CHAPTER 5

Sustainability of water services in Ethiopia

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Ethiopia has made significant progress in extending access to improved water sources under its Universal Access Plan (UAP). Although data are contested, all sources confirm the strong upward trajectory. However, the ability of the country to sustain progress is difficult to predict. One key challenge is ensuring that investment translates into sustainable services that continue to meet users' needs in terms of water quantity, quality, ease of access, and reliability. Although data are limited, available evidence suggests that many schemes provide unreliable services or fail completely. Service sustainability is not a new issue in Ethiopia, or elsewhere in sub-Saharan Africa (SSA). The available evidence suggests that perhaps 40 per cent of handpumps are non-functional in SSA; in Ethiopia, official data suggest that 20–30 per cent of schemes have failed, or experience frequent outages. But a long-standing emphasis on capital investment and new infrastructure, coupled with weak monitoring and evaluation (M&E), has tended to obscure the problem, and few rigorous studies have been carried out on this topic. In this chapter, we review the evidence from Research-inspired Policy and Practice Learning in Ethiopia and the Nile Region (RiPPLE) research in two Ethiopian woredas *(districts) – Halaba Special* woredas *and Mirab Abaya – looking at water coverage, the number of non-functioning water schemes, and the factors that determine service sustainability, focusing particularly on rural water supply. Drawing on Ethiopian and wider regional research, we then highlight lessons and recommendations for addressing the problem at different decision-making levels.*

Introduction

Sustainable access to water supply is central to social and economic development, improving health and educational achievement, reducing child mortality, and improving livelihoods (Hutton and Haller, 2004). But these benefits are not sustained if access to water supply itself is not sustainable.

While there is very limited data available on water service sustainability, it has been estimated that in most developing countries, 30–60 per cent of rural water supply schemes are not functioning at any given time (Brikké and Bredero, 2003). In sub-Saharan Africa (SSA), the proportion of non-functional schemes has been estimated at almost 50 per cent, with most breaking down within three years of construction (ibid.).

Ethiopia has developed a plan to extend access to safe water. The ambitious UAP, launched in 2005, has been instrumental in galvanizing political and financial support for water supply and sanitation as a means of alleviating poverty (see Chapter 1), but sustaining services remains a huge challenge. Coverage data based on systems installed and assumed number of people served tell us little about the services people actually receive over time, as noted in Chapter 2. A recent high-level review of service delivery highlighted 'increased sustainability of infrastructure' as a key priority (AMCOW, 2011: 3).

Commentators have proposed different 'recipes' for sustainability, with community management high on the list of ingredients (see Chapter 3). In addition, factors such as gender sensitivity, partnership with local government and the private sector, and sufficient levels of cost recovery for basic maintenance and repair have also been emphasized (Brikké, 2002; Carter et al., 2010). In Ethiopia, the recent strategic shift by the government towards lower-cost technologies and 'facilitated self-supply' (see Chapter 3) is a response to the challenge of delivering and sustaining services in low income areas (AMCOW, 2011).

This chapter draws on RiPPLE research to look at the factors that affect the sustainability of water supply systems and services in Ethiopia, drawing on field work conducted in Halaba Special and Mirab Abaya *Woredas*. There are over 700 *woredas* in Ethiopia, so the research provides only partial insights. However, the chapter also draws on wider international experience to inform the discussion and conclusions.

Conceptual framework

What do we mean by sustainability? More specifically, the sustainability of what, and for whom?

In simple terms, sustainability is about: 'whether or not WASH services and good hygiene practices continue to work over time. No time limit is set on those continued services and accompanying behaviour changes. In other words, sustainability is about permanent beneficial change in WASH services and hygiene practices' (Carter et al., 2010: 2). In this chapter we use this definition, with a focus on water services, but draw a distinction between functionality and sustainability, and also between the service itself and the system used to provide it (Box 5.1).

Five key aspects can be separated to help understand the underlying drivers of service sustainability, highlighted in Figure 5.1. We argue that sustainability is more likely to be achieved when there is a balance between all five, represented by their intersection.

In brief, we can summarize as follows:

- Technical determinants, including the siting, design, and construction of water systems used to withdraw and deliver water to users.

Box 5.1 What is a water service?

A water service is sustainable if it continues to work over time, with service itself defined in terms of the quantity and quality of water accessible to users over time. Specific indicators include:

- Quantity, measured in litres per capita per day (lpcd).
- Quality, in terms of one or more separate indicators of chemical and biological quality.
- Distance from a household or centre of a community to a water point.
- Number of people sharing a source, often termed 'crowding'.
- Reliability, in terms of the proportion of the time the service functions to its prescribed level.

Monitoring the services accessed by individuals over time and space is clearly difficult. This is one reason why planners have focused on systems and the extension of new supplies, with assumptions then made about service levels using government standards (see Chapter 2) to determine water coverage.

Source: Moriarty et al., 2011; see also Butterworth et al., 2012

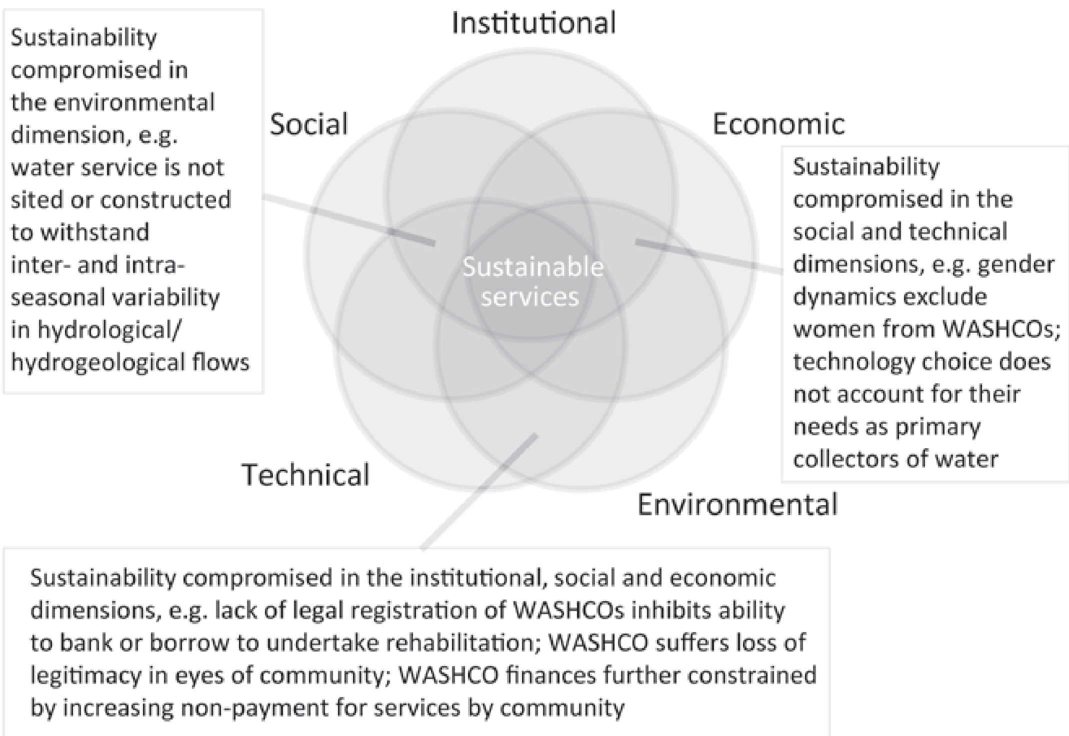

Figure 5.1 Conceptual framework for sustainability of water services

- Social determinants, including the relations and networks between individuals and communities.
- Institutional determinants: the formal and informal rules and structures governing the management of water supply schemes.
- Financial determinants: financial resources from various sources to meet all costs for long-term viability without undermining social development goals, such as poverty reduction.
- Environmental determinants, including the availability and quality (across time and space) of the water resource, linked to characteristics that affect the supply and its sustainability.

Water service sustainability – policy and practice

This section considers the progress of the water sector in Ethiopia on accelerating and sustaining access, highlighting the challenges to sustainability and emerging policy responses.

The substantial increase in resources and policy attention devoted to water, sanitation and hygiene (WASH) under the government's UAP has led to significant progress in extending access to safe water and sanitation. Addressing sustainability was a key aim of the original 2005 UAP, which aimed to do so in the first two years of implementation by focusing on rehabilitation and maintenance of existing schemes (MoWR, 2006a). The UAP reflected current global debates on sustainability, adopting such principles as demand-responsive approaches (DRAs), community contributions for operation and maintenance (O&M), and 'the participation of relevant bodies, especially women' (MoWR, 2006b: 6–7) in an effort to strengthen local ownership of water services and their sustainability (see Chapter 3).

While all sources confirm the positive trajectory in access, precise data are contested (Chapter 2). However, there is a general consensus that coverage estimates, based on the number of systems built and assumed number of people served from construction onwards, overestimate access to services. This highlights the difference between systems and services explained earlier, and the pitfalls of estimating coverage by counting the number of systems implemented without considering whether they are in fact providing the planned and desired level of service. The UAP's most recent revision estimated that close to 50,000 schemes were 'not functioning' for at least a few days each year – almost 30 per cent of the total (MoWE, 2010). However, even estimates from the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) Joint Monitoring Programme (JMP), derived from household surveys, provide only a partial snapshot of the problem as technology type is used as a crude proxy for the level and quality of service provided (Moriarty et al., 2011).

Research carried out for RiPPLE using the Water Economy for Livelihoods (WELS) framework highlights seasonal variation in functionality and service levels. While this is associated most obviously with climatic variation, it may be exacerbated by, for example, the coinciding of the peak labour period with the long dry season, with access compromised by long queues at water sources and the need to divert household labour to income-generating activities (Coulter et al., 2010).

Such seasonal challenges may intensify with climate change as rainfall becomes increasingly unpredictable (Chapter 7). The climate change challenge for sustainability should also be seen alongside expected population growth of nearly 90 per cent by 2050, which will place more pressure on existing services (Calow and MacDonald, 2009).

These observations highlight the need to go beyond conventional measures of coverage when considering service sustainability. The data challenge – knowing who has access to what services and where – will be partially addressed by the National WASH Inventory (NWI). As discussed in Chapter 2, however, this will capture functionality data for only a single point in time.

Ethiopia faces continued capacity and funding challenges at the local level. As is pointed out by Lockwood and Smits (2011) and in this book (see Chapter 1), government capacity remains very low. This problem is exacerbated by the decentralization of responsibilities but not finance, and the tendency for donor agencies and international non-governmental organizations (INGOs) to privilege capital investment in new systems (the hardware) rather than support structures and capacity for the maintenance and rehabilitation of existing schemes. The One WASH programme (see Chapter 1) instituted in 2006 has helped to consolidate sector efforts, although with greater impact on the implementation of new services than the maintenance and rehabilitation of existing ones.

The new draft UAP includes detailed human resource development plans, setting available capacity against required capacity by job type. Technical roles (handpump technicians, drillers, mechanical engineers) are the most difficult to fill (MoWE, 2010: 57) with serious implications for O&M, and there is a lack of clarity on how more than 120,000 skilled and professional staff are to be recruited, trained, and retained. One suggestion is to set up Operation and Maintenance Support Units (OMSUs) to support communities managing their own schemes, which will eventually evolve from public–private partnerships into full private entities. The new WASH Implementation Framework (the WIF – FDRE, 2011) also places the private sector at the centre of sustainability (McKim, 2011: 7; MoWE, 2010).

Water services sustainability in Ethiopia – learning from experience

This section draws on RiPPLE case studies conducted in Halaba Special and Mirab Abaya *Woredas* in the Southern Nations, Nationalities, and People's Region (SNNPR). The studies, carried out between November 2007 and February 2008, investigated the extent of, and reasons for, problems with service sustainability. Qualitative and quantitative methods, including water-point mapping; focus group discussions; and knowledge, attitude, and practice (KAP) surveys were used to trace the causal chains leading to unsustainable services. The two *woredas* have some similarities, including a prevalence of intestinal parasites and diarrhoeal disease, but differ significantly in the type of water supply systems used.

In Halaba the groundwater table requires deep boreholes, connected by distribution networks to water points. Water supply coverage had been estimated at around 40 per cent (BoFED, 2006), with 37 per cent of schemes estimated to be non-functional (AW-WRDO, 2007). The study found that only 24 of the 76 rural *kebeles* (communities) in the *woreda* had potable water supply from boreholes, distributing to a total of 65 water points. Ten schemes (42 per cent), and 40 water points (65 per cent) were non-functional – a greater water supply challenge than previous estimates suggested.

In Mirab Abaya the hydrogeology permits a range of technologies: hand- and machine-dug wells, boreholes, and protected springs. Thirty of the 70 schemes were found to be non-functional (43 per cent), of which 11 had been abandoned (Abebe and Deneke, 2008). Before the study, non-functionality was reported at 26 per cent (MAW-WRDO, 2007).

Scheme breakdowns were attributed to the technical failures of pumps and generators in most cases in Halaba. But these failures persisted for a range of social, institutional, and financial reasons, including the absence of follow-up support from the *woreda* or zone and insufficient training for operators. Environmental factors, such as water table drawdown and turbidity, were identified as the immediate causes of non-functionality for six of the schemes in Mirab Abaya. This ultimately raises questions as to whether these schemes were located and designed appropriately.

Technical challenges

Choice of technology can determine how easily sustainability can be ensured in relation to other aspects. The practical difficulties in involving communities in technology choice should not exclude them from planning, and technologies should be as user-friendly as possible. In Halaba Special *Woreda*, with its deep water table, WASHCOs and the *Woreda* Water Resource Development Office (WWRDO) preferred submersible, rather than mono-lift, pumps which were viewed as more prone to failure and requiring significant manpower to start (not always available).

Community participation from the outset can ensure sustainability by embedding an understanding of technology upkeep, maintenance and, proper usage. Despite being relatively simple, almost half of the hand-pumped wells in Mirab Abaya (20 of 48) were non-functional, with ‘inappropriate use’ reported as a major cause of failure by both WWRDOs and users. The lack of involvement of the primary users – women – in the planning and management of water services, can have done little to enhance familiarity and ownership of the technology. Research has shown the diverse benefits of such involvement for scheme functionality and women's empowerment (Fisher, 2006).

As noted previously, scheme functionality is one key element of service sustainability. The average round trip water collection time observed in Halaba Special *Woreda* was five hours. Such a heavy time burden may encourage users to revert to using unsafe but more local sources, especially during the wet seasons when surface water is more abundant, or to restrict water use. In both case studies consumption was generally below the 15 lpcd service level specified as 'adequate' in the UAP.

Social challenges

Involving communities effectively in the planning and management of their water services requires an understanding of socio-cultural norms – the attitudes and relationships that inform community interest in and usage of services.

Gender is key, given the time-consuming and physically demanding burden that insufficient, distant, and poor quality water supply places on women and girls – those typically responsible for collecting water and managing household water, sanitation, and hygiene. This makes it especially important to involve women in planning and managing the water services in which they have such a high stake.

The participation of women throughout the project cycle is emphasized in Ethiopia's sector policies, but the case studies suggest their continued exclusion. Focus group discussions with female users of water schemes indicated that WASHCOs rarely include women members; for some, the all-female focus group was the first chance to air their views (Box 5.2).

Observational evidence from schemes where women hold the majority of WASHCO positions – those implemented by the NGO Water Action in Halaba Special *Woreda* – indicated that they have better financial management and higher user satisfaction than those dominated by men. Various stakeholders confirmed that the model followed in Halaba Special *Woreda* was beneficial for scheme management, though time-intensive (Deneke and Abebe, 2008a), with women often unaware of their rights and opportunities to participate.

Box 5.2 Unheard voices

'No-one has ever before heard our voice with regard to water supply, which is women's major concern. Today, even though you are here not to provide us with water, we feel as if we have had a result. Because you are here at least to listen to what women say about water'. (elderly woman, Lower Lenda)

Source: Deneke and Abebe, 2008b

Regardless of gender, however, all water service management requires well-motivated personnel – often a question of social acceptance as WASHCO positions are voluntary (BoWR SNNPR, 2002). Where there are material incentives, however, these can distort: for example the availability of a *per diem* for WASHCO members to travel to the *woreda* office to report breakdowns encourages a culture of dependence even for relatively minor problems (Deneke and Abebe, 2008: 23–6).

These examples illustrate the challenge of designing criteria and procedures to overcome social relations and attitudes that may compromise service sustainability. These criteria and procedures comprise the institutional aspect considered in the next section.

Institutional challenges

WASHCOs are prominent institutional structures at the most decentralized level of communities and *kebeles*, but their impact depends on the existence of institutional rules and their effective implementation. Explicit rules for governing 'downward' accountability, from WASHCO to community, are limited to a stipulation that WASHCOs should report to communities every three months on income and expenditure. But this rarely happens, and a vague expectation that interaction between WASHCO and community will be formalized on an ad-hoc basis (BoWR SNNPR, 2002) often leaves users disenfranchised and unable to hold anyone to account for poor services (Deneke and Abebe, 2008: 41; Deneke and Abebe, 2008: 24).

WASHCOs lack formal legal status at present, so *woreda* finance offices will not audit them, creating a climate for weak financial management – cited as a reason for the replacement of some WASHCO members, and a source of dissatisfaction among communities (Deneke and Abebe, 2008). That said, informal arrangements may be sufficient in some cases: the lack of legal status has not stopped schemes opening bank accounts – predominantly with microfinance institutions in Mirab Abaya *Woreda*.

The WWRDO of Mirab Abaya attempts to visit WASHCOs to identify problems and respond to maintenance requests. However, with less than half of its positions staffed, few motor vehicles, and no budget for running costs, these activities are severely constrained – suggesting that the causal chain for sustainability failures can be traced from the institutional to the financial. In Halaba Special *Woreda* the WWRDO maintenance team lacks the equipment for major maintenance, and relies on three functional motorbikes to visit schemes, the furthest over 100 km away. However there are also significant gaps in skills and experience at *woreda* level in many cases, which limit the effectiveness of WWRDO planning, technical support, and monitoring.

While RiPPLE's sustainability case studies focused on the community up to *woreda* level, they also provide perspectives on capacity gaps at levels of government. The SNNPR Bureau of Water Resources (BoWR) has only one crane for major maintenance, for example. Delays attributable to lack of capacity, unclear communication channels, and inadequate motivation at all levels mean that obtaining support for major maintenance from the BoWR can take a minimum of three months in Halaba. In Mirab Abaya obtaining support can take up to a year as the Zonal Water Resource Development Office (ZWRDO) provides a level of support before the regional BoWR.

Given the failures of existing arrangements to provide systematic support to communities and WASHCOs in their management and maintenance of water services, it is not surprising that alternatives are being sought. The latest policy initiative to create OMSUs and increase the role of the private sector is an example, and there are positive experiences emerging from other countries in terms of the establishment of such units (e.g. India – Rajeev, 2012), and in information transmission between user-community and service agent through mobile and 'smart handpump' technologies (Hope, 2012; Rajeev, 2012). However, these tend to work best where there is a minimum density of water points that creates economies of scale for service agents. In rural Ethiopia, this may be difficult to achieve. More generally, new initiatives can increase institutional fragmentation and worsen coordination problems if not carefully crafted and piloted.

Financial challenges

Cost appears to lie behind many instances of unsustainable water services, with insufficient funds blamed for problems including lack of technical capacity and spare parts. As Cardone and Fonseca (2003) point out, cost recovery for a sustainable service requires all costs throughout the service lifetime to be met from different funding sources – users, government, and development partners. However, financial sustainability also requires that available funds are used effectively and raised equitably.

Cost-effective services require sound financial management to prevent the misuse of scarce funds. Only one of the schemes visited in Halaba Special *Woreda* had a coherent book-keeping system, and standard practice is for WASHCOs to collect revenue from the tap attendant on an ad-hoc basis. However, WASHCOs were trying to improve financial management by, for example, issuing receipts for water payments and in some cases banking savings. The good financial management practices of some schemes in Halaba Special *Woreda* indicate that it is possible to recover regular O&M costs from user fees, even where a low unit price (e.g. 10 or 15 cents per 25-litre can) is charged. However, whether this level of cost recovery is sufficient to fund major repair, or the upgrading and extension of services, is questionable. Certainly the international evidence, patchy though it is, suggests that the full costs of sustaining handpump services may be many times greater than the costs (of minor repairs) users are typically asked to meet (Baumann, 2006).

Raising funds equitably is vital to sustainable cost recovery and use of services: if poor users are priced out it deprives the service of revenue, and deprives users of safe water. While the capacity of WASHCOs to set complex tariff regimes is limited, an average tariff covering O&M costs should be affordable (Fonseca, 2003), though community consultation may be needed to identify those who may struggle (e.g. for cash contributions at certain times of year), and to find ways to cross-subsidize the poorest and most marginalized. On average, tariffs in Mirab Abaya were lower than in Halaba Special *Woreda*, and WASHCOs offered either a monthly fixed price or on-spot fee, with free water available to the poorest. In Halaba Special *Woreda*, however, the community perceived the tariff as too high to purchase water for everyday activities. Community consultation on tariff levels was rare and limited to male community members.

Just as at WASHCO level, where a *per diem* encouraged needless trips to seek *woreda* support, financial incentives can interact in unexpected ways at other administrative levels. In both case study *woredas*, the view was expressed that an expectation of supplementary NGO funding for water services constrained the amounts released by the *woreda*. Representation and dialogue are therefore critical in the politicized local government budgeting process: members of Mirab Abaya WWRDO felt that direct representation in the *woreda* cabinet would help ensure attention for water issues – a challenge also at zonal level. Allocations have fallen short of requests in recent years, but actual disbursements increased in the last year for which data are available.

Given the constraints, other solutions are being sought to increase the availability and effectiveness of finance, including facilitated self-supply, the Community-Managed Project (CMP) mechanism, and multiple-use water services (MUS – Chapter 3).

Self-supply is arguably an extension of DRA, with full responsibility for technology choice, financing, and implementation entrusted to the community or, more likely, the household. There are concerns that the new policy emphasis on self-supply may mean large-scale implementation precedes the development of vital support elements, such as finance, credit, and marketing capacity (Sutton, 2010). While households will have a clear incentive to maximize the sustainability of wells they have paid for and built themselves, poorly sited or constructed water services will fall into disuse or pose a health risk, just as in other implementation approaches. The provision of Water Extension Workers to provide backstopping support and guidance in *kebeles* with substantial self-supply activities (McKim, 2011: 65) will be critical to counter these risks.

The CMP approach is viewed as a scaled-up version of existing schemes based on the Community Development Fund (CDF) approach used by the Finnish–Ethiopian Rural Water Supply and Environmental Programme (RWSEP). Ownership of a CMP scheme would be entrusted to beneficiary communities from the outset, with communities receiving the responsibility and funds to plan and implement their own schemes, rather than relying on external agencies for implementation. The WIF foresees stringent criteria to determine community eligibility for the CMP mechanism. However, there is no dedicated programme to increase the limited number of communities that would currently be eligible. Initial monitoring from pilot regions suggests that the CMP approach is associated with high functionality rates, though these are short-term findings and as with all snapshot functionality figures, tell us nothing about service levels and whether these meet user needs.

MUS, detailed in Chapter 3, attempts to maximize the value extracted per 'drop'. RiPPLE case study evidence from Boro Gutu *Woreda* in Oromia Region suggests that multiple-use services (irrigation and domestic water) have higher up-front costs and may be more complex to manage, but exhibit better overall cost–benefit ratios than single-use (irrigation or domestic only) schemes (Adank, et al., 2008). MUS is expected to enhance productive uses that could increase communities' ability to afford maintenance and repair (Faal et al., 2009).

A final critical component is a functioning market around spare parts and skills. The emphasis on increased private-sector involvement in the revised UAP acknowledges the need for proper incentives to consolidate spare part and pump supply across a region to achieve sufficient scale (MoWE, 2010: 36). However, neither the UAP nor the WIF provide details on capacitating the private sector beyond the evolution of OMSUs and their transition to private entities.

The financial aspect is not necessarily the end of the causal chain, however. Hydrogeological conditions may determine operational and repair costs by, for example, mandating more costly technology, especially where motorized pumping is required. Such environmental aspects are considered in the next section.

Environmental challenges

The environmental aspect of water services sustainability brings us back to the resource itself. Most rural water services rely on groundwater, which is not invulnerable to degradation, but provides a natural buffer against climate variability and drought – responding much more slowly to meteorological conditions than surface water – and generally requires little treatment (Calow et al., 2010).

Wells and boreholes are less likely to be seasonally dry if they are carefully located in good aquifers with enough porosity and permeability for storage and movement of groundwater (MacDonald and Calow, 2009) – see Figure 5.2. Hydrogeological maps may be supplemented with geophysical techniques to identify likely groundwater resources and the amount of investment required to develop a sustainable water point. During drilling or construction, pumping tests and close control over the process can enhance prospects for sustainability.

The quality of the resource also has an obvious bearing on the quality of the water service. Two naturally occurring contaminants, fluoride and arsenic, are particular health concerns (Hunter et al., 2010). RiPPLE has identified that over ten million people could be at risk of fluorosis in Ethiopia,

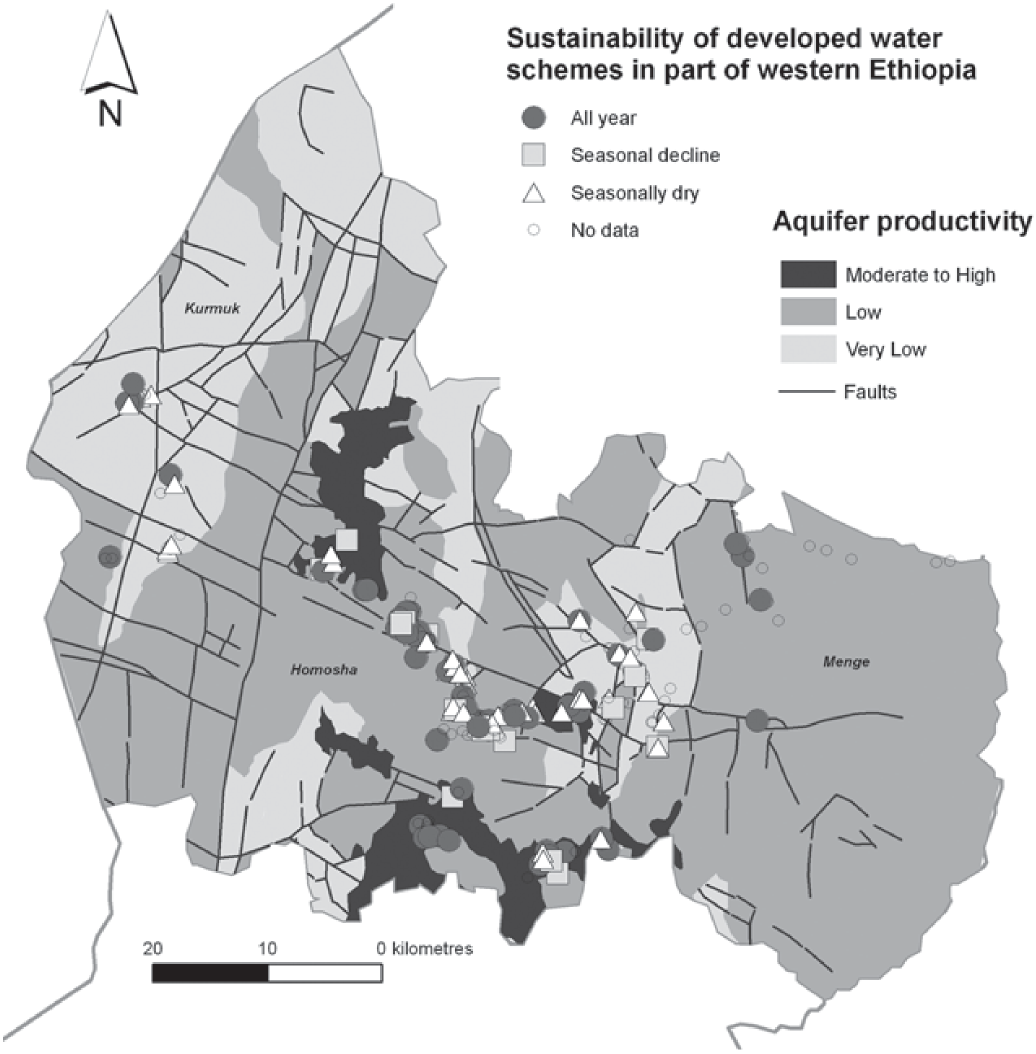

Figure 5.2 The sustainability of water points related to aquifer productivity for three *woredas* in Benishangul-Gumuz

Source: MacDonald et al., 2009

though wells or springs that are only a short distance apart may have radically different fluoride concentrations. Groundwater quality (and potentially long-term health and productivity) can also be compromised by surface contaminants, including animal and human excreta. Promotion efforts such as Community-led Total Sanitation (CLTS) have rapidly reduced open defecation, but not confined excreta (MoH, 2011). Visible quality problems such as turbidity can prevent people using even technically safe sources, as observed for two schemes in Mirab Abaya.

While falling water tables are often reported as major concerns, data on water tables across Africa are limited. Calow et al. (1997; 2010) demonstrated that in low permeability aquifers, immediate drawdown due to pumping has the greatest effect on water levels, which can be reduced by siting wells and boreholes in more productive parts of an aquifer. Constructing wells or boreholes to levels well below the dry season water table and testing them accordingly can enhance sustainability, given natural seasonal changes of several metres in the water table.

Longer-term changes in water-tables are harder to measure and predict, with a complicated relationship between rainfall and recharge that is mediated through land use and other factors. However, studies indicate that rainfall above 500 mm per annum will *generally* provide sufficient recharge for rural water supplies (Edmunds, 2008; Calow and MacDonald, 2009). The impacts of climate change on groundwater availability and quality are uncertain, and much depends on the timing, frequency, and distribution of rainfall events – still difficult to model – rather than long-term average trends (Box 5.3). Developing water supplies that can accommodate current natural variation will help ensure resilience to future climate change (Howard et al., 2010; Bonsor et al., 2010; Calow et al., 2011).

Box 5.3 Implications of climate change for water services sustainability

Global warming will lead to higher rates of evapotranspiration and a likely increase in the intensity and variability of rainfall (Christensen et al., 2007; Conway, 2011), and most scientists agree that both surface run-off and groundwater recharge will become less reliable. In Ethiopia specifically, annual rainfall is actually forecast to increase in highland areas.

The potential impacts of climate change on water services include (after MacDonald et al., 2009; Bonsor et al., 2010; Howard et al. 2010; Calow et al., 2011; MacDonald et al.,2011):

- Unimproved, shallow water sources are likely to be more vulnerable to increased climate variability because sustainability is closely coupled to rainfall.
- Improved rural water sources that access groundwater over 20 m below ground surface are likely to be more sustainable, however, a significant minority of people could be affected by more frequent and longer droughts – particularly in areas with limited groundwater storage (Figure 5.3).
- Water supplies reliant on groundwater close to the coast are at increased risk of salinization.
- Extreme weather events such as storms and floods will lead to a greater destruction of water infrastructure, from large city supplies to small community supplies, and increase the risk of contamination.
- Some water supply technologies will have a higher degree of resilience to climate change, strengthening the rationale for using multiple sources throughout a year, each with a different risk profile.
- Access to water rather than absolute water availability will remain the key determinant of water security in most areas.
- An additional complicating factor is the impact of climate change on demand. Abstraction of reliable groundwater for non-domestic purposes such as irrigation could increase, though this could in turn enhance water security by strengthening livelihoods and ability to contribute to maintenance and repairs.

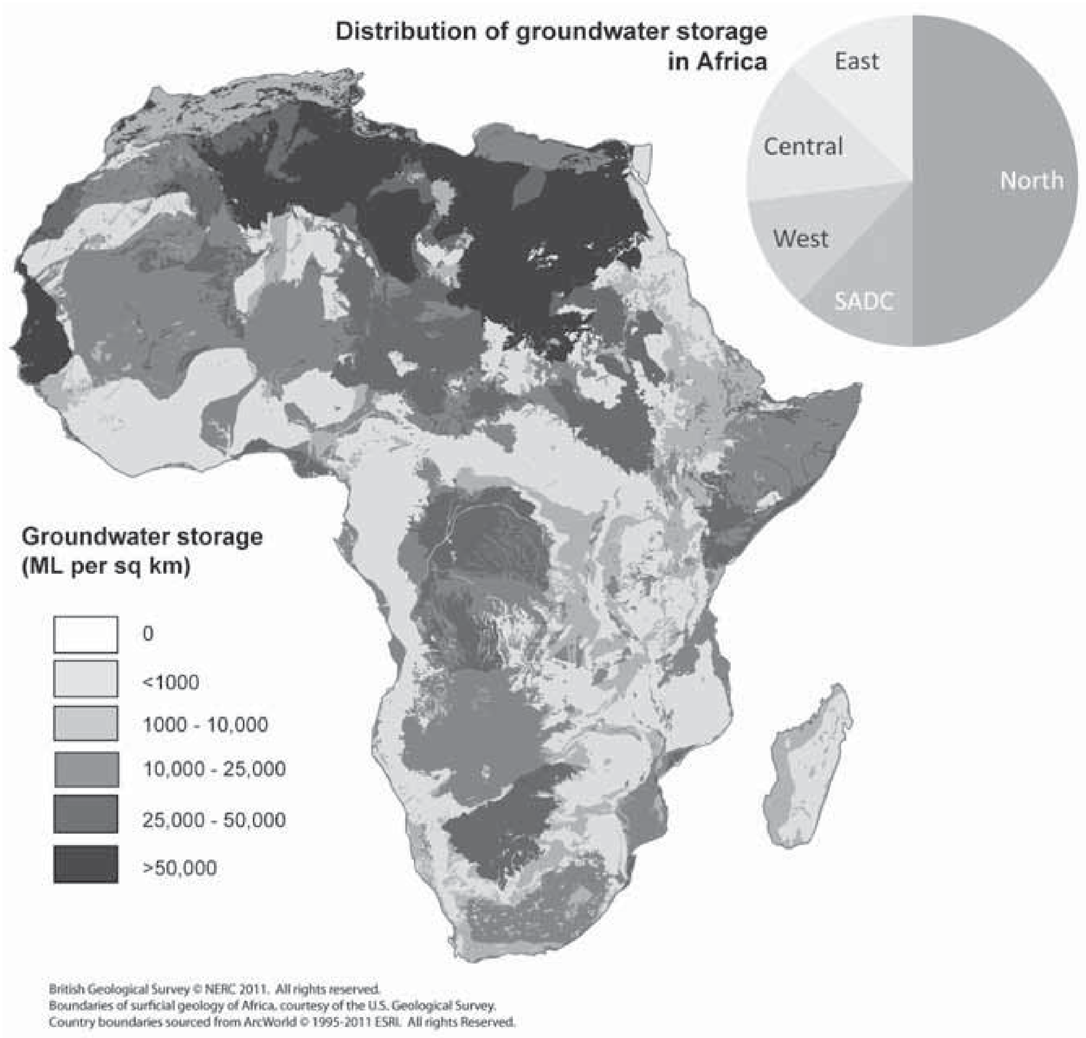

Figure 5.3 Estimated groundwater storage in Africa

Note: The large aquifers in North Africa contain a significant proportion of Africa's groundwater, but are 'fossil' aquifers because they do not receive contemporary recharge from rainfall. Less productive aquifers throughout much of SSA have less water, but storage is still sufficient to support domestic and minor productive uses. High average annual recharge will increase the resilience to short-term (i.e. interannual) climate variability.

Source: British Geological Survey © NERC 2011 in MacDonald et al., 2012

Though the environmental aspect is considered last in the list of five used to frame this discussion, it is not necessarily the end of the causal chain for unsustainable services. In many instances, choice of technology, social sensitivity, robust institutions, and a realistic approach to long-term economics can do much to mitigate the innate risks associated with the water resource itself.

Conclusion

The sustainability of water systems and services in Ethiopia depends upon a complex interaction of technical, social, financial, institutional, and environmental factors. Efforts to extend and sustain water services will founder without a clearer understanding of these contributory factors, and their influence on both systems and services.

The following recommendations draw on the RiPPLE case studies and wider learning, with a focus on Ethiopia but with broader applicability to rural water services in SSA.

- Monitoring and evaluation should go beyond new schemes and increased coverage. The National WASH Inventory (NWI) is a positive step, with its focus on functionality if not broader service levels, but effectiveness will depend on: access to data; capacity for its use in planning and budgeting; and the regularity of the process. The implicit incentive structure arising from targets for increased coverage also needs to change; for example targets could focus on sustainability as well as the number of new schemes. In the short term, the effects of seasonality should be built into monitoring by capitalizing on existing information resources such as seasonal WASH assessments around food security – with seasonality integrated into the NWI in the longer term.
- Capacity building is required at all levels, but especially among WWRDOs and WASHCOs. This includes technical training for scheme maintenance and operation, but also training on the broader institutional skill set including planning, budgeting, and monitoring. The UAP ambition to recruit and train over 120,000 skilled professional staff requires significant resourcing and careful planning aimed at training – and retaining – new recruits. Vocational training, including the innovative Guided Learning on Water Supply and Sanitation (GLoWS) programme currently being piloted through vocational colleges (Chapter 8) – can help meet this goal.
- The revised UAP and associated WIF emphasize the role of the private sector in supply chains, in O&M, and in scheme implementation. Private-sector capacity remains limited, however, in part because of high entry barriers and public sector monopolies, and because profits are likely to be thin or non-existent when dealing with dispersed rural communities. Nonetheless, support for the establishment of OMSUs is an encouraging step, even if transitions to public–private or full private status cannot be achieved where water point densities are low.
- Water service sustainability depends on sufficient financial resources and effective financial management. The preceding recommendations require additional funds, but those funds need to be used effectively, and bottlenecks that limit the absorptive capacity (Chapter 1) of local government need to be addressed. WASHCOs need particular support

to develop better financial management skills and systems, and to raise the participation of women. However, the ability of user-groups to fund all ongoing operation and maintenance, including major repairs, is questionable. Cost-sharing arrangements between communities, government, civil society organizations (CSOs), and donors may therefore need to be extended beyond project planning and implementation phases.

- Alternative systems for rural water supply, such as MUS and self-supply, have potential benefits for service sustainability. MUS fits well within a broad concept of sustainable services – incorporating the idea of different sources for different uses, in different seasons – since it demands a more holistic assessment of water needs, matched to available resources. The resource base could be enhanced by development of local, decentralized water storage as a buffer against variability. In the case of self-supply, greater understanding is needed of how communities and households can be better supported to ensure sustainability of their own services. There is a particular need to better understand where, and for whom, self-supply is appropriate, and to clarify the role of local government in implementation and backstopping.
- From a resource perspective, groundwater development provides an opportunity to extend reliable water services, at reasonable cost, to dispersed rural populations. A key advantage of groundwater is the buffer aquifer storage provides against rainfall variability – now and in future. To make the most of this potential, however, water systems (MUS, self-supply, shallow and deep boreholes, etc.) need to be closely matched to hydrogeological conditions as well as existing and potential user demand.

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