OXFAM
RESEARCH
REPORT

# Towards Sustainable Water-Supply Solutions in Rural Sierra Leone

*A Pragmatic Approach, Using Comparisons with Mozambique*

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A report by Oxfam GB, in collaboration with WaterAid

WaterAid

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# Executive summary

Despite making considerable progress since the end of the civil war in 2002, Sierra Leone is a long way from being able to meet the needs of its citizens for safe water, still less attain the Millennium Development Goal of halving the proportion of people without access to safe water by the year 2015.

To protect the population from water-borne diseases, the government of Sierra Leone has established firm guidelines to prescribe the types of hand pump that may be used. To improve sustainability, the government says that communities should pay the full cost of operating and maintaining their own water supplies.

Oxfam is concerned that these guidelines may be having, or may in future lead to, almost the opposite effect: of constraining people's ability to obtain regular access to safe water. Unless the technology matches the communities' capacity to maintain their water points, then officially prescribed systems will not be sustainable.

Oxfam research in Kailahun District in February 2006 set out to investigate this hypothesis and potential options for extending access to safe water. This report also uses research by WaterAid to compare the situation in Sierra Leone with that in Mozambique. It ends with recommendations for consideration by the government of Sierra Leone.

The report shows that hand pumps supply the safest drinking water and are the water-lifting device that most people prefer. Most pumps are working, but then most have been installed only recently. However, the report questions over-reliance on Kardias and the other pumps specified by government, and it also expresses some concern about excessive reliance on hand-pumps generally. It raises questions about the capacity of communities to maintain them. Obstacles are both social – poverty, lack of community cohesion, women's workload and position in society – and technical – including lack of tools and spares, and the need for extensive training of caretakers and mechanics. The survey found that people were not informed about the likely long-term financial cost of hand pumps when they were being installed, which made properly informed choice impossible.

When pumps break down, the difficulties of doing repairs mean that people have to go back to less-safe sources. But communities anyway cannot meet all their water needs from improved sources, especially in the dry season. They continue to resort to traditional wells, springs, and streams on a regular basis. The research showed that traditional wells were particularly prone to bacteriological contamination. Given that people will continue to have to use these wells anyway, it is important to find ways to improve water quality.

Most traditional wells are privately owned, and owners continue to invest in them. (In contrast to the problems involved in raising funds for the maintenance of collectively owned supplies.) The report suggests that finding ways to do low-cost upgrading of traditional wells could lead to significant improvements in access to safe water.

Furthermore, no matter what the water source, whether it be lined wells supplied with hand pumps, or traditional wells, or spring boxes, water becomes rapidly contaminated once it enters people's homes. This fact demonstrates the urgent need for more integrated public health and hygiene interventions alongside all or any water-supply improvements.

Regular refresher training of mechanics is also needed. Such training should particularly focus on women, who are the principal users of water and less likely than men to move away from the community. But it needs to be recognised that this added responsibility would add to women's workload, which is already heavy.

Overall, the report suggests that the government of Sierra Leone could move further towards a demand-responsive approach. (Interesting parallels with Mozambique support this view.) This would mean giving communities a real choice of technologies that best suit their financial and social resources. Development of lower-tech options does not preclude the possibility of upgrading or modernising systems in the future, as resources become available.

To enable this to happen, donors should support the government's efforts to decentralise responsibility for infrastructure to the local level, which means supporting communities' own efforts to achieve sustainable supplies of safe water. Expecting communities to pay all operation and maintenance costs is simply unrealistic, so appropriate government assistance is essential. This should include devising and implementing systems for more regular water-supply surveillance. The research findings suggest that sanitary surveys could be a simple and effective first line of defence to spot potential contamination problems.

For the immediate future, the report endorses the government's efforts to establish a functioning chain and network for the supply of spare parts for the specified hand pumps, together with training for mechanics. But it suggests that agencies and government should together explore, through pilot schemes, wider water-supply options (spring protection, gravity schemes, and rainwater harvesting) as well as developing appropriate types of pump.

# Introduction: the water challenge in Sierra Leone

This report assesses the practical difficulties facing the government and people of Sierra Leone in their efforts to provide safe water in rural areas. It draws comparisons with a similar situation in Mozambique, and recommends new ways of tackling the problem.

Surveys undertaken by the Sierra Leone Water Company (SALWACO) on behalf of the Ministry of Energy and Power in 1999 revealed that only 15 per cent of the population of some five million people had access to a sustainable supply of safe drinking water from a protected source. By 2003, this proportion had increased to 22 per cent of the population. Nevertheless, the shortfall of 78 per cent means that the country has a long way to go to achieve the Millennium Development Goal (MDG) of halving the proportion of people without sustainable access to safe drinking water by the year 2015. It is even further away from the government's own targets: to reach 65 per cent coverage by the same date, and 95 per cent coverage by 2025.[1]

The Sierra Leone pilot census survey of 2003 indicates that some 1.5 million people take water from shallow unprotected wells, and more than two million rely on surface water.[2]

## *The challenge of the Millennium Development Goals*

Across Central and West Africa as a whole, 66 million people, about one-third of the rural population, are still taking their drinking water from unprotected wells, and more than 46 million rely on rivers, streams, and swamps.[3] To provide even half of these people with safe water by conventional means would require investment to double or even treble. It is highly questionable whether investment on this scale will happen. Government investment is hampered by lack of money; furthermore, water supply, especially rural water supply, is a low priority in most countries' poverty-reduction strategies.

In Sierra Leone, water services (via SALWACO) were allocated 1.5 per cent of total recurrent public expenditure in the government's budget for the financial year 2003: approximately 3.3 billion Leones (US$ 1.1m).[4] The government's budgetary commitment in real terms fell from 1.89 per cent of GDP in 2003 to 1.59 per cent in 2004.[5]

Furthermore, much of the water-supply infrastructure that existed was destroyed in the ruinous civil war that officially ended in 2002. In post-war Sierra Leone, once-scarce piped supplies are now almost totally non-existent. Some traditional wells too have been abandoned; people will not use them, because they fear that they are contaminated by

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[1] *A Review of the Water Supply and Sanitation Sector*, by E.T. Ndomahina and I.S. Kabia for Government of Sierra Leone, Poverty Alleviation Strategy Coordinating Office (*PASCO*), July 2004.

[2] Figures from various sources: meeting of DACO / SLIS DEPAC (Development Assistance Co-ordination Office / Sierra Leone Information System Development Partnership Committee), January 2004, on the Water Supply and Sanitation Sector, Sierra Leone; UNDP *Human Development Report 2004*; Sally Sutton, 'Self Supply in Sierra Leone', report for the Rural Water Supply Network (RWSN), April 2005; 'Mapping of Sierra Leone's Water Resources and its Management Framework', draft report, November 2005, by Francis Moijue for ECOWAS Water Resources Coordination Unit; and the Economist Intelligence Unit country profile, 2005.

[3] S. Sutton, 'Preliminary Desk Study of Potential for Self-Supply in Sub-Saharan Africa', WaterAid, October 2004.

[4] L2,900–3,000 to the US$.

[5] Tearfund: 'Making Every Drop Count: Financing Water, Sanitation and Hygiene in Sierra Leone, 2005'; and DACO / SLIS DEPAC, *op.cit.*

dead bodies or poison. Two million people were displaced during the civil war. The population is still in flux, with large numbers of people congregating in some places, especially towns, which puts stress on water sources and makes planning difficult. Rural populations are still, however, generally scattered and live in relatively small groupings.

Water provision has to compete with other urgent priorities. However, clean water, sanitation and hygiene knowledge and practices all play a big part in reducing both maternal and child mortality (diarrhoea is the third biggest child killer in Africa[6]). Of Sierra Leone's 4.9 million people, 70% live below the basic-needs poverty line. The under-five mortality rate, which reached 284/1000 in 1999, during the civil war, had been cut to 265/1000 by 2004, and the government aims to cut it to 80/1000 by 2015. Maternal mortality at 1,800 per 100,000 live births is the highest in sub-Saharan Africa and the target is to reduce this to 450/100,000 by 2015.[7]

### Box 1: The history of Oxfam's programme in Sierra Leone

*Oxfam Great Britain (GB) began working through partner organisations in Sierra Leone in 1961. In 1998, in response to the escalating conflict, Oxfam established direct operations. During the emergency, its work focused on delivering water and sanitation in the north and west (Freetown, Koya rural, Port Loko) and the south-east (Bo, Kenema, Kailahun). The programme received funding from a variety of donors, including ECHO, DFID, and UNHCR. Since early 2004, the programme has moved towards a more development-orientated approach. Raising the status of women is a major goal.*

# Government water policy and guidelines in Sierra Leone

The government's draft policy on hand-pump maintenance has now been incorporated into the wider Draft National Policy Guidelines and Action Plan on Water Supply and Sanitation of January 2005. This lays down stringent guidelines, as follows:

- Only certain types of hand pump can be used: the Kardia, Inkar Mark II, and PB Mark II.
- Communities should pay the whole cost of the operations and maintenance of rural water supply.

In addition, hand-dug wells should be lined to their full depth with reinforced concrete, and should have an internal diameter of 1.8 metres.

These are the policies of SALWACO (the parastatal Sierra Leone Water Company)[8] and WSD (the Water Supply Division of the Ministry of Energy and Power).[9] They are guided by several important considerations. First and foremost is the desire to ensure high standards of technology, perceived to be the best guarantee that citizens will be provided with safe water. (Communities themselves generally express a preference for sealed wells with hand pumps, because they consider these safe.) The second consideration that determines the official policies is the desire to ensure a sustainable system. The

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[6] *Dying for the Toilet*, WaterAid 2004.

[7] Government of the Republic of Sierra Leone, Millennium Development Goals Report, 2005.

[8] SALWACO are currently responsible for five provincial urban water systems.

[9] WSD are responsible for the rest of the country's urban water systems, rural water policy and regulation.

proliferation – at least in the past – of different types of hand pump in Sierra Leone was seen as an obstacle to ensuring a consistent and reliable supply chain for spare parts. Finally, community ownership and maintenance are seen as crucial for sustainability.

Regarding wells, it is argued that full well lining is a necessary national standard. It guarantees technical durability, no matter where in the country, in no matter what geological conditions, and regardless of who digs the well. It also improves safety standards for well diggers.

### *Decentralisation*

Another potentially very important policy that the government is introducing is that of decentralisation of responsibility for infrastructure and services. Responsibility for building and maintaining rural water supplies is supposed to pass to the new district councils (elected in 2004) later in 2006, following decentralisation of responsibility for agriculture, education, and health and sanitation in 2005. The councils have authority to impose taxes to finance district development plans and the delivery of basic services. Although the details remain to be worked out, it is expected that SALWACO / WSD will appoint water and sanitation technicians in each district. Decentralisation has the potential to move control of basic services closer to citizens.

### *An important opportunity*

This is therefore an important opportunity to put the best policies in place from the start. Oxfam GB (referred to hereafter as 'Oxfam') is concerned that the guidelines currently in place, while clearly intended to protect the population from water-borne diseases, may be having, or may in the future lead to, almost the opposite effect: of constraining the ability of people to obtain regular supplies of safe water. This report summarises the findings of an Oxfam survey in Kailahun which illustrates these concerns. The experience of WaterAid in Mozambique is also particularly pertinent in this regard.

## The water situation in Kailahun District

In Kailahun District in the south-east of Sierra Leone, only 14 per cent of the population – some 50,000 people – have access to safe water (the lowest proportion in the country).[10] Kailahun was identified by the Sierra Leone Integrated Household Survey (2003–04) as the district with the highest incidence of poverty, which makes the long-term sustainability of arrangements for water-point maintenance particularly critical. Kailahun suffered especially severely during the war. Infrastructure, agriculture, industries, health-care facilities, water supply, sanitation, housing, and education were all destroyed, badly damaged, or neglected. The majority of the population was displaced.

Kailahun's population of 233,838 in 1985 had grown to 358,190 by 2004, according to the national censuses of those years. To provide even half of the current population with safe water would require an extension of coverage to an additional 129,000 people. That would require the installation of more than 500 additional water points, on the basis of 250 people per water point.[11] Although most displaced people may have returned by

[10] Sierra Leone Government, 2003 figure cited in Draft National Policy Guidelines, January 2005; and DACO / SLIS DEPAC.

[11] SPHERE standards prescribe one water point per 250 people in 'normal' circumstances, and an upper limit of 1:500 in emergencies.

now, at a similar rate of increase there would be at least another 120,000 people in Kailahun by 2015.[12] See Table 1.

**Table 1: Population figures, Kailahun**

| Census year | Population | Increase | % increase | Total increase (%) |
|---|---|---|---|---|
| 1963 | 150,236 | | | |
| 1974 | 180,365 | 30,129 | 20 | |
| 1985 | 233,839 | 53,474 | 30 | |
| 2004 | 358,190 | 124,351 | 53 | 138 |

### Box 2: Oxfam's programme in Kailahun

*Oxfam has worked in Kailahun since 2002 and has constructed more than 150 water points in some 85 communities. Its current Health, Empowerment, Livelihoods and Protection (HELP) programme will run until July 2007, after which a new, large-scale, five-year programme is planned. With EU funding, Oxfam will now concentrate work in some 200 communities, to strengthen community management and maintenance of water points, and intensify public-health work to raise community awareness of hygiene issues and change hygiene behaviour.*

# Oxfam's research in Kailahun

To investigate appropriate and sustainable water-supply technologies, Oxfam conducted research over the course of two weeks in four chiefdoms in Kailahun District in February 2006. The research team consisted of Oxfam staff, representatives from the WSD and the Ministry of Health and Sanitation of the government of Sierra Leone, and a lecturer and research students from Njala University College.

These four chiefdoms – Kissi Tongi, Luawa, Mandu, and Upper Bambara – were places where Oxfam had been operating since 2002. However, the research was not confined to Oxfam-installed water points. The research team selected at random a 25 per cent sample of each of the five main types of water point in each chiefdom, as follows:

- lined wells with hand pumps (43)
- boreholes with hand pumps (13)
- traditional wells (unlined) (16)
- gravity schemes (4)
- spring boxes (10)
- other (2).

In all, the team reviewed a total of 88 water points in 52 communities. The research concentrated mainly on rural areas, although some water points in peri-urban areas were also examined. The research used focus-group discussions, questionnaire interviews, observation, water-quality testing, and a sanitation survey.

[12] Kailahun Water and Sanitation Survey Report, National Recovery Committee, February 2004; Sierra Leone Government national census, 2004.

By assessing its own efforts, Oxfam was able to begin to compare work conducted under current government specifications with other types of water-supply improvement work, whether implemented by communities themselves or by other agencies.

This report sets out the findings from Oxfam's research. It then goes on to describe the work of WaterAid in Mozambique and compares the policy context there with that in Sierra Leone. It also draws on research work on 'self-supply' in Sierra Leone, carried out by Sally Sutton for UNICEF and the Rural Water Supply Network (RWSN), and on other relevant literature and agency experience.[13]

# General findings from the research

Groundwater is the main source of supply in Kailahun. The construction of boreholes is limited by the poor availability of drilling equipment. So hand-dug wells, lined or unlined, are the main sources of drinking water.

1. **Lined hand-dug wells with hand pumps**. These are constructed following government specifications that include a minimum diameter of 1.8 metres and depth varying from about 7m to 15m. The wells have concrete linings to the complete depth and are provided with a head wall, 1m high, with slab. The wells are generally sealed completely, with a hand pump fitted as a lifting device. The wells are provided with appropriate protection on the sides and have a drainage channel leading to a soakage pit. The construction work is good. The wells are generally well maintained by communities, and fenced with controlled access (during certain hours of the day). Most of the wells studied during the research were those constructed by Oxfam GB from 2002 onwards. In line with government specifications, the most common lifting devices used were Kardia hand pumps with a few (more recent) examples of Inkar or India Mark II. Some pre-2002 pumps (non-Oxfam) were also fitted with India Mark II pumps. The wells have been either rehabilitated or newly constructed. Rehabilitation of wells generally involves cleaning and re-deepening, re-plastering, and changing the hand pump.
2. **Boreholes with hand pump**. After 2002, Oxfam GB drilled all the 13 boreholes studied during the research. These are generally 20–30m deep and fitted with Kardia hand pumps. They are well protected with concrete aprons and drainage channels.
3. **Traditional wells.** The traditional wells are mainly constructed by the community or in private ownership. These are unlined wells with minimal protection or none at all. Very few of the wells seen had a concrete platform constructed around the opening; most had wooden planks or old tyres to provide a platform around the well, with makeshift lids. The sanitary conditions around the traditional wells were generally poor. Rope and bucket are commonly used as a lifting device; five of the traditional wells observed had a dedicated rope and bucket protected from pollution. All but one of the traditional wells were working well, and most had been in use for several decades.
4. **Gravity schemes**. The four gravity-fed schemes studied were constructed in the 1980s with WaterAid support, and three were rehabilitated by UNICEF or Oxfam in 2002/03. A typical gravity scheme consists of a small storage dam constructed in the hills on a perennial stream. The water in this storage dam is conducted to tanks by

[13] Similar studies have been conducted by other agencies e.g. Action Contre la Faim (ACF) in Gbonkolenken and Tane Chiefdoms, Tonkolili District; by GOAL in Kenema District; and by COOPI in Koidu town, eastern Sierra Leone.

galvanised iron pipes. The tanks are generally located in suitable places in the village, and water is supplied through public stand posts.

**Table 2: Summary of the status of water-lifting devices studied**

| Type of lifting device | No. of water points with the device | Working well | Working with problems | Not working | Percentage not working |
|---|---|---|---|---|---|
| Kardia | 44 | 33 | 9 | 2 | 4.5 |
| India Mark II | 12 | 6 | 4 | 2 | 17 |
| Inkar Mark II | 4 | 1 | 1 | 2 | 50 |
| PB Mark II | 1 | | | 1 | 100 |
| Rope/bucket | 14 | 13 | | 1 | 7 |
| Gravity scheme | 4 | | 4 | | 0 |
| No device | 9 | | | | 0 |
| **TOTALS** | **88**<br>**Pumps only = 61** | **53**<br>**Pumps = 40** | **18**<br>**Pumps = 14** | **8**<br>**Pumps = 7** | **9%** |

# Community ownership and caretaking

On a day-to-day basis, people are generally taking reasonable care of their water points, especially those where Oxfam has worked. Caretakers are in place, with responsibility for cleaning the water points and enforcing rules and regulations. These 'bylaws' seem to be generally understood and obeyed, with fines for non-compliance.

## Box 3: Management of water points

*Typical 'bylaws' enforced at water points:*

*Take off shoes before entering the water point.*

*Women must cover their hair.*

*No babies allowed carried on the back.*

*Only one person at a time.*

*Age limits: no children under a certain age or height; or children must be accompanied by an adult.*

*Orderly queuing and no jostling or fighting.*

*Only one bucket per person.*

*In addition, the caretaker(s) are responsible for carrying out, and/or organising the community to contribute to: regular cleaning of the water point; installing fencing around it to stop children and animals encroaching on it; monitoring usage and behaviour; and locking the pump at certain times. Most water points have fences, although these are rarely adequate to stop all animals encroaching.*

*Pumps are occasionally locked to prevent constant use, to avoid damage to the equipment and depletion of water levels. The pump may be locked, for example, when school ends for the day. The caretaker may also have power to lock the pump as a punishment for abuse or for failure to contribute to cleaning. This is important for sustainability, but it may mean that people temporarily resort to other sources. (Locking needs to be monitored, because control of the key gives some people a degree of power over others. This may compromise the safety of women in particular.)*

This sense of ownership is encouraging, because research in other countries has indicated that 'Village Level Operation and Maintenance' may suffer from community reluctance to take ownership of the communal pump.[14]

## *Needs outstrip supply*

The research found that people's water needs outstrip the supply. Although not definitive, the findings indicated that the average population per constructed water point exceeds 500 (the figure set by SPHERE standards as the upper limit for the ratio of people per water point in emergency situations). And while people use water from improved sources for drinking, in no case is it is enough for all community needs. So other sources – traditional wells, springs, and streams – continue to be used for cooking, washing, irrigating gardens, etc.

A further problem revealed by the research was that of the 88 water points examined, 27 have low yields and five dry up entirely during the dry season. In nearly half those cases, people reported having to rely on unprotected sources for their water. Boreholes and spring boxes provided the most consistent source of water all year round. As for gravity schemes, the low yield in one particular case (Potoru, Mandu chiefdom) was due to wartime damage to the pipeline, which has not been repaired yet. Table 3 presents a breakdown of the sources with low yields.

**Table 3: Water sources with low yields**

| Type of water point | Total number | No. with low yield | % of total | No. that go fully dry | % of total | Oxfam wells with low yields |
|---|---|---|---|---|---|---|
| Lined well with hand pump | 43 | 18 | 40% | 3 | 7% | 11 |
| Borehole with hand pump | 13 | 3 | 25% | 0 | | 3 |
| Traditional wells | 16 | 7 | 44% | 2 | 12.5% | 0 |
| Spring box | 10 | 2 | 20% | 0 | | 1 |
| Gravity schemes | 4 | 2 | 50% | 0 | | 0 |

## *What happens when hand pumps break down?*

Overall, out of 61 hand pumps studied, seven (11 per cent) were not working at all during the time of the study, and 14 hand pumps (23 per cent) were working with problems. The most common problems seen were the following:

a) Pumping (handle operation) is difficult.

b) The water has a high iron content (very common in India Mark II pumps with galvanised iron risers, due to corrosion of the pipes).

c) Several strokes are required to begin to get yield from the pump (probably due to leakage from the cylinder or from pipe joints).

Some of these problems can lead to complete failure of the pump. So far the occurrence of pump failure is relatively low, and 89 per cent of the pumps visited were functioning. However, most were constructed after 2002 and are therefore relatively new. Only two Kardias are not working at all, but another nine are working with some problems. Of the other government-approved pumps, two out of four Inkars, and the only PB Mark II examined, were not working. Of 12 India Mark II hand pumps, which are technically

[14] See for example, 'Lessons Learned from Village Level Operation and Maintenance (VLOM)' by Jeremy Colin, Report Summary of WELL (DFID) Task Force No. 162, March 1999 (WELL: Water and Environmental Health at London and Loughborough – Resource Centre Network for Water, Sanitation and Environmental Health).

simpler than the Kardias – and, like them, all (bar one) installed since 2002 – two are not working, and four have problems.

When hand pumps break down entirely, the situation is serious. People said that 14 water points (12 with hand pumps and two spring boxes) had remained broken for 'several weeks' or even 'several months'. When this happened, people in nine cases said they had to use sources like streams or swamps. Only in large villages, where more than one source has been developed, can people go to other safe sources. In one case, men said there was no particular problem, as they could go to any water point in the village; but women said that if there was a long queue at their own pump, or the water there was low, they could not go to another water point: they had to go back to the stream.

Pump breakdown is therefore exposing people to an increased risk of disease in a significant number of cases. Why do water points break down? More importantly perhaps, why do they stay broken for so long? The answer lies partly in the technology used and partly in people's ability to manage it.

### *Community capacity for operation and maintenance*

People knew that it was their responsibility to look after the water points, and that they were the owners – which is why they generally took such good care of them. People sometimes mentioned helping with the construction. However, beyond day-to-day caretaking as described, there were no organised management systems in nearly half the cases examined. There were specific water-point committees in just under one-third of cases, but it was doubtful how active these committees were.

There were only a few examples of communities collecting money to pay for water-point maintenance. People all said that they were desperately short of money, and it would be difficult for them to contribute anything. Many villages are only just being re-established after the war, and such communities may not be cohesive yet. In some places, crops such as cocoa, neglected during the war, are not yet being produced again. Income is, in any case, seasonal.

There were regular contributions of cash for only eight water points examined, although more people contribute for occasional repairs and general maintenance. Where money was raised regularly, the contribution was approximately 100L–500L per house (US cents 3–15), depending on whether money was raised weekly, fortnightly, or monthly. However, most people generally consider even this small amount prohibitive.[15]

Some people said they were told about the need for a maintenance fund, but most people interviewed seemed not to have thought about it at all. Mostly, communities said they would wait for a breakdown to occur before collecting contributions. It is easier to collect money when there is an obvious need, but starting from scratch in this way means longer downtimes. In case of breakdown, larger, one-off sums were collected, even up to 3000L (c. US$ 1) per household in one case.

Where communities did collect money, it was often for a general village fund that could be used for a variety of possible needs. The needs are many – for example, housing for those still homeless, and re-establishing agriculture – and these needs may compete with water supply as a priority. (The question of who decides what a village's priorities are is doubtless influenced by gender-related factors, but the research did not explore this

[15] The most perishable components of the Kardia are the sealing cups and O-rings. Sealing cups cost L25,900 ($US 8.50), and O-rings L2,275 ($US<1). Grease, essential for preventative maintenance, costs L24,150 ($US 8) per 400g. Note that these are Freetown prices; costs can be expected to be higher outside the capital, especially in remote communities (source: Associate Investment Enterprise, Freetown, price list 21/09/05).

question; it was noted, however, that the Chief in every community visited by the researchers was a man.[16])

The task of collecting regular contributions is complicated by a lack of nearby banks, as well as by shifting populations in villages, and lack of community cohesion. People (including some Chiefs interviewed) worry about accountability. In only one case examined – in Kailahun town – were regular contributions collected; here the money was used to pay a stipend to a caretaker for regular oversight of the use of the pump. But even there, people were still worried about accountability. One focus group in Mobai town said they paid taxes for services, but they did not know where their tax money went and so were unwilling to pay extra.

Some communities are organising ways to raise money for future emergencies by cultivating a specific field of rice or cassava, the proceeds from which are intended to fund repairs.

# Mechanics, tools, and spares

The research indicates that water points without hand pumps are out of action for the shortest length of time, and the capacity to repair them without NGO involvement is greater.

**Table 4: Capacity to carry out repairs at water points**

| Type of water point | Total seen | Number that have broken at least once | Average time taken to repair | Who repaired |
|---|---|---|---|---|
| Lined well with hand pump | 43 | 17 | Several weeks to several months | Most commonly a village mechanic with help from an NGO. A few were repaired by mechanics from other villages. Five are still unrepaired. |
| Borehole with hand pump | 13 | 2 | Two weeks, and one still unrepaired | Mechanic in village with help from an NGO |
| Traditional well | 16 | 3 | Less than one week | Privately repaired |
| Spring box | 10 | 4 (2 have a hand pump, 2 have no lifting device) | Less than one week (for hand pumps) | Mechanic in village with help from an NGO |
| Gravity scheme | 4 | 3 (note: damage related to taps) | About three weeks in two cases; one still unrepaired | Mechanic in village |

In case of breakdowns, 50 per cent of interviewees said they would take action in the community to try to solve the problem themselves – working with others, or with the committee, speaking to the Chief, or contacting the mechanic. People usually said that they would go to the Chief. However, when asked, Chiefs and mechanics usually said that they would in turn go to Oxfam, or whichever agency installed the pump. Other options, like seeking assistance from the WSD or the newly formed local councils, were not mentioned.

Agencies that installed pumps arranged for the training of mechanics, and there were trained mechanics in every village where a pump was installed. In most cases there were also trained mechanics for protected wells and gravity schemes, and for half the spring boxes examined. Most had basic tools (mainly spanners) sufficient to take care of above-

[16] This is fairly typical of traditional authority structures in Sierra Leone. Only nine out of 149 Paramount Chiefs, for example, are women.

ground repairs. However, they said that some breakdowns (of Kardias particularly) are beyond their capacity to repair.

In none of the reported cases of complete breakdown was the pump mechanic in the village able to carry out repairs alone. Support was sought from the NGO that had installed the pump, or from other mechanics in neighbouring villages, or even farther afield.

None of the mechanics had any spares, and they did not know the cost of the spares likely to be needed. Some 30 per cent of people interviewed said they did not know where to go to buy spares. Half would 'go to Oxfam'. It appears that spares (for all pumps) are not readily available locally. Only a few people interviewed said they had been able to find any, and only spares for India Mark IIs, a simpler pump. Only nine per cent of people said they would go to the market to find spares.

Remote villages are at a particular disadvantage, as people have to travel longer distances, at greater cost, to report breakdowns or try to find a mechanic. The cost of hiring a mechanic – typically travel costs plus wages – was given as L15,000–L30,000. In some cases, trained mechanics have moved away; in most cases, existing mechanics have not received any refresher training.

Nearly all of the trained mechanics (as opposed to day-to-day water-point caretakers) are men. Oxfam has trained both female and male mechanics, although men are more active. In one case the woman mechanic had said that she could not continue unless she was paid. This probably reflects the commonly acknowledged 'triple burden' of women's productive, reproductive, and community workload.

### Box 4: An unaffordable repair

*In Buedu village, Kissi Tongi, the community complained that a borehole drilled by Oxfam had insufficient risers to reach the water table in the dry season. They asked a mechanic to look at it. The mechanic dismantled the pump and asked for L40,000 (US$ 13) for adding a length of pipe. The community was unable to afford it.*

# The problem of contamination

A sanitary survey was done at 80 water points. A score of four or more indicates a health risk. Thirty water points registered such a score.[17]

**Table 5: Results of sanitary survey**

| Type of water point | Total surveyed | Number with sanitary score >4 (risk) | Best score | Worst score |
|---|---|---|---|---|
| Lined well with hand pump | 39 | 6 | 0 | 9 |
| Borehole with hand pump | 13 | 2 | 0 | 5 |
| Traditional well | 13 | 13 | 5 | 12 |
| Spring box | 7 | 4 | 3 | 10 |
| Gravity | 2 | 0 | 2 | 4 |

The most common risks are posed by the following factors:

[17] The water points were evaluated according to 12 criteria, including whether there was a latrine within 30m, or a latrine was on higher ground than the water point; whether fencing was adequate; and whether the headwall was cracked. The range of possible scores was 0–12.

a) inadequate fencing, allowing animals to access the water point (in 62 cases);

b) cracked drainage or poor drainage, causing water to pond around water points (over 40);

c) rope and buckets exposed to contamination (this was the case in all the traditional wells).

## *Water quality*

The pattern of contamination risk identified by the sanitary surveys in Kailahun District was confirmed by water-quality tests carried out using a DelAgua kit. Bacteriological contamination, pH, and turbidity were tested. The results show that traditional wells, gravity schemes, and spring boxes are most prone to serious bacteriological contamination. The trends for bacteriological contamination are shown in Table 6. The pH values of all the samples were found to be within acceptable limits. Turbidity values were found to be high in some traditional wells. Generally the turbidity for 'developed' sources was within acceptable limits.

**Table 6: Water-quality results**

| Type of water point | Total number tested | Samples found contaminated | | Per cent contaminated (>10) |
|---|---|---|---|---|
| | | Count 1 to 10 | >10 | |
| Lined well with hand pump | 31 | 12 | 3 | 10% |
| Borehole with hand pump | 13 | 1 | 1 | 8% |
| Traditional well | 13 | 1 | 12 | 92% |
| Spring box | 8 | 3 | 4 | 50% |
| Gravity scheme | 4 | 1 | 3 | 75% |

(For comparison, we note here that the NGO COOPI [Cooperazione Internazionale] recently tested 16 hand-dug wells in Koidu town, eastern Sierra Leone. Most had been recently constructed by various agencies and fitted with government-approved hand pumps. In 10 out of 16 cases there was slight or medium E. Coli contamination. This could be due to the high level of the water table during the rainy season, and/or to adjacent mining activities. Many wells also showed poor yield during the dry season.)

## *Sanitary surveys: a first line of defence*

The study found a close correlation between high scores (>5) in the sanitary survey and bacteriological contamination revealed by water-quality tests. This suggests that sanitary surveys could be used as a trigger to alert water-quality monitors. In a few cases sanitary scores were low, but coliform counts were high. In these cases, latrines were close by (<30 metres), or latrines were situated above the water point. This suggests that these factors should be given additional weighting in future sanitary surveys.

## *The household contamination problem*

However, water samples were also tested for possible contamination inside the house. A total of 38 samples from houses were tested for contamination. Out of these, 27 samples showed an increase in contamination (71 per cent) above the base value. This increase was above 10 coliforms per 100ml in 20 samples (52 per cent). This indicates that no matter how safe the water when it leaves a water point, a lot of contamination occurs

very soon afterwards, either in the containers used or otherwise at household level. No matter what the technology, post-delivery practices are key to the risk of contamination.[18]

## *The impacts on health*

When pumps break down, or in the dry season when yields are low, people may resort (in more than 50 per cent of cases) to alternative sources such as streams or swamps, as well as to traditional wells. According to the District Health Management Team (DHMT), the most common water-borne diseases in Kailahun District are watery and bloody diarrhoea, due to faecal contamination. Under-fives are most at risk from watery diarrhoea, a problem largely caused by lack of personal or household hygiene (for example, handwashing) among mothers, leading to contamination of the water; another cause is the fact that children play on the ground and eat things found there**.** Watery diarrhoea is most common in the early dry season (February to April), when water levels in wells are in most cases lower. But people also regularly take water from sources such as scoop holes if they are working in their fields and cannot afford time to go to the protected source. There is a peak of bloody diarrhoea in the rainy season (September to November), when farmers are busy in their fields and have to drink there.

As the findings on household contamination indicate, therefore, hardware alone cannot stem the spread of water-borne disease. What is crucial is the 'software' of people's use and management of the water provided. This is as true in Sierra Leone as it is elsewhere. For reference, Table 7 summarises the relative impact of different public-health interventions on the reduction of diarrhoeal diseases,[19] drawn from experience in several countries.

**Table 7: Impact of various public-health interventions**

| Intervention | Reduction in diarrhoea (approx. %) |
|---|---|
| Water quality | 15 |
| Water quantity | 20 |
| Hygiene | 33 |
| Sanitation | 35 |

Adequately addressing hygiene and sanitation issues has been shown to have a greater effect on the reduction of diarrhoea than water quality. But to guarantee maximum impact, all four components must be addressed in an integrated approach to public health.

## *The sealing dilemma*

In nearly every case, the lined hand-dug wells with hand pumps surveyed had been sealed completely, including the wells constructed by Oxfam. This is a common practice. Communities too prefer it. However, it means that if the pump breaks down, there is no way at all for the community to gain access to the water by rope and bucket. In fact, the policy of the WSD is to have a covered inspection hatch for just such an eventuality, as well as to facilitate inspection and repairs.

[18] Current (post-2004) SPHERE standards are zero faecal coliforms per 100ml. Previously the contamination baseline was over 10/100ml.

[19] Presented in Technical Brief no. 52 of Waterlines, WEDC. Original source: S. A. Esrey, *Waterlines*, Vol. 14 No. 3, 1996, cited in Strategy Paper on Drinking Water Supply Surveillance, Bikaba / Becks, Oxfam GB.

### Box 5: Two case studies

*Baiima village in Mandu Chiefdom has a gravity-based water-supply system that was constructed in 1986. UNICEF rehabilitated it in 2003. There seems a strong sense of community ownership. The community has requested assistance to refurbish the system (for example, with fencing to stop pigs getting into the reservoir) and to provide the pump caretaker with refresher training.*

*Pendembu is a large community in Upper Bambara Chiefdom. It used to be served by a public piped system, which is no longer operational. Now it has a number of different water points of all types. The Paramount Chief has requested the services of the most knowledgeable pump mechanic to service pumps across the whole Chiefdom.*

# People's views on technology choices

In nearly every case, communities interviewed expressed a very strong preference for 'new' systems – sealed wells with hand pumps – rather than 'old' ones. The reasons given were *'it is not easily contaminated'* and *'it is free from accidents and danger to the children'*. This is true: almost all the traditional wells examined had contamination problems and lacked aprons, fences, etc. that serve both hygiene and safety/security functions.

In addition, people in some communities no longer wished to use certain open wells that they had been using before the war, because they did not know what might have been thrown into them. The research did not explore attitudes in depth, but it seems unlikely that any testing or cleaning programme would be able to overcome people's worries, so in such cases these particular wells may never be functional again.

When asked about choice, only 15 per cent of people said that they had been consulted over choice of technology, i.e. whether to have a hand pump or not, although most were consulted about the location of the water point.

On the question of quality, it was noted that people preferred drinking water to be 'cool', 'sweet', 'clear', or 'colourless/odourless', and these adjectives were particularly applied to water from springs. This apparent preference would be worth investigating further.[20]

WaterAid's experience in Mozambique, referred to later, does suggest that it is possible to create genuinely informed demand if certain conditions are in place.

## *Well lining*

SALWACO / WSD guidelines say that hand-dug wells should be lined with reinforced concrete throughout. In adherence to this policy, the hand-dug wells constructed by Oxfam in Kailahun are all lined to their complete depth. SALWACO / WSD also set out a recommended internal diameter of 1.8 metres.

In discussions of the findings of this research, Oxfam HELP staff pointed out that an internal diameter of this size requires the use of a considerable amount of additional building materials. They felt that the internal diameter of wells used exclusively for domestic drinking-water purposes may be reduced to 1.4 or 1.2 metres. This would reduce costs and encourage well-digging. They also queried the need for full well lining, saying that wells need to be lined – and even then, may only need to be partly lined –

[20] For an overview of the different possible technologies, with the advantages and disadvantages of each, e.g. see the Rural Water Supply Network (RWSN/skat foundation): *Technology Options in Rural Water Supply*, by Erich Baumann, September 2003. See also *Handpumps Specification and Selection Guideline Manual*, Oxfam Public Health Engineering Team, September 2003.

only in particular conditions, that is, if the sides are liable to collapse. In many places, dug shafts are stable without lining, and lining according to need would save money.

## Encouraging self-supply and private investment

Nearly all the traditional wells in villages seen by the Oxfam research team were privately owned and maintained, but accessible to all. The owner of one such private well (with rope and bucket), interviewed in Kailahun town, explained that her husband had dug it and invested further in deepening it. They maintained it and allowed anyone to draw water, without charge, at set times. She explained that water was a gift from God that should be shared. The DHMT occasionally chlorinated the well; if this did not happen, she herself bought chlorine. She expressed the wish to further upgrade the well with a cement lip around the hole.

Self-supply expert Sally Sutton[21] made a rapid appraisal of the situation in Bo town in Sierra Leone in April 2005. She observed that households had already made sizeable investments in traditional water supplies, were often keen to upgrade them, and shared them with their neighbours and wider community. She concluded that low-cost upgrading of such supplies could lead to significant improvements in water quality. This could be particularly suitable for scattered communities and those of 200 or fewer – the number below which a hand pump is generally considered to be an uneconomical investment. Also, because there is no piped supply to link to, people live in more scattered and less nucleated settlements, even in peri-urban areas around Kailahun town. This in turn means that it will be more expensive in future to provide a pipe network, and people will have to continue to rely on their own wells.[22]

In Bo town, a piped water supply serves only five per cent of the population, while more than 3,000 traditional wells are estimated to exist now. These wells are generally owned by an individual but shared with neighbours, with no payment involved. Householders generally paid between US$ 100 and US$ 150 – substantial sums – for the excavation of their well and for limited protection. Asked about the future, most interviewees said that they would like to complete an apron and drainage and install a hand pump if possible, especially if there was a pump available for under US$ 100. Private investment of this sort could be facilitated by credit or savings systems.

## Demand-responsive approaches: WaterAid's experience in Mozambique[23]

Like Sierra Leone, Mozambique has endured a ruinous civil war, along with a string of natural disasters. Communities are only now re-forming, and levels of trust between families are often low. Capacity is limited, and communities are often small and dispersed. Although there are differences between the two countries (for example, towns are farther apart in Mozambique), Mozambique's experience of trying to deliver

[21] 'Self supply' is defined as an approach to water supply, which concentrates intervention and management at a household or small-group level and which is complementary to communal supply.

[22] SPHERE guidelines for hand pumps in normal situations are for 250+ people per pump (500 in emergencies).

[23] This section is based upon 'Demand-Response Approach in Practice: Why Sustainability Remains Elusive', by Edward (Ned) Breslin, WaterAid, March 2003, with updated information provided in March 2006.

sustainable safe water supplies to its citizens shows interesting parallels with that of Sierra Leone.

The government of Mozambique has implemented an explicitly demand-responsive approach (DRA) to water supply as national policy. Before the development of the National Water Policy (in 1995) and subsequent Implementation Manuals (the first drafted in1999), Mozambique's water-supply policies were supply-driven. The government recognised that this approach did not lead to sustainable services, because of a lack of community involvement and the absence of technology that could be maintained by local communities.

For several years WaterAid has examined the arguments for and against DRA, as experienced in its programme in Niassa Province. Niassa is the most sparsely populated province in the country, with a population of 809,800 in 1997. It has some of the highest rates of poverty, illiteracy (particularly among women), and infant mortality, and some of the highest percentages of people without access to potable water in the country.[24]

### *Problems with the supply-driven approach*

Under the previous supply-driven approach, the only technology available was the Afridev hand pump for hand-dug wells and boreholes. While these are excellent hand pumps which, when maintained properly, can provide valuable service to communities for at least ten years, they are expensive to maintain and require access to spares that are not locally manufactured. Today, abandoned Afridevs litter the countryside. The community's financial, technical, and social means to sustain Afridevs (which are much simpler and cheaper pumps than Kardias or Inkars) were not considered. The decision driving Afridev use was premised, as in Sierra Leone, on the need for sound water quality.

In terms of management, each community was instructed to form a committee of two men and two women to manage its scheme. These committees lacked the ability to respond to technical problems and the influence to secure community contributions for spares, so breakdowns were common. The Provincial Government of Niassa estimates that more than 35 per cent of water points in the province are broken, and in some districts, 90 per cent of pumps have broken down.[25] The National Department of Rural Water estimated that $US 28 million had been lost by the sector, nationally, as a result of pump failure.

Monitoring and evaluation work by WaterAid and its partners showed that more than 80 per cent of communities have never repaired their hand pumps, and the remaining communities either do not have the financial means to repair them or have done so only once, using the spares kits that were provided as part of the projects.

In response to these project failures, the lack of sector capacity, and a need to transfer more responsibility to the communities, DRA offered a dramatic new approach to water supply in Mozambique. The new National Water Policy and official Implementation Manuals argue that communities are more likely to sustain their new water systems under the following conditions:

- If they initiate the project themselves. Rather than being given a project, the participating community must request a project, to show that they are interested in addressing their water problems.

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[24] Republic of Mozambique, 'Action Plan for the Reduction of Absolute Poverty, 2001–2005' (PARPA, published in April 2001), cited by WaterAid, *op. cit*.

[25] DAS-Niassa 'Banco de Dados', 2002, cited by WaterAid, *op. cit*.

- If they make decisions on technologies, management systems, and hygiene programmes.
- If they contribute money up-front. Communities must contribute two to ten per cent of the total cost of the water service, to demonstrate their commitment to the project and their financial and organisational capacity to sustain the project over time.
- If they manage their own system. Communities must accept full responsibility for their water service by deciding on a tariff structure and paying all operation, maintenance, and replacement costs.

The policy and manuals also call for the decentralisation of responsibilities from national to provincial and district levels, in keeping with DRA principles.

# Technology choice under the demand-responsive approach

Technology choice is a key component of DRA, on the basis that technologies need to be matched to the needs and economic and organisational capacities of local communities, and on the assumption that local people are best placed to decide what is most appropriate. This was recognised in the government's draft Implementation Manuals of 1999 and 2000. Both drafts included several options, including hand-dug wells with or without a hand pump. This meant that protected wells with a windlass and dedicated bucket could be considered along with Afridevs and other hand-pump options.

Since the expansion of the technical options, protected wells (hand-dug lined wells with windlass and bucket) have become the favoured choice of communities throughout the districts supported by WaterAid partners. They are inexpensive to maintain, and the simple technology does not require special equipment or complex training; communities can buy ropes and buckets from almost any private-sector merchant. Many communities asked for their broken hand pump to be replaced with a protected well because, understandably, they would rather have a regular and reliable supply of water that they can sustain than a hand pump that supplies higher-quality water but is unreliable and too expensive to maintain over time.

### Box 6: Rethinking in-kind contributions

*WaterAid partners have explored commonly applied in-kind contributions and found them to be of limited value in guaranteeing sustainability. For instance, the fact that members of a community can dig a well does not necessarily mean that they will be able to collect the necessary funds to repair a broken hand pump. They are now experimenting with alternative models: for example, if a community chose an Afridev hand pump, a good sustainability indicator would be a contribution of a rod, a PVC pipe, a foot valve, a complete spares kit, and a sack of cement. For a rope pump, an indicator of ability to sustain the technology over time might be two ropes, a guide box, and a bag of cement.*

There is evidence to demonstrate the benefits of protected wells in sustainability terms. From 2000 to 2003, WaterAid financed 146 protected wells, 139 hand pumps, and 55 hand-pump rehabilitations. During this period, only two protected wells fell into disrepair; but during the same period, 32 of the 39 evaluated hand pumps experienced technical problems or broke down. The evidence suggests that communities are not sustaining Afridevs.

Unfortunately, the government's third version of the Implementation Manual, published in 2001, narrowed the technology options again. It no longer allowed protected wells.

This effectively eliminated low-cost sustainable options for communities that are organisationally weak and impoverished. It meant that the DRA-inspired policy that requires communities to be wholly responsible for the operation, maintenance, and replacement of their water supplies effectively became impossible, because the technologies that communities could sustain were eliminated as options.

The government's arguments against protected wells focused on issues of water quality. It was feared that litter, debris, and disease organisms, particularly cholera, could easily contaminate protected wells. While this concern was understandable, in reality a well-maintained, protected well is better than a broken hand pump and much better than the alternative – collecting water from polluted rivers, streams, or swamps.

To address this challenge, WaterAid and its partners pointed out that the key clauses on technology choice were not operable while the Afridev was the only approved option. As an alternative, the government authorised WaterAid and its partners to test a local version of the rope-and-washer pump. This experiment began in Niassa in 2003/2004. Initial results were positive and led to a groundswell of support for the expansion of rope-and-washer pumps into other provinces. In 2005, following a study managed by the National Government, a pilot initiative was started in the four northern provinces of Mozambique. The intention is to learn more about local manufacturing of rope-and-washer pumps, and about community interest and sustainability of the technology.

There are clearly no easy answers: initial results indicate that the spares problem is still an issue, even for the simpler technology of the rope-and-washer pump. While supplies of rope are generally available, supplies of PVC piping are limited. Furthermore, communities have no experience of using PVC piping. Breaks in this piping, which can happen when communities have to replace the rope, may lead to the total failure of the system.

It seems that perhaps 20 per cent of rural Mozambicans are unable to sustain hand pumps of any kind at all. This is particularly the case in poor, small, isolated, and remote communities. The government seems to have recognised this, because it announced at the end of 2005 that it would allow 'lower-cost options' once again, besides the Afridev and the rope-and-washer pump. The lower-cost option now allowed is the protected well with a dedicated rope and bucket. In fact, evidence shows that water quality in protected wells with a dedicated rope, bucket, and windlass is quite good.[26] Government water-supply departments in Zimbabwe, Zambia, Malawi, and South Africa now consider protected wells to be a legitimate technical option. However, the key is good community management, based upon strong community awareness of public health and hygiene issues.

The acceptance of lower-cost options in government policy, if formally adopted, will open up a broad range of technology options for communities to consider – the Afridev, the rope-and-washer pump, and the protected well – on the basis of their own capacities to sustain their choice.

## Stimulating community demand

Some government leaders in Mozambique feared that the shift from a supply-driven approach to a demand-responsive approach might lead to a severe reduction in the number of communities serviced per year. A common argument is that a long time is needed for communities to learn about and understand the policy and to express demand. However, the contrary has been demonstrated by WaterAid's work in Niassa.

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[26] K. Nyundu and S. Sutton, 2001, cited in WaterAid's report, *op. cit.*

Demand can be generated. In fact, in Maua and Nipepe districts, demand for improved water sources has outstripped previous targets set by the provincial government. A number of critical factors explain this trend.

- **Guaranteed long-term funding.** In this case, the funds have come from WaterAid. This has raised the confidence of district government and local communities, who can see results in other villages and have assurance that government will respond to their demands.
- **Simple but multiple communication channels**, including radio, drama, and exchange visits.
- **Investment in government structures.** On-going visits by government officials are essential to gain and keep communities' confidence, particularly once they have made a formal request for support.

It is also crucial for women to be recognised as critical players, and not mere water collectors. WaterAid's experience is that, as the main users, women generally respond more quickly to technical problems at water points, and have greater capacity than is generally acknowledged within the sector. This is pertinent to Sierra Leone.

# Conclusions

For the best of motives, the government of Sierra Leone has imposed rigid specifications regarding the types of hand pump that can be used in the country. The Kardias, for example, are hardy, robust and long lasting. But although establishing the essential spares chain needed to sustain these relatively 'hi-tech' pumps has started, progress appears to be slow and difficult.[27] Furthermore, even if spares do become available at an affordable price, the pumps themselves are – in Oxfam's experience – beyond the scope of a village-level mechanic to repair, and this situation is not likely to change for some time.

Unless an efficient and affordable parts-and-maintenance chain can be established, any breakdown is likely to be a long-term problem that might force communities back to reliance on unsafe water sources for a considerable period of time. Although people's attitudes suggest that they will not easily shift to 'old' systems, as they see them, communities are continuing to use alternative sources of all kinds, including traditional wells, out of necessity. It seems likely that they will have to continue in this way for a long time to come.

It seems that although agencies consult people about their preferences, in most cases the only water-lifting technology that they actually offer is a hand pump – and of a particular kind. Furthermore, the full implications of having a hand pump (a Kardia, Inkar, or PB Mark II) and the financial burden if it breaks down are rarely made explicit to communities to enable them to make an informed choice and begin to plan ahead properly.

There is inevitably a continuous and progressive rate of breakdown of hand pumps (of whatever type) each year, as a result of problems beyond the capacity or willingness of communities and pump menders to repair.[28] Although some types of hand pump are more suitable for 'Village Level Operation and Maintenance', a review of literature on the subject suggests that communities cannot in fact be expected to do all the required pump maintenance and will always need a level of external support. This is not to say that hand pumps are a bad option, or that communities should not choose them. Indeed, in some areas a borehole with pump may in fact be the only feasible option. The key question is: how sustainable is the technology currently on offer, in the present context?

We would suggest, on the basis of our research, that Sierra Leone is likely to face real problems in sustaining hi-tech hand pumps in the next five to ten years. This looming problem, combined with the high levels of contamination in the traditional wells, on which people remain heavily reliant, creates a double need to find ways to upgrade traditional wells and strengthen their management systems, and look at options other than hand pumps. This research has helped Oxfam to become more aware of the shortcomings of the approach we have been implementing in Kailahun, how to improve it, and the need to extend the range of options.

Development of lower-tech options would not necessarily preclude the possibility of upgrading or 'modernising' systems in the future, as resources become more readily available. If the route of lower-tech options is increasingly followed, it needs to be

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[27] For an analysis of the problems of supply chains in Africa, eg see RWSN/skat_foundation: 'Supply Chain Issues for WES Facilities' by Karl Erpf and Erich Baumann, August 2004; and the HTN Network for Cost-effective Technologies in Water Supply Issue Paper: 'Supply Chains', 01/05/03, e-mail info@skat.ch

[28] Sally Sutton calculates a failure rate of five per cent per annum, based on calculations from inventories in Mozambique, Mali, and Zambia.

accompanied by extra investment in public health and hygiene measures of various kinds. Such measures are in any case essential to counter the problem of household-level contamination of water. The Oxfam research suggests that sanitary surveys could be a simple, inexpensive, first line of defence in monitoring water quality.

WaterAid's experience in Mozambique shows how government policy change in the direction of DRA, and technology choices based on a pragmatic assessment of community capacity for operation and maintenance, can bring about tangible improvements in community ownership and sustainable management of water points, and can thus ensure progress towards the MDG of improving access to safe water. The government of Sierra Leone, donors, and international and local NGOs active in the water sector might learn from the experience of Mozambique to guide their policy development and infrastructure-improvement plans for rural supply.

# Recommendations

### *A. Move towards a demand-responsive approach*

The government of Sierra Leone and humanitarian agencies should move much further towards a demand-responsive approach (DRA), which means a long-term strategy to stimulate and respond to community demand and to give communities a real choice of technologies that they have the capacity to maintain. This means being open to other possibilities: discussing the advantages and disadvantages of each option, both for water supply and for water lifting, and presenting communities with financial projections for the cost of maintenance in each case. Communities must be able to make an informed choice, and allowed to choose the technologies that best suit their financial and social resources. As part of DRA:

**Rethink in-kind contributions:** in line with WaterAid's experience in Mozambique, in-kind contributions should be rethought so that they demonstrate how government obligations and community responsibility go hand-in-hand. New models should be found for communities to contribute in ways that demonstrate greater understanding of, and commitment to, the likely demands that the chosen technology will make of the community in the future.

**Develop realistic government support systems:** expecting communities to pay all operation, maintenance, and replacement costs is not only unrealistic but also not a sound, equitable policy practice to ensure the provision of water, unless the technology offered is appropriately simple and cheap. This has been WaterAid's experience in Mozambique, and the Oxfam research strongly suggests that the same applies in Sierra Leone. There is a need for a clear, transparent, and widely understood definition of what repairs are likely to be needed, what aspects could realistically be within the capacity of each community and as such could be considered their responsibility, and what repairs are beyond their capacity and are therefore their responsibility to undertake. The challenge is then to develop 'on-call' government support systems to make those repairs in a fast and effective way so that communities do not resort to unsafe water sources.

**Strengthen government capacity:** decentralisation has the potential to give citizens greater control over basic services, and to stimulate DRA. But community management needs support; without efficient and sustained government support at local level, sustainability will always be in doubt. Donors must invest in long-term support to build up the capacity of the Sierra Leone government, especially in its decentralisation efforts, so that districts have the capacity to meet government obligations to increase access to water supply in

collaboration with communities' own efforts and reasonable contributions. Support could involve, for example, training in financial management, training and equipping the central and district-level WSD technicians, and helping to set up water-surveillance systems. Local government support for village water committees could include regular monitoring of the facility; water-quality monitoring; support for repairs that are beyond the scope of communities; and assistance to management committees if they falter or fail.

## *B. Promote public health and hygiene understanding and practice*

**Promote hygiene:** the identified levels of household water contamination indicate a general and on-going need for much greater hygiene awareness and improved hygiene practice. Specifically, no water scheme should go ahead without being preceded by and accompanied by an integrated public-health programme of hygiene promotion, emphasising hand washing in particular. This would be in line with the '3-in-1' policy of the WSD, which is to offer *water supply plus sanitation plus hygiene education*. The devolution of environmental sanitation to District Health Management Teams (DHMTs) offers a potential opportunity for better, more integrated working in this area. This approach would assist communities to understand the implications of the range of options on offer under DRA, including inspection hatches and systems to manage rope-and-bucket options.

**Water-supply surveillance:** a more regular, comprehensive system of water-supply surveillance is needed, particularly where lower-tech options are developed. This would identify water points that have a higher risk of becoming contaminated, and would activate and bolster responses. Surveillance is primarily a government responsibility, but sanitary surveys would be a useful first line of defence and could be done by communities themselves. Surveys do not require any equipment, and they are easy to administer, using simple diagrams. Sanitary surveys could also be used as a tool to identify post-delivery risks and contamination at the household level.[29] Surveys can be used to sound the alarm so that action can be taken both by communities themselves and by local government.

## *C. Action on hand pumps*

**A working spares chain:** in the immediate future it is important to establish and – even more important – sustain a working spares chain for all the Kardia pumps and other pumps that have been installed already, as the government and UNICEF are seeking to do. In the case of the Kardias, there may be time to do this, as their newness and reliability means that breakdowns will not begin to occur regularly for some years yet. However, the very fact that spares will be slow moving for some years is a problem for traders.[30]

**Refresher training:** there should be a sustained programme of regular refresher training of mechanics, concentrating especially on women. Agencies working in the field and the WSD should do this. Because the Kardias in particular are new, mechanics may well have moved away by the time that serious breakdowns occur. Men, especially young men, are more likely to move away than women and girls; the latter, as the principal users, may have stronger motivation to

[29] See Oxfam Strategy Paper on Drinking Water Supply Surveillance.

[30] The quality of spare parts for India Mark IIs on the market is said to be very variable (this also applies to the Afridev in Mozambique), and donors should press manufacturers to improve standards.

maintain the facilities. The issues of additional workload for female mechanics will need to be addressed in discussion with communities.

**Pilot other types of pump:** our research leads us to believe that it is time to explore wider options that seem more likely to be sustainable. One way would be to extend the guidelines to explicitly allow other types of pump to be piloted and, if successful, approved for general use. Field trials might include, for example, the hybrid U3M pump, India Mark III, Tara, Volenta, Elephant, or rope-and-washer pumps. Some might be suitable for local design and manufacture. It would be very important for those pilots to be conducted with government involvement.

## *D. Consider wider options*

**Pilot alternative options:** in co-operation with the government, agencies should explore alternatives to hand pumps, such as spring protection, gravity-fed schemes, and even rainwater harvesting. Agencies and government could further develop criteria to judge effectiveness in terms of safety, regularity of supply, ease of community management and maintenance, cost, etc., and they should collaborate to monitor the relative effectiveness of options over time.

**Traditional wells and self-supply**: the sustainability problems of high-tech hand pumps, combined with the high levels of contamination in traditional wells, upon which people still have to place heavy reliance, demonstrate the urgent need to find ways to upgrade privately owned traditional wells and to assist and encourage private well owners who share water with their neighbours. This could involve helping owners to deepen, clean, and protect these wells and their surroundings. Instead of seeking to replace such sources, low-cost upgrading of these systems could lead to significant improvements in water quality and convenient access. This may be particularly useful for urban and peri-urban areas and for isolated communities. It could be linked to micro-credit schemes. (Oxfam, for example, is promoting the establishment of Village Savings and Loan groups in Kailahun, as a development of traditional savings and credit systems [*osusus*].) It might also be possible to build on and build up the local well-digging sector and its network of skilled and experienced artisans – well diggers, masons, blacksmiths, etc.

**Flexibility on lining wells and well diameters:** there should be scope to reduce the internal diameter of wells used solely for domestic (drinking water) purposes. Similarly, there could be more flexibility on well lining, so that the amount of well lining corresponds to geological circumstances.

**Leave a hatch:** where wells are sealed, agencies should aim to install a covered inspection hatch, in line with WSD policy. This facilitates inspection and repair. It also means that if the pump goes wrong, people can still access the water. As some agencies have done, it should also be possible to install an angle iron bracket for a windlass at the same time, so that a pulley, rope, and dedicated bucket can be installed if and when needed. In view of people's preference for sealed systems, noted above, a demand-responsive approach should entail a discussion of the advantages and disadvantages with communities, who would remain free to opt for an alternative to a sealed well if the hatch remained unacceptable to them.

# Acknowledgements

The research team in Sierra Leone comprised Daudi Bikaba, F S Bokari, Michael Sammy, Andrew Lamina, Eku Frazer, and John Magrath of Oxfam GB; Ajeet Oak, consultant; Francis Moijue, Water Supply Division, Ministry of Energy and Power; Brima J Dasama, District Health Management Team; Isheka Turay, lecturer, and Watta Bundu, Yatta Musa, Deborah M Conteh, students, at the Department of Geography and Rural Development, Njala University College. Thanks to all for their invaluable enthusiasm, insights, and hard work. Ellie Kemp, Oxfam's Deputy Country Programme Manager, commissioned and guided the research.

The material about Mozambique is taken with permission from the WaterAid report 'Demand Response Approach in Practice: Why Sustainability Remains Elusive', 2003, by Edward (Ned) Breslin, then WaterAid Country Representative, Mozambique, who also contributed an update for this report. This report also draws on Sally Sutton's work on self-supply in Sierra Leone. Thanks to all involved for all their comments, especially Ellie, Daudi, Ajeet, Ned and Sally, Michel Becks, Othman Mahmoud and Michel Anglade of Oxfam, and the Oxfam HELP team; Belinda Calaguas and Ian Bray of WaterAid; Peter Cawley of Concern; Damien Blanc of Action Contre la Faim (ACF); Andrea Ferrero of COOPI; and many others.

## *Disclaimer*

This paper was written by John Magrath with substantial contributions from Ellie Kemp, Ajeet Oak, Daudi Bikaba, Sally Sutton, and Ned Breslin. The views expressed in the text and its recommendations are those of Oxfam and supported by WaterAid. They are broadly supported by, but may not reflect in every detail, those of the whole research team. The author takes responsibility for any errors herein.