. Sand dams constructed in seasonal rivers accumulate sediment that acts as an artificial aquifer, protecting water from evaporation and contamination.

Figure 17 – A sand dam constructed to trap sand grade sediment, forming an artificial aquifer in a seasonal river bed





A sand dam constructed in a seasonal river bed by Excellent Development in Kenya.

WaterAid/Vincent Casey

Sub-surface dams offer another means of trapping groundwater flows[72].

Groundwater development

WaterAid has traditionally developed groundwater using hand-dug wells, boreholes and spring capture. Boreholes may be fitted with manually-operated or motorised pumps.

The importance of groundwater for improving access

Groundwater offers several advantages as a water source for improving water security:

1. It is not as drought-prone as surface sources due to the protection afforded to it by overlying soils and rock[49].
2. Large quantities are present within the natural storage provided by aquifers. This may act as a buffer during periods of prolonged climatic change.
3. It may be developed close to households.
4. It may be developed relatively cost effectively unlike surface sources which require ongoing treatment before use.
5. It is generally of good quality because of the natural filtering properties of aquifers.

1.3 billion people use boreholes and a further billion people use dug wells and springs globally, meaning over two billion people are dependent on groundwater[22].

Manually-operated handpumps can be used where groundwater levels are up to 50m below the surface. Motorised pumping is generally required at greater depths. 85% of Africa's population lives in areas where groundwater is no more than 50m below the surface. 80 million people in Africa live in areas where groundwater depths are between 50 and 100m[73].

Good quality water cannot be guaranteed where aquifers have been polluted or contain naturally high concentrations of undesirable constituents such as arsenic or fluoride.

In Nepal, Ethiopia, Madagascar and Timor-Leste, WaterAid develops springs, piping water to communities by gravity. Schemes are generally designed to use no more than a certain percentage of dry season spring flow to accommodate inter-annual fluctuations in supply, and the water needs of the environment and downstream users.

Water treatment

There are numerous different products available for the treatment of water. Some are intended for use at household-level and others are aimed at providing community-level treatment. Many options are highly effective at removing contaminants from water; however, this is not the biggest challenge in low-income environments. Often the biggest and most overlooked challenge facing water treatment programmes in the context of long-term water supply development (rather than emergency relief) is the creation of viable business models for marketing, distribution and sale of treatment products in areas where there is weak or negligible demand for them and very little income to pay for them.

Treatment products require some level of maintenance to ensure that they remain effective. Filters must be backwashed or replaced, filter media must be recharged, and systems must be checked to ensure that they continue to deliver water of suitable quality. These maintenance demands can be difficult to service in poor communities.

Where clean water cannot be obtained from any source, the use of treatment is recommended. In these cases, WaterAid selects options that are affordable with replacement components available on local markets. Proprietary filters or bulk treatment units developed outside the country of application do not generally fall into this category as they tend to be too expensive for low-income communities to procure on local markets. There are exceptions to this, where producers of treatment products have taken time to understand local market conditions and have developed business models based on local private sector marketing, distribution, sale, operation and maintenance.

Inclusive design

It is important that all users are able to access water resources. Improved services should be inclusively designed so that those with disabilities or chronic illnesses are not excluded because they cannot physically operate a source.

Designing for multiple uses in drought-prone areas

Part 2 highlighted that droughts are normal, natural events that affect many regions of the world, although there is concern that their frequency is increasing in some areas. Despite their regular occurrence, they are often responded to as unexpected disasters with short-term food and water supply measures that do nothing to reduce the effects of subsequent drought events. Long-term planning for drought mitigation at community level is often not considered, greatly accentuating their impact[74].

Improvements to WASH that provide for other small-scale water uses can do much to improve household-level food security through provision of water for garden irrigation and livestock watering, as well as income generating activities such as brewing and brick making[75]. Improvements in health derived from having enough water available for basic hygiene increase the body’s ability to absorb nutrients and therefore improves nutrition[76].

Improved WASH interventions should therefore form a key component of drought resilience and food security plans, in addition to short-term food aid responses. ODI/BGS research draws attention to basic steps that can be taken within WASH programmes to improve drought resilience:

1. Drilling new or back-up boreholes to provide more access points to the resource and relieve pressure on existing sources.
2. Boosting storage capacity using rainwater harvesting or small dams.
3. Deepening wells.
4. Repairing pumps (only works if the pump is the problem; will not address damaged, poorly designed or low-yielding boreholes).

Short-term responses to drought include:

1. Water trucking.
2. Surface water abstraction, storage treatment and distribution.

A WaterAid in India study of drought impacts in Bundelkhand[77] recommends similar responses to those above, together with broader recommendations to arrest environmental degradation and inappropriate policy-making which are seen to further exacerbate drought conditions.

In areas where there are limited surface sources available to provide water for livelihoods, communities inevitably use water supply infrastructure to meet all water needs. Water sources designed for human drinking water provision alone are frequently used for cattle watering, brick making and food production. If livelihood water uses are not factored into the design of such water supply services, this additional activity can place pressure on the water resources immediately around water sources and mechanical stress on water supply infrastructure[75].

Drinking water service provision can be better linked to water for food production and livelihoods using a multiple use services approach, where water supply services are designed for all water needs. This approach links water security to food security[78]. WaterAid's in-country partners rarely work exclusively on drinking water provision. Many have wider portfolios of work covering livelihood development. This presents an opportunity to advance MUS with livelihood elements co-funded by other organisations.

Self supply

Heavily donor-subsidised water supply options can be expensive for communities to operate and maintain. Where this is the case, improvements in access may be achieved through user investment in incremental improvements to traditional water sources. Users may also choose to invest in treatment and rainwater harvesting. Dual purpose water sources for domestic and productive use create the potential for income generation which helps to pay for operation and maintenance as well as further source improvements[79].

Summary

Community-based water resource management (CBWRM) complements national-level integrated water resource management (IWRM) plans, and can be applied in environments where institutional capacity to manage water resources is weak. It builds upon the principles and procedures of water safety planning, drawing together reliable access, quantity, quality and risk factors. It acknowledges traditional approaches to water management where they exist, considers multiple water use priorities and promotes good water resource development[63]. WaterAid's experiences of CBWRM in India, Nepal, Burkina Faso and Madagascar, together with the ABCDE approach and Day's CBWRM framework, form a good basis for community-level water security planning. Practical activities can realistically be undertaken by WaterAid partners, local governments and communities.

Part 5

WaterAid's minimum commitments to ensuring water security

This section draws upon previous parts of this framework and sets out a list of minimum commitments that WaterAid will implement as a mandatory component of water supply programmes. These form our programme policy on water security. They are basic minimum undertakings aimed at ensuring high quality programme work that meets the needs of users on an ongoing basis. Of course, much more can be done.

For ease of use, these minimum commitments have been divided up into units that relate to the type of intervention being implemented. We will plan and budget for implementation of all the commitments listed below, and the work will be recorded in project documentation for audit purposes.

Seven overriding minimum commitments that apply to all interventions

1 WaterAid will assess and document the target community's demands for water at the project feasibility stage. This includes all water uses so that programmes may be designed taking the likely demands on sources into account. This need not be an in-depth assessment. It can be based on discussions with key water users and a small sample of households. Future water demands will be factored into programming.

2 WaterAid will assess whether sufficient water resources are available to meet the demands.

3 The water quality of all new and rehabilitated water sources will be tested before any source is put into public service, in line with the country programme's water quality policy.

4 Water sources will not be developed in locations where there is a risk of contamination from latrines or other sources of groundwater pollution. Conversely, latrines will not be constructed in areas likely to contaminate water sources. National safe siting distance regulations will be adhered to.

5 All significant threats posed to reliable access, quantity and quality (from source to point of use) will be assessed, documented and mitigated in programme design.

6 Water source design and management should ensure easy access and use by all members of the community.

7 WaterAid will strengthen local government capacity to assist communities when their water security is threatened.

Minimum commitments applying to drilled water wells

8 Qualified supervision representing WaterAid will be present at all drilling sites.

9 In areas where drilling success rates are below 70% it is recommended that scientifically founded reconnaissance techniques are used to determine the most productive sites for drilling.

10 Drilled water wells will be constructed deep enough (at a time of year when water levels are at their lowest) to accommodate seasonal fluctuations in static water levels as well as drawdown due to pumping.

11 Care will be taken not to drill wells unnecessarily deep, incurring excessive cost.

12 Boreholes will not be upgraded from manual to motorised pumping without a pumping test to establish if motorised pumping can be sustained, a full assessment of groundwater recharge, and an assessment of the impact on other nearby water sources.

13 Motorised pumping installed by WaterAid will not interfere with nearby water sources.

14 Where a WaterAid supported borehole or well has been found to fail, the causes of failure must be fully investigated and documented.

15 WaterAid will commit to ongoing monitoring of groundwater levels in a small number of boreholes in each country programme, with the objectives of understanding drivers of water stress, building learning into future programmes, and contributing data to sector discourse on drivers of water stress. Local institutions will be supported to carry this out where possible.

Minimum commitment applying to hand-dug wells

16 Hand-dug wells will normally be constructed with the aid of mechanical dewatering, deep enough (at a time of year when water levels are at their lowest) to accommodate seasonal fluctuations in static water levels (ideally 3m below dry season static water levels).

Minimum commitments applying to spring/river-fed gravity schemes

17 The potential for inter-annual fluctuation in dry weather spring flow, together with the water needs of the environment and downstream users, will be taken into consideration when designing spring-fed gravity schemes.

18 Spring flows on schemes serving over 2,000 people will be monitored.

Minimum commitments applying to use of water treatment

19 Treatment will only be used when it is not possible to obtain clean water from deep/shallow groundwater, rainwater or surface water economically. Treatment will not generally be used as a first resort because of the difficulty of managing it at community level.

20 Treatment will be used as part of hygiene, sanitation, water quantity and safe household storage interventions rather than as a standalone activity. It is not a substitute for source protection, hygiene promotion or campaigning against the root causes of pollution.

Minimum commitment applying to drought-prone areas

21 Where relevant, water supply programmes will be designed to meet multiple community water use priorities. Where programmes can substantially improve household-level food security, small-scale livelihood water demands such as kitchen garden irrigation and livestock watering should be considered in their design. Where there is the risk that water, sanitation and hygiene infrastructure will come under pressure from livelihood water uses because of the scarcity of alternative sources, programmes should be designed to safely accommodate these uses without the risk of source contamination or failure. Funding and expertise for implementation of livelihood aspects should be sought from partners who specialise in this area.

Continued learning

22 WaterAid will stay informed of emerging issues and challenges that communities face and will adjust programme approaches appropriately to ensure that they continue to remain relevant.

Practice advocacy

23 Best practice will be documented and disseminated to inform practice and policy in the wider sector.

Appendix

Definitions of water security[80]

David Grey and Claudia Sadoff World Bank

> '[Water security is] the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies.'

Len Abrams hydrologist

> '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.'

Eric Guttierez and Patricia Wouters law academics

> 'A comprehensive definition [of water security] goes beyond availability to issues of access. Access involves issues that range from a discussion of fundamental individual rights to national sovereignty rights over water. It also involves equity and affordability, and the role of states and markets in water's allocation, pricing, distribution and regulation. Water security also implies social and political decision-making on use – the priority to be accorded to competing household, agricultural or industrial demands on the resource.' (2005)

Bangladesh Institute of Peace and Security Studies think tank

> 'Water security is essential for human access for health, wellbeing, economic and political stability. It is essential to limit risks of water-related hazards. A complete and fair valuation of the resource, sustainability of ecosystems at all parts of the hydrologic cycle and an equitable and cooperative sharing of water resources is very necessary.' (2009)

Malin Falkenmark academic

'The greatest water problem [is] our inability to link environmental security, water security and food security. Water security is linked to a safe water supply and sanitation, water for food production, hydro-solidarity between those living upstream and those living downstream in a river basin and water pollution avoidance so that the water in aquifers and rivers remains usable, ie not too polluted for use for water supply, industrial production, agricultural use or the protection of biodiversity, wetlands and aquatic ecosystems in rivers and coastal waters.' (2001)

Tony Allan academic

'Water security is just what we choose to eat [and] nothing to do with the environment or science etc.'
'Water security is linked with food trade – as "energy security" is (more obviously, perhaps) linked with oil trade.'
'Secure use of water is defined by political processes. Water security is achieved outside the watershed (in the "problemshed").'

Patricia Wouters academic

'There are three important elements of "water security":

1. Water security is based on three core freedoms: freedom from want, freedom from fear and freedom to live in human dignity;
2. Ensuring water security may lead to a conflict of interests, which must be capable of being identified and effectively dealt with at the international, national and local levels;
3. Water security, like water, is a dynamic concept, and one that needs clear local champions and sustained stewardship.' (2005)

Mark Zeitoun academic

'Social and physical processes combine to create or deny water security. Sustainable water security is interpreted as a function of the degree of equitability and balance between interdependencies of the related security areas, played out within a web of socioeconomic and political forces at multiple spatial levels... The "web" of water security identifies the "security areas" related to national water security. These include the intimately associated natural "security resources" (water resources, energy, climate, food) as well as the security of the social groups concerned (individual, community, nation). The "web" recognises the interaction occurring at all spatial scales, from the individual through to river basin and global levels. In this sense, an individual's water security may coexist with national water insecurity, as in the case of wealthy farmer-sheikhs with the deepest wells (who may be temporarily water secure) in the dry highlands of Yemen (which is not, on the whole, water secure).'(2012)

Appendix

Glossary[25, 81, 82]

Abstraction	The removal of water from a water body, usually by pumping. Measured in m^3/day or l/s.
Aquifer	A rock formation that is sufficiently porous and permeable to be useful for water supply.
Blue water	See page 12.
Borehole/Tubewell	A cylindrical hole (usually greater than 20m deep and less than 0.5m in diameter) constructed to allow groundwater to be abstracted from an aquifer.
Community-based water resource management	A strategy that enables local water users, community-based institutions and the lowest professional level of local government to be involved in and responsible for the management of water resources as part of ongoing rural water supply service delivery.
Consumptive use	See page 12.
Discharge	Natural flow of groundwater from an aquifer, via springs and seepages to rivers.
Ecosystem services	The collective benefits that humans derive from their natural environment, such as purified water and soil nutrients.
Food security	Food security exists when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.
Greenhouse gases	Gaseous constituents of the atmosphere, both natural and emitted as a result of human activity, that trap heat within the surface-troposphere system. This property causes the greenhouse effect.
Green water	See page 12.
Governance	Policy and institutional processes by which decisions affecting water sector development are made and implemented.

Groundwater	Water stored in an aquifer, in pore spaces or fractures in rocks and sediments.
Human-induced climate change	Climate change caused by the production of greenhouse gases emitted by human activity.
Improved water source	A source that is likely to provide safe drinking water. This could be a household connection, public standpipe, borehole, or protected spring.
Inclusive design	Infrastructure design that takes into account the needs of women and men who have difficulties using standard infrastructure because of disability, age, chronic illness or other factors.
Integrated water resource management (IWRM)	See page 32.
Light integrated water resource management (Light IWRM)	A type of IWRM that focuses specifically on the implementation of water resource management with a high level of involvement from governments and water utilities at the local level to bridge the gap between the lowest level of private and state regulating authorities and community-based institutions.
Marginal lands	Fragile areas prone to environmental degradation when settled or cultivated inappropriately. Some marginal lands carry a high risk of flooding, landslide or other disasters.
Millennium Development Goals (MDGs)	The eight Millennium Development Goals are international targets to halve world poverty by 2015, agreed upon by all 189 United Nations member states at the UN Millennium Summit in 2000.
Non-consumptive use	See page 12.
Practice advocacy	Concerted attempts to influence change in the practices of other players.
Recharge	Water that replenishes groundwater resources, for example from direct infiltration of rainfall or leakage from streams and rivers.
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions[83].

Seasonality	Seasonal fluctuations in temperature, rainfall, solar radiation or other parameters that vary throughout the year.
Sector-wide approach (SWAp)	Coordinated approach to development, bringing together governments, donors and stakeholders under a government-led plan. The SWAp aims to improve aid effectiveness.
Unimproved water source	A source likely to provide water that is unsafe for drinking, eg an unprotected spring or hand-dug well, a street vendor or tanker.
Virtual water	Also known as hidden water, it refers, in the context of trade, to the water used in the production of goods or services.
WASH	Water, sanitation and hygiene.
Water-intensive foods	Foods that require large amounts of water to produce.
Water resource	See page 3.
Water safety plans	A plan to ensure the safety of drinking water through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.
Water scarcity	See page 9.
Water security	Reliable access to water of sufficient quantity and quality for basic human needs, small-scale livelihoods and local ecosystem services, coupled with a well managed risk of water-related disasters.
Water security plan	A comprehensive plan of action that aims to ensure access, quantity, quality and threats to water supplies are addressed at community level.
Water source	See page 3.
Water stress	See page 9.

Appendix

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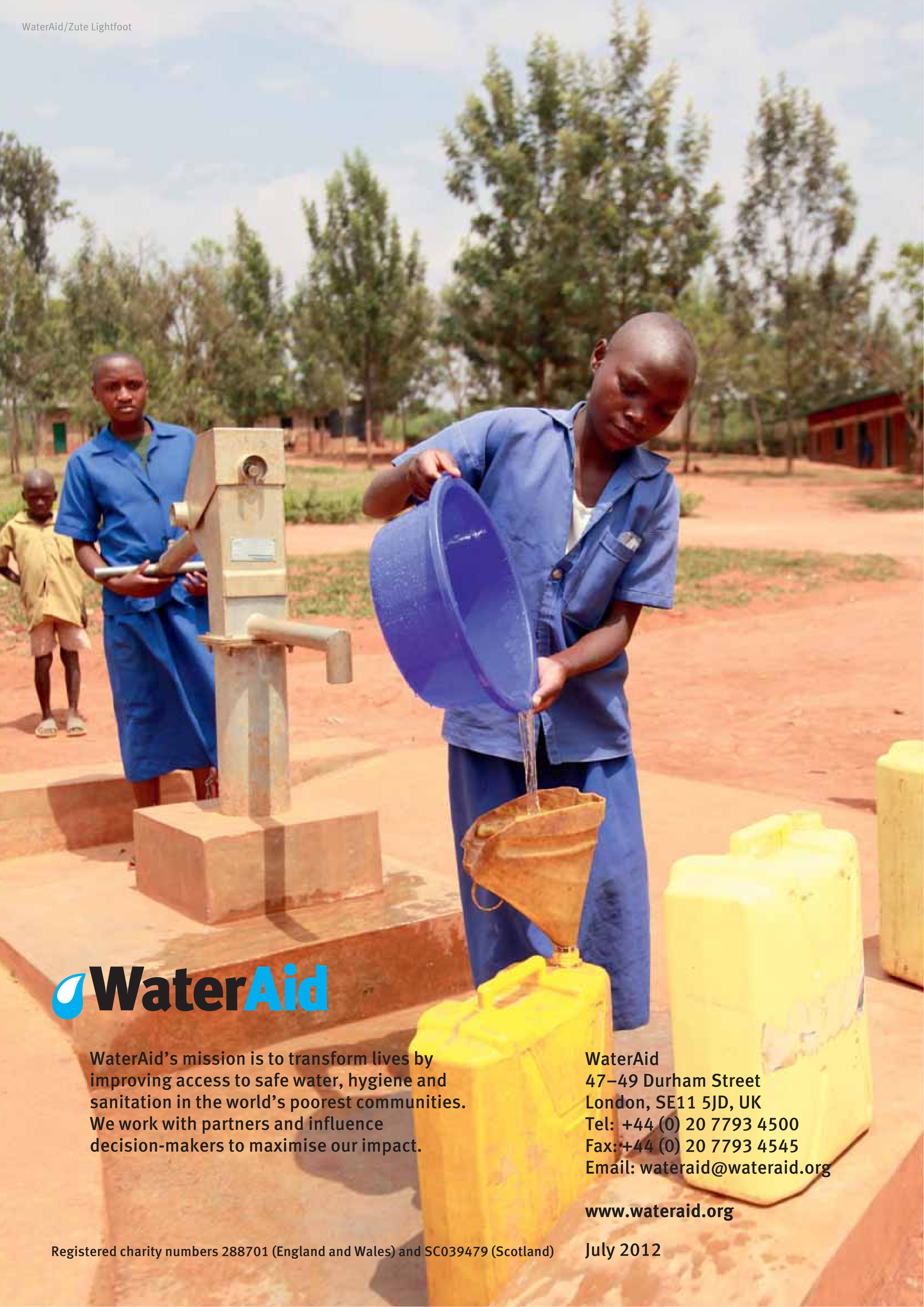

WaterAid/Zute Lightfoot

WaterAid's mission is to transform lives by improving access to safe water, hygiene and sanitation in the world's poorest communities. We work with partners and influence decision-makers to maximise our impact.

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