CRANFIELD UNIVERSITY

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IMPACT AND POTENTIAL OF SELF SUPPLY IN AMURIA DISTRICT, UGANDA

SCHOOL OF APPLIED SCIENCE

MSC WATER MANAGEMENT

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Abstract

In Uganda, 87.7% of the population remain in rural areas (UBOS, 2006). Considerable efforts have been and are being made to reform the water sector and address issues of sustainability in rural areas, nevertheless, the literature suggests that although progress is being made in increasing rural coverage, challenges continue to be faced in achieving the country's national and international targets (MWE, 2006).

The majority of rural water supply initiatives globally focus on communal supplies for groups of between 200 – 500 persons, however, many communities are too geographically scattered, and socially discordant to achieve sustainable management of a given water source (Sutton, 2004a). In addition, the focus of support on communal interventions tends to suppress local initiatives by households and small groups to improve their own situation with regards water.

Although greater funding is being channelled to the sector, new approaches are needed if international targets for safe water supply are to be met in rural areas. Supported self-supply is one such approach. By focussing on building a supporting environment, supported self-supply builds on local initiatives, seeking to encourage and improve them. A pilot project was initiated in 2006 in Uganda to explore the potential of such an approach.

This thesis examines the impact at one of the pilot sites in Uganda. Using a combination of water quality sampling and semi-structured interviews with water-users, research was conducted in Wera, Amuria District.

The evidence suggests that supported self-supply is able to achieve significant improvements in water quality, access and sustainability, using simple technologies in line with locally-available skills and materials, and at a lower per-capita cost than more conventional communal approaches.

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Contents

List of Appendices:

List of Tables:

List of Figures:

Glossary of Abbreviations:

ACT	Action by Churches Together
COHRE	Centre on Housing Rights and Evictions
DWD	Directorate of Water Development
DWO	District Water Officer
HIPC	Heavily Indebted Poor Countries
IHL	International Humanitarian Law
IHRL	International Human Rights Law
JMP	Joint Monitoring Programme
LC1	Local Council One
LRA	Lord's Resistance Army
MDG	Millennium Development Goal
MWE	Ministry of Water and Environment
NGO	Non-Governmental Organisation
NTU	Nephelometric Turbidity
O & M	Operation and Maintenance
PEAP	Poverty Eradication Action Plan
PRSP	Poverty Reduction Strategy Paper
RWSS	Rural Water Supply and Sanitation
SIP	Strategic Investment Plan
SWAP	Sector-Wide Approach
TTC	Thermo-Tolerant Coliform
UGX	Ugandan Shilling
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
UWASNET	Uganda Water and Sanitation NGO Network
WEDA	Wera Development Association
WHO	World Health Organisation
WUC	Water User Committee

1. Introduction

1.1 The Global situation

In 2004, 1.1 billion people across the globe lacked access to an improved source of drinking water (JMP, 2006a). In recent years there has been growing international concern on the issue, reflected in the inclusion of water and sanitation within the Millennium Development Goals, the declaration of 2005-2015 as the International Decade for Action 'Water for Life', and moves to explicitly recognise water as a human right within international human right mechanisms, amongst many others.

Despite these laudable international efforts, sustainable progress is proving complex to put into practice in many areas of the world. The WHO/UNICEF Joint Monitoring Programme for Water and Sanitation tracks progress towards the MDG target to 'reduce by half the proportion of people without sustainable access to safe drinking water'. According to the JMP (2006a), the world is still moving towards achieving the target, however, the rate of progress is deteriorating and at current rates would miss the target.

The issues are many. In urban areas water provision tends to be a very capital intensive undertaking [1]. Providers frequently face challenges of poor water infrastructure, dilapidated and inefficient systems, weak management, fast-growing population rates, high poverty levels, and decreasing financial support (Amayo, 2003) - making it difficult to operate a self-sustaining business. Meanwhile, in rural areas, problems of sustainability have frequently plagued Government and NGO efforts.

[1] Richard Franceys, Personal Communication during the 'Financing and Managing Water' module of the Cranfield University MSc Water Management.

In providing sustainable water in rural areas several key challenges have shown themselves over the years[2]:

1. Technological issues: the appropriateness of the technology used in terms of its ease of management, maintenance, availability of spare parts and technical expertise to address breakdowns.
2. Social issues: such as the degree of ethnic homogeneity or inter-ethnic relations, leadership, gender relations, the degree of poverty, the concentration of the population, a sense of ownership.
3. Institutional issues: the nature of the agreements between different stakeholders, and their capacity to undertake their roles and responsibilities, the degree of training provided, the degree of external support, the policy and donor environment.
4. Economic and financial issues: the ease of cost recovery, income levels, availability of infrastructure and supply chains, private sector incentives.
5. Cultural issues: religious and other factors affecting source use and management and hygiene practices.
6. Environmental issues: affecting the type of technology used, reliability across the seasons, and the impact of water and sanitation activities on the environment.

1.2 The issue

The current international focus on access to safe water often tends to be couched in terms of health impacts, although this is gradually expanding. An intrinsic link between safe water access and poverty is increasingly recognised, as is its importance in achieving adequate living conditions and human dignity; UNESCO's World Water Development Report (2003) notes that 'the poverty of a large percentage of the world's population is both a symptom and a cause of the water crisis' which has its roots in the mismanagement of the resource.

[2] Based on information from Webster *et al*, *Sustainability of rural water and sanitation projects*, Harvey and Reed, *Sustainable rural water supply in Africa: Rhetoric and reality*, Carter and Tyrrel, *Impact and sustainability of community water supply and sanitation programmes in developing countries*, and as noted in course material from the Cranfield MSc Water Management (Community Water Supply).

Within the context of this thesis several of these multiple and extensive linkages should be noted. Water is crucial for basic human survival and health - water-related diseases are behind millions of deaths and illnesses worldwide, and yet the tragedy is that many can be easily prevented through simple source protection and safe hygiene practices. However, those who lack access to safe water are often those most marginalised socially, and the efforts, time and resources expended in collecting water or addressing health issues further adds to their burden. In addition, many income-generating activities and food security rely on the availability of water, be it for the production of crops, or for the maintenance of the environment and ecosystem. Improvements in this regard hold the potential to break the cycle of poverty.

1.3 Uganda

In Uganda, 87.7% of the population remain in rural areas (UBOS, 2006). Considerable efforts have been and are being made to reform the water sector and address issues of sustainability in rural areas, nevertheless, the literature suggests that although progress is being made in increasing rural coverage, challenges continue to be faced in achieving the country's national and international targets (MWE, 2006).

The relevant literature suggests that current solutions to improve rural water supplies focus on allocating further resources to the sector, strengthening community management, the development of national support structures, and the encouragement of the private sector in service provision (MWE, 2006), reflecting similar approaches adopted elsewhere (Kwadzokpo, 1997). However, evidence from across the globe suggests that such approaches have a mixed success (Phiri, 1996), and that new approaches may be more successful in certain circumstances.

The majority of rural water supply initiatives globally focus on communal supplies for groups of between 200 – 500 persons (Sutton, 2004a), however, many communities are too geographically dispersed and lack the homogeneity to ensure sustainability of, or even to qualify for, a community source. Consequently, numerous households and groups invest in developing and managing their own water sources, which, although appreciated for their proximity, taste and productive use by users, tend to be ignored by policymakers who consider them to be unsafe and to be replaced by an improved system (Sutton, 2004a).

Meanwhile, these self-supply initiatives by households and small groups are undermined by more conventional communal approaches. According to Dr. Sutton (Personal communication) evidence indicates that once an organisation initiates a community supply project in a given area, the number of self-supply sources constructed drops-off significantly.

1.4 Self-Supply

An alternative approach, termed 'Self-supply' seeks to build on and improve such initiatives by rural households of groups. The approach aims to encourage traditional source construction, thus increasing water supplies; to support and promote source protection and household storage practices, thus improving water quality; and to ease water-lifting, allowing productive use to be made of the water (Sutton, 2004b). Given the limitations of current solutions to the issues outlined above, such alternative approaches are crucial in achieving national and international safe water coverage targets, and their wider associated benefits.

Elsewhere in sub-Saharan Africa, the approach has demonstrated its ability to achieve sustainable water supplies, improve water quality, and even stimulate economic activities. Despite its high popularity amongst users policymakers often remain an obstacle, viewing the approach as inferior to the provision of communal and more technical solutions.

1.5 Aims and Objectives of the Thesis

In Uganda, a Self-Supply pilot project was initiated in 2006 in two rural areas to explore its potential impact and viability as a complementary approach in areas with dispersed communities, or in areas of shallow groundwater where such self-supply sources are already prevalent. This thesis represents research undertaken at one of the pilot locations: Wera, Amuria District.

The overall aim of the thesis is to explore the impact and feasibility of self-supply in the study area. Specifically:

1. To compare self-supply sources to more conventionally improved sources in terms of five key parameters: access, quality, reliability, management and cost.
2. To highlight the key features of self-supply to identify the approaches' strengths and weakness within a given context.

Below the relevant literature is explored to set the context of the Pilot project. The research methods employed are explored, and the findings presented. From these, the potential of the approach is assessed, and recommendations are made for future action.

It is hoped that the findings of the thesis will serve to inform any further expansion of the approach as a complementary approach in the study area or elsewhere in Uganda, and to assist the relevant stakeholders in further improving the process.

2. Literature Review

2.1 The Millennium Development Goals

The Millennium Development Goals emerged from the UN Millennium Declaration in September 2000, when all UN member states committed to a set of eight inter-linked goals which aim to reduce global poverty in a sustainable and rights-based manner (IRC, 2004). Water is intrinsically linked with all eight goals, and drinking water has been specifically included as a key target of the MDGs: to halve 'by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation', with sanitation added in 2002[3].

The MDGs are distinct in that they have been committed to at the highest political level, and also call for a global partnership that recognises the role that all countries have in supporting the process, which is reflected by the adoption and integration of the MDGs by other major international and regional financial institutions (The Millennium Campaign, 2007). In addition, the goals are not beyond reach, they are realistically achievable, and progress is being closely monitored internationally (The Millennium Campaign, 2007).

In so doing, the MDGs have been invaluable in raising the importance of water and sanitation on the international agenda, and highlighting their interconnections with health, development, and dignity as reflected in the other goals.

The WHO/UNICEF Joint Monitoring Project (2006a) reported that in 2004 an estimated 1.1 billion people globally lack access to drinking water from improved sources, in addition, 2.6 billion people lack access to basic sanitation. They also identified sub-Saharan Africa as the area of greatest concern as the number of people without access to drinking water and sanitation actually increased by 23% and 30% respectively over the period 1990 – 2004.

[3] At the Johannesburg World Summit on Sustainable Development

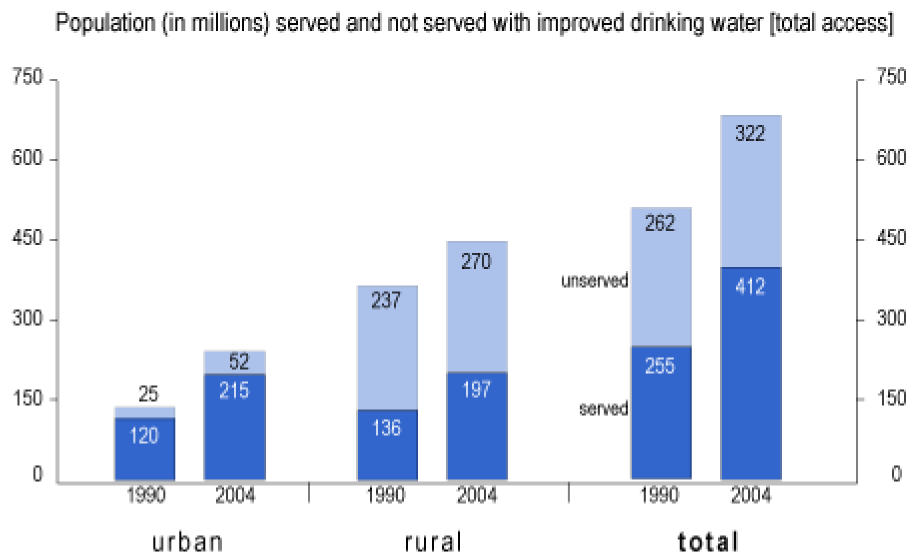
In monitoring MDG Target 10, WHO and UNICEF use the following definitions of improved and unimproved sources:

Table 1: Improved and unimproved sources

Improved Sources	Unimproved Sources
Piped water into dwelling plot or yard	Unprotected dug well
Public tap/standpipe	Unprotected spring
Tube well/borehole	Cart with small tank/drum
Protected dug well	Bottled water
Protected spring	Tanker-truck
Rainwater collection	Surface water (river, dam, lake, pond, stream, canal, irrigation channels)

The JMP (2006a) suggests that the world is on track to reach the Target, however, rates of progress are deteriorating, and specific regions are unlikely to achieve the Target, such as sub-Saharan Africa where progress and coverage remain low.

Figure 1: Sub-Saharan Africa - Water Supply Coverage in 1990 and 2004



The urban population has increased by 85% between 1990 and 2004, and the number of urban unserved doubled. In rural areas, the number of unserved in 2004 is estimated at 270 million, also an increase on 1990 levels, and five times that of urban areas.

Despite this regional trend, JMP (2006b) data from Uganda suggests that water coverage has increased from 40% in 1990 to 56% in 2004, although serious challenges to increasing this rate of progress remain as will be seen below.

2.2 The Right to Water

Discussions surrounding a distinct human right to water are relatively recent, nevertheless, the right to water is already enshrined within numerous international and regional treaties to which Uganda is a party. Different from the time-bound MDGs goals and targets, these represent legally binding, if largely unenforceable, obligations of the Ugandan State towards its citizens.

The right to water has been interpreted as inherent to numerous other rights, such as the rights to health, adequate standards of living, and life, and may be found in other instruments (Right to Water, 2007). A thorough analysis of the various bodies of IHRL, and IHL[4], is beyond the scope of this thesis; the following are international treaties which Uganda has ratified, and which *explicitly state* a right to water. These include the International Covenant on Economic, Social and Cultural Rights, the Convention on the Elimination of all forms of Discrimination Against Women, the Convention on the Rights of the Child, and the African Charter on the Rights and Welfare of the Child.

In addition, General Comment 15 of the UN Committee of Social, Economic and Cultural Rights should be highlighted[5]. It states that States must 'ensure that each person has access to sufficient, safe, acceptable, accessible and affordable water for personal and domestic uses' which include 'uses to necessary to prevent death from dehydration, to reduce the risk of water-related disease, and to provide for consumption, cooking, personal and domestic hygiene requirements (COHRE, 2004)'.

[4] Given the instability and conflict that still affects parts of Uganda, certain aspects of International Humanitarian Law may also be relevant.

[5] Certain treaty-monitoring committees are entitled to elaborate or clarify the meaning of specific aspects found within the relevant covenant. General Comment 15 is an official elaboration of the right to water within the International Covenant on Social, Economic and Cultural Rights.

A synopsis by COHRE (2004) details the major components of the Right to Water, and the obligations of the State in achieving this Right in a national context, is tabulated below[6].

Table 2: State obligations under the right to water

COMPONENTS	
Availability	Water supply must be sufficient and regular for personal and domestic uses, as per WHO guidelines - 50-100L/person/day, 20L minimum.
Quality	Personal and domestically used water must be safe, and be of acceptable colour, odour and taste. Safe sanitation is needed to protect water quality, and the right to privacy, dignity and health.
Accessibility	Water must be in safe physical reach, and address the needs of different groups. To achieve the minimum quantity of water per person, the source must normally be within 1km.
Affordability	Water should be affordable and not reduce a person's ability to buy other essential goods.
DUTIES	
Implementation	The State has an obligation to move as quickly as possible to achieving the right to water, to the maximum allowed by available resources. This requires the establishment of clear, targeted water programmes.
Non-discrimination	The State must ensure no discrimination on the basis of characteristics such as race, national or social origin, gender, age, etc. resource allocation should benefit a wide section of the population, and provide special attention to previously marginalised groups or those who have special needs for water.
Respect the Right to Water	The State must not interfere with any persons enjoyment of the right to water, and in no circumstance can a person be deprived the minimum essential amount of water.
Protect the Right to Water	The State must also ensure that third parties do not impede any person's enjoyment or access to water.
Fulfil the Right to Water	The State must also undertake positive action to assist individuals or communities if they are unable to realise the right themselves. The State must ensure that its legislation and policies are geared towards achieving the right to water, and implement participatory programmes to expand and ensure access to water. Indicators and targets for progress must be established and monitored.
Accountability	The State must ensure judicial or other appropriate remedies at the national level for any person who has been denied the right to water.

In addition to these legally binding international obligations – which given national sovereignty are not easily enforced – the State of Uganda has also incorporated the right to water within Ugandan National Legislation, specifically, Article 14 of the Ugandan Constitution (1995), which states:

[6] These are based primarily on the General Comment 15 of the UN Committee on Economic, Social and Cultural Rights.

> The State shall endeavour to fulfil the fundamental rights of all Ugandans to social justice and economic development and shall, in particular, ensure that… all Ugandans enjoy rights and opportunities and access to education, health services, **clean and safe water**, decent shelter, adequate clothing, food, security and pension and retirements benefits (emphasis added).

It has not been possible to further investigate other instances within the body of national legislation, nor the degree of independence of the national justice system. Nevertheless, it is worth noting that while it is beyond the capacities of a legal court to set national policy, the case of South Africa has clearly shown that a Constitutional Court can examine a given policy to ensure that it does indeed meet the international and national duties of a State[7].

2.3 The Ugandan Rural Water Supply Sector

The Water Sector:

The Ugandan Water Sector has undergone considerable reform in recent years. Recognising the need to improve basic service delivery in order to facilitate wider development, the Government has followed three key approaches (Robinson, 2002a):

1. Decentralisation
2. Privatisation
3. Poverty Alleviation

This focus has informed the 1997 Poverty Eradication Action Plan (PEAP), which was revised in 2000, and 2004, and forms the basis of the Poverty Reduction Strategy Paper (PRSP) – which was itself received by the WB and IMF qualifying Uganda for debt relief under the Heavily Indebted Poor Countries Initiative (HIPC) (Robinson, 2002a).

[7] Personal Communication (2006) by Justice Albie Sachs. This refers to the Grootbloom case, with regards the housing rights in South Africa, over which Justice Albie Sachs presided.

The reforms are in response to a failure of investments to achieve the increases in coverage and service levels expected, and have been further driven by the allocation of HIPC funds (Robinson, 2002a). They aim to provide water and sanitation services with increased performance and cost effectiveness, and to reduce the financial burden on Government but not at the expense of equitable and sustainable service provision (Cong, 2005).

Amongst others, the reforms have shifted responsibility for rural service-provision to District level authorities, and are encouraging private-sector involvement in urban services (Robinson, 2002a). In addition a Sector-Wide Approach (SWAP) was adopted in September 2002 which shifts the emphasis from individual projects to sector-wide programmes, and channels funding for water and sanitation from both Government and other development bodies through a single Government-managed mechanism (MWE, 2006).

The overall Government policy objective regarding domestic water and sanitation is to provide 'sustainable provision of safe water within easy reach and hygienic sanitation facilities, based on management responsibility and ownership by the users, to 77% of the population in rural areas and 100% of the urban population by the year 2015 with an 80%-90% effective use and functionality of facilities (MWE, 2006)'. This goes much further than the MDG target discussed above.

Nevertheless, much remains to be done if this objective is to be achieved. Some issues identified include: the continuing need to re-orient and capacitate district-level staff with their new roles; a lag in private sector capacities to provide quality services; loss of economies of scale in district-level procurement; problems related to the issuing of funds; continued focus on physical outputs at the expense of longer-term capacity building for sustainability; and a continued need for greater interaction between the relevant ministries and development partners in SWAP (Kimanzi, 2003; Cong, 2005).

The Rural Water Sector:

The RWSS sub-sector is involved in the ‘provision and maintenance of adequate supply of water for human consumption and domestic chores. Sanitation aspects include sanitation promotion and hygiene education in rural communities and schools (MWE, 2006)’.

Funds are channelled directly to District authorities who have responsibility for rural water supplies, and whose capacities have been and are continuing to be expanded. To improve sustainability of rural supply communities are now considered responsible for ‘demanding for, planning, contributing a cash contribution to, operating and maintaining most rural WSS facilities. A water user committee (WUC) should be established at each water point (MWE, 2006)’, and greater emphasis is being placed on hygiene promotion, gender awareness and participatory planning (Robinson, 2002a). In addition, District authorities are to encourage the development of a local private sector for the ‘design, construction, and operation and maintenance of rural water supply and sanitation facilities and for the supply and distribution of spare parts and appropriate equipment (Robinson, 2002a)’.

Despite these efforts, the Performance Report 2006 (MWE) suggests that the sub-sector continues to face considerable obstacles in achieving its targets: -

Coverage: Despite differences[8], the data suggests that current levels of investment in rural water supplies are only just keeping up with population growth in the rural areas.

Investment costs: The average cost of supplying an additional rural person with safe water has increased by 85% over the past four financial years. A steady level of expenditure has meant that investments are failing to match population growth.

Functionality: Although average national functionality has increased from 70% in 2003 to 83% in 2006, functionality varies considerably across the country. Several initiatives to improve functionality are in motion. A National Framework for O & M of Rural

[8] Different data sources have used different methods of calculation.

Water Supplies was developed in 2002/2003, launched in 2004, and has been gradually disseminated since to all Districts in order to harmonise the approaches of the various actors, and improve local level capacities[9]. In addition, an initiative by the MWE/DWD is being facilitated to encourage private-sector suppliers to establish handpump and spare part outlets in each district[10]. NGOs have also been encouraged and are reportedly active in 'community mobilisation and sensitisation, formation and training of new water user committees; retraining of old WUCs, training and retooling of handpump mechanics in [several] Districts; [including the] establishment of a handpump mechanics association in Katakwi/Amuria and contribution towards maintenance of facilities in IDP camps'.

Water quality: No systematic post-construction monitoring is undertaken. A rapid survey of rural drinking water sources in 15 districts has indicated that rains do affect bacteriological quality, and there is need for regular water quality monitoring countrywide. Also, high levels of iron from boreholes and shallow wells are recognised as a problem in some parts of the country.

The Performance Report 2006 suggests that more funding is needed for the sub-sector, and distribution mechanisms between Districts should be reviewed to target the most needy. Regarding functionality, the Report recommends that current initiatives continue to be strengthened, and that greater resources be allocated to O&M issues, including regular follow-up of WUCs.

However, the above might also be interpreted as indicating that in certain areas current approaches and technologies used are excessively costly, and ill-suited to sustainable community management. This is also insinuated in two of the Report's recommendations to reduce per capita costs: to promote rainwater harvesting, and other

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[9] This includes: '(i) harmonise O&M approaches between different players at district and central levels; (ii) clarify guidelines regarding community contributions; (iii) improve sensitisation of WUC on financial management; (iv) provide refresher training and tools to all handpump mechanics; (v) ensure that bye-laws on operation and maintenance are established; and (vi) to have the requirement for an 8-year O&M plan reduced to three years (MWE, 2006)'.

[10] Private sector suppliers were awarded contracts in order to establish handpump and spare part outlets across the country, with at least one outlet in each district. As an incentive, and given that spare parts supply is a slow business, the suppliers were also contracted to supply handpumps.

such self-supply systems which could help to free public funds to target the very poor; and to investigate alternative low-cost water supply options.

2.4 Self-Supply

Below the concepts of self-supply are defined to avoid confusion in terminology, in addition, experiences of self-supply in Zimbabwe and Zambia are drawn from, and the history of the Ugandan self-supply pilot laid out.

Self-Supply Concepts

Dr. Sally Sutton has suggested the following as the basic self-supply concepts (Sutton, 2004b):

Table 3: Self-supply concepts

Self-Supply Concepts
Technologies are as far as possible replicable with minimum dependence on outside resources, encouraging local investment in systems over which investors have direct control
The application of minimum design standards can form the basis for phased and affordable improvements in supply, especially in areas of low population density.
Local artisans and contractors provide safe water supplies, easier water-lifting devices and promote low-cost options.
Where possible, linkage is made to economic and nutritional benefits as well as health benefits, increasing the perceived value (and therefore sustainability) of water supply.
Management is maintained within naturally developed groups, usually the household or existing source user group, and has access to adequate, unbiased information, empowering them to make choices and solve problems.
An enabling policy environment, combined with low cost and high proportion of private investment, allows rapid advance for large numbers of people, especially those in scattered communities for whom conventional protected systems may not be sustainable.

Self-Supply as an approach has been summed up by Dr. Sally Sutton as creating an environment that encourages that innate human drive to improve his situation (personal communication). An examination of supported self-supply elsewhere in sub-Saharan Africa may serve to illustrate these concepts.

Self-Supply Experiences in Sub-Saharan Africa

Instances of supported Self-Supply are relatively few in number, the literature suggests that there are projects in several countries, including Liberia, Sierra Leone, Mozambique and Benin (Sutton, 2004b). Below two case studies are presented from Zambia and Zimbabwe.

Zambia[11]*:*

The unserved rural population has increased over the last decade, surpassing levels of investment. Subsidies generally focus on communal supplies for larger communities (200 – 500 persons). Functionality is also a serious problem, due to issues of affordability of the technology, the supply of spare parts, and poor communal management. It is increasingly recognised that conventional improvements are not always sustainable, being affected by the population density, income levels, alternative water sources, and seasonal movements.

In order to reach the more isolated and scattered rural poor, and encourage them to improve their own water sources sustainably, a self-supply pilot was undertaken. The approach was characterised by a choice of progressively upgradeable technology, and easy replicability of the approach with little or no outside funding. This replicability is crucial in bringing rapid improvements to a large number of people, and is made possible given the low-cost technology, its progressive nature, and the use of local materials and expertise.

By focussing on naturally-formed user-groups – rather than user-groups created around a new source with potential management problems due to social, ethnic or other diversity – they were found to choose technologies which were within their managerial and financial capacities, and would invest in further upgrades when resources become available. Also, it was found that these naturally-formed management structures stimulate greater ownership and investment than conventional communal management. Water-use went beyond solely domestic-uses to income-generating activities (irrigation, brewing, bricks), increasing the perceived importance of the source, and thus the care and investment that goes into it. Although this aspect was not maximised, the potential for further stimulating the economy through involving private masons and carpenters in upgrading sources is considerable.

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[11] Based on information presented in Sutton, S. *Self-Supply: A Fresh Approach to Water for Rural Populations*.

It was also found that the low-cost technology and improved management led to significant decreases in TTC counts. The perceived improvements were sufficient to increase the number of users, and the digging of new household wells, both serving to save users time and effort in collecting drinking-water.

Finally it was found that per-capita costs were significantly cheaper for self-supply upgrades in relatively small communities of less than 200 persons – at this point more conventional communal approaches achieve similar per capita costs.

Zimbabwe[12]*:*

In Zimbabwe high demand has made the upgraded family well programme a great success, surmounting initial Government reluctance to endorse the programmes given its technical simplicity and the fact that it supported individual families rather than communities.

Like that in Zambia, the programme builds upon traditional features and improvements to family wells, making progressive upgrades and using local materials and capacities, the programme selects localities in conjunction with district and Governmental departments, trains local artisans in the upgrade steps, and thus create demonstration wells. Families must have a completed well before receiving small in-kind subsidies of cement, the windlass and tin lid.

Per capita costs were found to be smaller than any other approach, with the family contributing 2/3rds of total cost. Also, the simple technology and family-unit management has been found to overcome maintenance and sustainability issues that often undermine conventional approaches. These were also found to make significant improvements in turbidity and coliform levels.

The popularity of the approach has led to the construction of new family wells to take advantage of the assistance. Other benefits include the creation of new jobs, poverty

[12] Based on information presented in: Robinson, P. *Upgraded Family Wells in Zimbabwe: Household-Level Water Supplies for Multiple Uses*; and Morgan, P. *et al. Now in my backyard – Zimbabwe's upgraded family well programme*.

alleviation through irrigated agricultural production, uptake of household vegetable gardening, more water used domestically, less water-storage time, and less time and effort expended in water-collection.

Potential of Self-Supply:

Thus these experiences demonstrate that a self-supply approach can complement conventional communal supply initiatives, and provide other real benefits in many cases. The two approaches are compared in the table below[13]:

Table 4: Conventional and self-supply characteristics

Conventional communal systems	Self supply options
Best suited to nucleated, homogenous communities with good leadership	Suited to individual households and small groups
Technologies available for a wide variety of conditions, with greater flexibility in siting	Easily established where water is within 15 meters of surface or rainwater adequate
Focuses on outside knowledge and remote technologies	Builds on local knowledge, attitudes, and skills
Serves large numbers of people, who may or may not form a community	Serves households or small groups forming natural management units
Safety and quality of water usually assumed, not always correctly; perceived value among users may be less than assumed	Significant improvements in water quality, comparable to fully protected communal shallow wells but at much reduced cost; high perceived value among users
Generally marketed for health benefits; income generation often difficult because of communal ownership	Often generated multiple benefits including income, improved nutrition, and local employment
Depends on committee management which is not traditional and may take time to develop	Well-defined ownership and management by individual or well-established group
Provides good water within 0.5 to 1 kilometre, but households may have nearer alternative sources	Provides good water, usually within household boundary or within 100 meters
Requires large investment per unit, and very high subsidies (usually around 95%; typically US$15-20 per capita)	Low unit cost means that subsidy can be less than 50 percent (Zimbabwe 20 percent) (typically US$3-5 per capita)
Rapid construction, but construction teams not involved in maintenance	Rapid small changes, slow process to reach final product, construction teams also do maintenance
Long-term maintenance is expensive, requiring heavy equipment and transport	Regular and long-term maintenance can be carried out by local artisans, including re-deepening at low cost
Higher standards from the start but sustainability may be low	Gradual steps towards high standards, each bringing improvement
Often donor driven	Develops directly from local demand

[13] Reproduced from Sutton, S. *Self-Supply: A Fresh Approach to Water for Rural Populations*.

The Ugandan self-supply pilot

With the support of the Rural Water Supply Network and WaterAid, a preliminary desk-study study was conducted in October 2004 in order to identify the potential for a self-supply programme in five nominated countries. From these Uganda was selected, with parts of the country found to have considerable potential for adopting the approach.

A further in-country study in 2005 (Carter *et al*) found that:

> Self-supply water sources are those which have been constructed at the initiative of an individual or group of individuals in civil society, with little or no support from Government or NGOs. The individual or group provides most of the investment cost of the source, in cash or kind. While ownership may or may not be clear in law, there is no perception that Government or NGO has joint or total control of the source. Utilisation of the source is nearly always enjoyed by a larger group than the individual(s) who initiated and paid for construction. Upkeep is nearly always the responsibility of the initiator of the source, often with little or no support from the wider user group. In the case of trading centres and urban locations, it is common for users to pay user fees, on a volumetric basis; in rural areas this is still unacceptable. To date self-supply has received very little support from Government, and great caution will be needed if such support is proposed, to avoid undermining the strengths of self-supply.

As insinuated above, building on existing self-supply has the potential to meet the recommendations of the Sector Performance Report in reducing per capita costs and surmounting the management and sustainability issues identified.

The study also noted several key barriers to supporting self-supply in Uganda, which include: the position of authorities in discouraging the use of poor water quality sources; the focus of Government and NGOs in supporting communities over individuals; a lack of appreciation of the positive steps of local people in improving their own sources; the financial inability of most rural dwellers to invest in more expensive technological options (lined shallow-wells and boreholes) (Carter *et al*, 2005).

A pilot project was initiated in 2006 to further explore the potential scope of encouraging such incremental upgrades to self-supply sources in Uganda with funding from the DWD and WaterAid. A Steering Committee - chaired by the head of the

RWSS, and with members from the DWD, UWASNET and WaterAid - selected two NGOs from UWASNET for implementation, and also Technical Advisors to provide guidance to the implementing NGOs regarding the concept of self-supply, software, and hardware aspects. The Committee meets regularly to review progress and provide guidance to the Technical Advisor.

Both NGOs were advised to limit the geographic area of the work in order to minimise costs and maximise communication. The NGOs were also encouraged to be innovative and explore the various technology options and software approaches for supporting self-supply. The NGOs were advised to aim to reduce software costs through re-designs of the approach; to increase community contributions; to explore and determine incremental steps; and to decrease the external contribution to construction costs considerably. Funding proposals were submitted by the two NGOs, and implementation was begun in late 2006, continuing until end-2007.

Conceptual Framework:

Richard Carter (2006) has proposed a conceptual framework with which to evaluate a given water source. The framework goes beyond the dualistic 'improved/unimproved' thinking to include: accessibility; the quality of water; reliability of supply; affordability of the technology; and management of a given source. A trade-off often occurs between the first three factors and the last two, and the framework highlights these imbalances, taking into account both water professionals' and end-users' perspectives. Thus it also serves to highlight any aspects of a given source or approach which can be improved.

This conceptual framework has been adopted within the thesis as the basis of comparison between different approaches in the study area[14]. The scoring system is reproduced below (Carter, 2006).

[14] This Framework is further examined in the Discussions section.

Table 5: Water source scoring system

Proposed scoring system for water supply service			
Characteristic	**Score 0**	**Score 1**	**Score 2**
Access	Distance and/or ascent result in very limited consumption (typically less than about 8 litres per person per day)	Water is close to most users (typically within 0.5-1.0km), but still has to be carried home	Water is supplied to the yard or house
Water quality	Water is obviously polluted, reported to taste unacceptable, or is clearly at risk of contamination from pit latrines, livestock or other causes	Source is well protected but untreated. Any storage is covered, and there are no obvious routes for contamination	Water is treated (including disinfection), and treatment is managed to a high standard
Reliability	Source performance fluctuates with season, or dries up with heavy use, such that users have to go elsewhere at certain times. Unreliability or low yield may lead to conflict between users	Although consumption may be low because of access, the demands of the users can nearly always be met, and queuing times do not cause conflict or recourse to inferior sources	Water is always available on demand, and supply capacity exceeds 20 litres per person per day
Cost	Cost is high. In the case of some 'traditional' sources there is a high human cost in time, energy and ill health. In the case of some improved sources, capital cost can only be borne by a state or private investor. User fees may cover part or all of operation and maintenance costs, or users may pay no user fees	Typically the users can contribute 10-15 percent of the capital cost. User fees cover basic maintenance only, when the need arises (and no contribution to capital cost recovery)	Human costs (health, time expenditure) are low. Capital cost is such that users can bear at least 50 percent of the investment. User fees for operation and maintenance are negligible
Management	System operation and maintenance are of necessity the full responsibility of a competent body or person. The user contribution to management is purely financial. (If the private or public body provides a reliable service, raise score to 1. if the body is permanent, raise to 2.)	Long-term external support is needed to enable user management to function satisfactorily. In reality this refers to a situation of joint user/external agency responsibility for operation and maintenance tasks	The source, as constructed, can be managed and maintained by the users, without external support

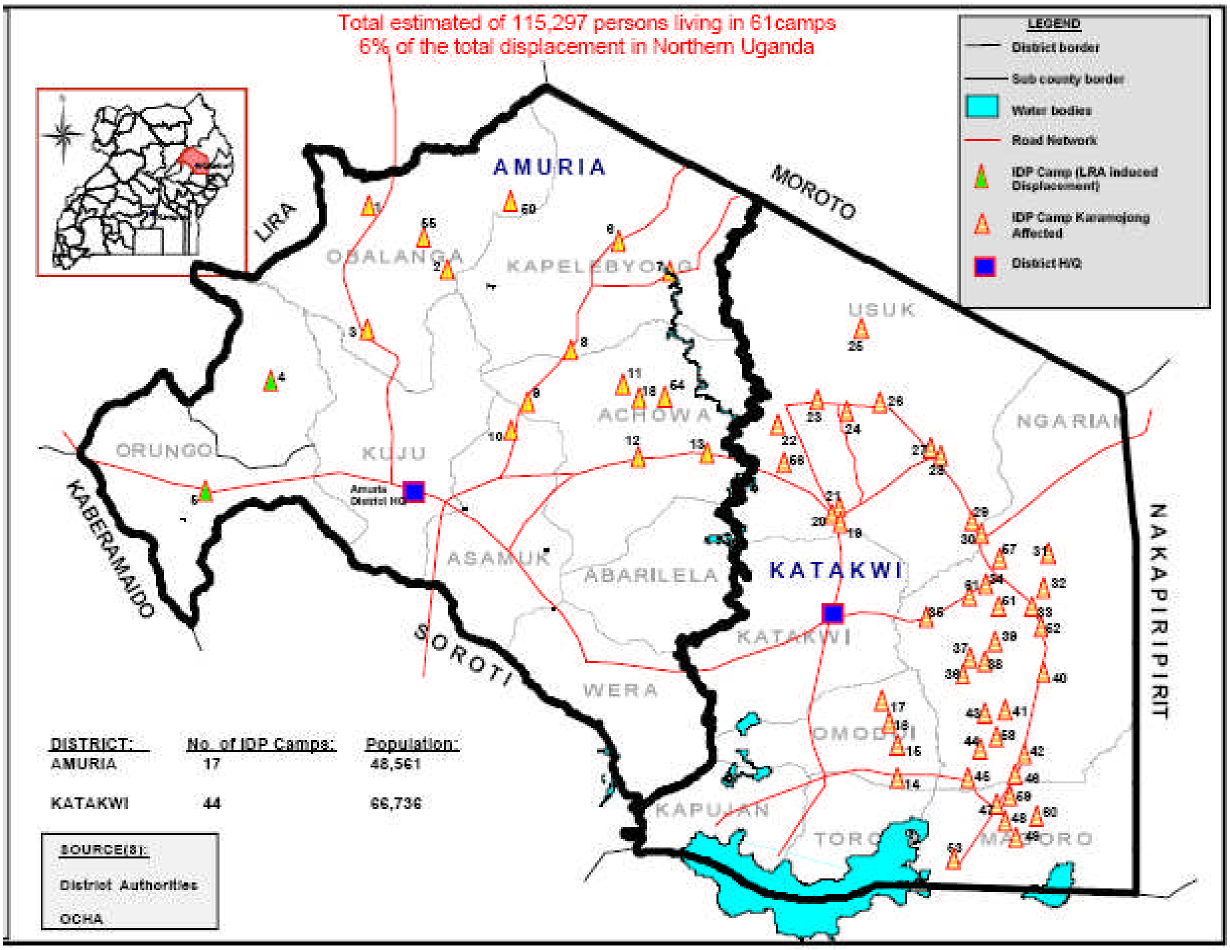
3. Methodology

3.1 Description of study area:

Amuria District:

Amuria was formed as a District in June 2005. Previously it had been a County of the Katakwi District. Amuria is comprised of two Counties: Amuria and Kapelebyong. Amuria County is further divided into five sub-counties: Wera, Asamuk, Kuju, Orungo, and Abarilela. Kapelebyong County is made up of Acowa and Kapelebyong sub-counties.

Figure 2: Map of Amuria and Katakwi Districts (OCHA, 2007)



The area that makes up what is now Amuria District has suffered from insecurity for nearly three decades. Since 1979 Karamojong warriors have carried out periodic raids to steal cattle and food from the agricultural area, often leading to rape, murder or mutilation of any who oppose them. In 1986, when the current President Museveni, took power, various militant groups throughout the Teso region rose to oppose him. Unrest in the area continued till the beginning of the 1990's, when the various rebel groups succumbed to central rule. According to some respondents, instances of localised conflict have occurred sporadically during the 1990s.

More recently, in June 2003 the region was affected by an LRA incursion into the area. In October 2001, the ACT estimated over 88,000 people were already living in displacement camps across what was then Katakwi District – around 30% of the population. The 'insurrection' forced many thousands more into various camps in the trading and urban centres in search of safety. Although the LRA were expelled within the same year by the Arrow Boys - a militia made up of Teso youth under the command of Wera-born Ecwegru Musa - this was not before many people had been killed, and thousands of young children abducted by the LRA.

Since that time, those displaced have gradually returned to the villages, and life is only now 'returning to normal'. The impact of the recent conflict can be seen in the remnants of the former camps, and the many people around the district who continue to rebuild their homes. Nonetheless, security is no longer an issue in the district, and people may move freely at all times.

Water access:

According to WaterAid (Katakwi Office), as of March 2007 safe water coverage in Amuria is only 47% of the population (See Annex D). Although this figure takes into account non-functionality, it is based on estimates of users per type of water source[15], the total is then taken as a percentage of the estimated population, as projected from the 2002 census (data from a 2007 census have yet to be integrated).

[15] Boreholes are estimated to serve 300 people, shallow wells 250, protected springs 150, and rain water tanks 150 people by season.

The District Water Office

According to Bernard Egangu (Personal communication), the District Water Officer, the district is unable to meet general demand, and consequently over 50% of the population remains without an improved source.

Within the District, borehole, shallow-well, and protected spring technology is used, although boreholes are by far the dominant technology (See Annex D) cutting across the geological limitations of shallow-well and spring sources. However, maintenance is a major challenge in the District – communities are generally too poor to afford major repairs, and the lack of spare parts outlet in the District complicates even small repairs. The nearest spare part outlets are in Soroti and Katakwi, which is not excessively far geographically, however, the limited roads and transport makes this a major challenge for isolated communities.

Although the Operation and Maintenance Framework is gradually being implemented, it is still young and will require considerable investments to increase capacities at all levels in the District. In addition, hardware investment levels are insufficient to keep pace with population growth.

The DWO sees considerable potential for the self-supply approach to improve supply in the District, being initiated and within reach of the people. Depending on the outcomes of the pilot project, the DWO hopes to support the scaling-up of the approach in the District.

WEDA Self-Supply Programme:

The most common and reliable forms of existing self supply in the implementation areas are springs and hand-dug holes initially intended as latrines. It is these existing sources that are the focus of WEDA's activities.

The initial programme involved consultative and planning meetings with the District and Sub-County authorities. In order to target communities where a basis for real ownership, and where a pressing need exists, communities were selected on the basis of existing demand, willingness to contribute, availability of existing water sources, degree of access to improved sources, and population. Once communities for the project had been identified, a baseline survey was conducted to determine the water and sanitation situation in each community.

Implementation in the selected communities involved initial sensitisation and feedback meetings to determine the nature of the external support. In addition a 'Cluster approach' was introduced for hygiene and sanitation promotion within selected communities. This involves the formation of clusters of 10-15 households who implement hygiene and sanitation activities, and whose leaders – who received training with regards their roles and management – represent the link between WEDA and the community. The Clusters also assisted the organisation of source upgrading and later operation and maintenance aspects. Through the Clusters, local materials and labour were mobilised, with WEDA providing technical inputs and cement.

However, following a visit by the Technical Advisors in May 2007, WEDA decided to reorient the programme towards private sources. Private sources are currently identified by word of mouth. Consequently, no baseline data has been collected at the private sources identified. In addition, the Cluster approach is not used for these small neighbourhood groups, and a new approach to hygiene and sanitation is currently being discussed.

The upgrade of private-sources follows a similar pattern in that the local user group must contribute local materials and some labour. WEDA provides support in supplying cement and technical inputs, and a local mason.

3.2 Water Sources:

Site Selection:

The focus of the study was on three broad source types identified in the study area: traditional sources; upgraded self-supply sources; and conventionally improved sources.

Table 6: Source types in Amuria District

Source Type	Description
Traditional	Include both communal and private self-supply sources of open springs, and hand-dug water holes.
Upgraded Self-Supply	Communal sources on private land upgraded by WEDA, including 3 spring-wells and 1 protected spring
Conventionally Improved	Include hand-dug, lined and sealed shallow-wells with a hand-pump, and drilled boreholes with a hand-pump.

A selection balancing the three types would have been the ideal. However, in practice, outside of the traditional self-supply sources identified for upgrade, and the four upgraded self-supply sources, site selection was guided by circumstance and practicality rather than an attempt at a systematic and representative sample, due to logistical restrictions. While this does not allow for an indisputable comparison, the data collected is consistent, and provides a basic picture of broad differences between sources (see Results).

Traditional sources:

Un-upgraded self-supply sources are in effect traditional sources. Consequently, the data collected regarding traditional sources is made up predominantly by WEDA-identified self-supply sources.

Upgraded Self-Supply Sources:

WEDA has completed four upgrades on community sources, and another was upgraded during the field visit. Upgrades have included the construction of a shallow-well structure over an existing spring, and protected spring structures where the gradient allows. Preparations had begun for upgrades in several other communities, however, following a visit by the Technical Advisors WEDA decided to shift the focus away from community sources to private sources.

At present eleven private sources have been identified for upgrades, of which three were in the process of upgrading during the study. Upgrades are to include the construction of a headwall and lining down to the hard formation. A cast cement slab is to cover and seal the source, with an opening for jerry-can collection until a cheap handpump can be installed.

The distinction between private and communal self-supply sources is not clear-cut. While both are located on private-land, Communal sources tend to be open springs used by a large community, while private sources tend to be hand-dug holes used by a smaller group of households.

Particular focus was given to those sources already upgraded - in order to collect data with regarding the impact of the upgrade - those sources in the process of upgrading during the field visit – in order to collect before and during data, and those sources to be upgraded – in order to provide a baseline for future testing.

Conventionally Improved Sources:
With regards conventionally improved sources, 7 boreholes, and 5 shallow wells were visited. Given limitations in time and transport, the majority of these were those located around the Wera Catholic Mission area, and in Kupujan sub-county in Katakwi District where WEDA is implementing a separate programme.

3.3 Water Quality:

Comparisons:

One aspect of the thesis is to compare the impact of different approaches on water quality in terms of Thermo-Tolerant Coliform levels (TTCs). Comparison of water quality data is problematic at best, and further complicated by a lack of any baseline data, nevertheless, three types of comparisons were made from 29 sampled sources:

Table 7: Water quality comparisons

Comparison	Description
Before and during	Where possible samples were taken prior to and during the upgrade process
Old and new	Where possible samples were taken from the still existing traditional source, and from the upgraded source (an upgraded source is sometimes located a few meters upslope from the traditional source, making such a comparison possible)
Broad comparison between technologies/ approaches	Geometric means were compared from samples taken from conventionally improved sources, upgraded self-supply sources, and traditional sources

Table 8: Summary table of sources sampled

Source Type	Number of Sources Sampled	Total Sample Size
Borehole	6	18
Shallow-well with handpump	5	18
Upgraded communal self-supply	4	42
In process of upgrade	4	62
Traditional/private self-supply	13	71
Total	**32**	**211**

A wider and more systematic testing of the different technologies employed was not possible due to limitations of time and mobility. A geometric mean average is used to compare the impact of each technology so as to minimise the statistical impact of any deviant values (Neuman, 2003). While not extensive, the water quality data is consistent and points to broad trends regarding each approach.

Water Quality Testing:

Testing was conducted using an OXFAM DelAgua kit, which allows testing of three parameters: thermo-tolerant coliforms; nephelometric turbidity; and pH. All testing and preparation of sampling materials was conducted in line with the standard recommended procedures (see Annex A).

At each source the turbidity and pH were tested on-site. In addition, a ‘sanitary survey’ and photos were also used to contextualise the TTC results obtained (see Annex E).

After initially using sample volumes recommended within the DelAgua Manual, these proved impractical given the amount of bacteria and solids found in initial samples. For open sources 1ml samples were filtered, and for protected sources 10ml or 50ml samples were used as appropriate given the solid content of the water.

3.4 Water User Interviews

Information regarding other aspects of the different approaches was gathered through interviews with water-users at each source visited.

Initially a decision was made as to the type of interview to be conducted. Given a focus on the experiences of water-users, and their personal views and feelings towards the water source and the approach used, and with the complications of an unknown cultural divide, standardised interviews were rejected as a possible approach. Instead what was needed was a form of exploratory interview.

Of these it was considered that a semi-structured approach would be best given limitations of time, and the particular focus required by the study. An initial attempt was made at drafting such a structure before arrival at the study area, however, it was quickly realised that the numerous specific prompts and probes included worked against the spirit of the study and risked introducing considerable bias[16]. A more open approach was similarly impractical due to difficulties in generating information relevant to the focus of the study.

Finally a semi-structured interview based on the following key areas was used and any issues that emerged during the interview were probed further:

- source history;
- source use;
- source users;
- source management and ownership;
- source attributes;
- experience of the upgrade process;
- future plans.

Responses were recorded by hand-taken notes, and typed-up electronically. In analysing the interviews, categories were extracted from the data, in order to avoid distortion and bias that may occur with predetermined categories (Drever, 1995).

[16] A tendency to reply ‘yes’ to any question not clearly understood was found.

Interviewees:

It was initially hoped to concentrate on a cross-section of persons who are engaged in water collection. However, upon arrival it quickly became evident that although women and children may be the main fetchers for domestically consumed water, all members are heavily reliant on and concerned by the local water source, and it is generally the men who are involved in any source improvement. Furthermore, the necessary formalities of arriving at a village involved meeting the LC1 and soon after members of the WUC, who were found to be better placed to provide information regarding source history and any improvement process. Subsequently, it was attempted to have *at least* 3 interviews per source, including the LC1, a WUC member, and one or more water users.

Throughout the field study, cultivation was ongoing, affecting who was available to be interviewed, and for how long, at a given source. Lack of communication infrastructure, fluctuating meteorological conditions, and cultural differences in time-conception made the scheduling of interviews impossible. Consequently, it was not possible to standardise the interviews obtained, and a variety of interviews have been gathered at each source.

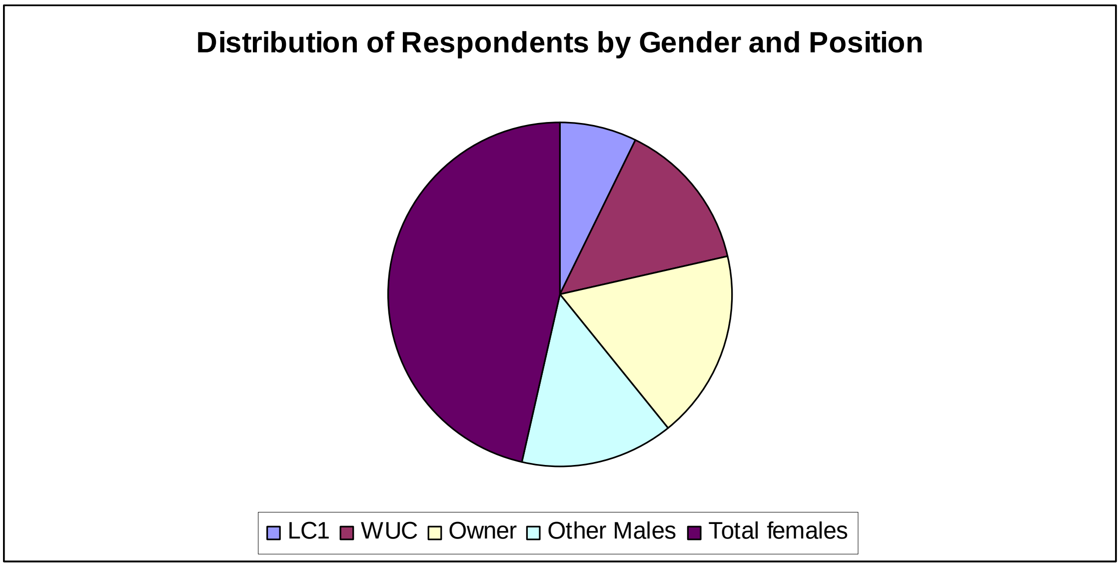
Table 9: Summary of formal interviews conducted

Source type	Number of sources	Number of respondents
Private self-supply	11	23
Communal self-supply	3	9
Upgraded self-supply	4	10
Shallow-well	5	10
Borehole[17]	4	4
Total female		26
Total male		30
Total		**56**

The males interviewed included local leaders (LC1), Water User Committee members (WUC), source owners (Owners), and others. This breakdown is represented in the pie-chart below.

[17] At three other boreholes around the Mission area, data was collected through informal discussions with neighbours over several weeks.

Figure 3: Distribution of respondents by gender and position



Although not clearly defined, nor sufficient to draw out differences between user-groups, respondents' views and concerns were found to be consistent and can be considered representative of the key challenges and concerns for water in the District, and are further supported by many informal discussions between the author and local residents.

3.5 Other sources of information

Cost data for each approach is based on an average of expenditures by WEDA on boreholes and shallow-wells elsewhere in the District, and on expenditures on communal and private self-supply upgrades (See Annex C).

The Results are further informed by direct observations by the author, and by informal discussions by the author with a variety of respondents across the District. This is highlighted where it reinforces more formal data it is noted in the Results.

3.6 Limitations

Water quality data:

Testing was frequently completed by candlelight or paraffin lamp, though counting was always conducted in daylight hours, and any batches displaying contamination of the control were excluded from the results.

In addition, all sterilisation of sampling bottles, petri-dishes and pipettes was done by boiling the relevant piece of equipment. This frequently proved cumbersome, again being done by paraffin lamp, and given the time to heat coals and bring the water to boil.

The TTC counts collected attempt to provide a meaningful comparison between the sources sampled. It must be recognised that all sampling was conducted during the rainy season, which can be assumed to have an impact on water quality (MWE, 2006). Rainfall was non-uniform in quantity and in frequency, and consequently it was not possible to obtain samples with the same antecedent climatic factors.

Finally, given logistical constraints and the limits of the DelAgua kit, the researcher was not able to collect a greater number of samples for each source. Consequently, the findings represent only what can be concluded from these samples, which are limited in their number and time-range. Nevertheless, as noted the data is consistent and provides a general picture of broad differences between approaches.

Furthermore, there are questions as to the reliability of TTCs as an indicator for the presence of other pathogens (Gleeson & Gray, 1997). The incubation process which serves to eliminate non-thermo-tolerant coliforms is not infallible given that there are other thermo-tolerant bacteria, and given that there are many strains of *E. coli* that are not thermo-tolerant and are unable to ferment lactose. In addition, the presence of viruses or protozoa falls outside the scope of the test, and yet is often behind many waterborne outbreaks in the world. Consequently, while a sample may show a source to be safe, this may not be the case.

Water User Interviews:

Again given logistical constraints it was not possible to engage an independent interpreter for field visits to most sources. Although English is widespread in Uganda, in rural Teso region, few spoke the language fluently. Translation was initially conducted through a WEDA staff member accompanying the researcher, and it must be recognised that the respondent or interpreter may have held back on certain aspects or embellished others.

The number of respondents was limited, again due to logistical and time limitations, and cannot be considered a uniformly representative cross-section of the water users in the area. Nevertheless, none of the responses obtained indicate any serious derivation from the majority.

In addition, gender was noted to play a role during interviews. Frequently, women were found to be less responsive than men, and it was noted during one site-visit that responses came easier when using a female interpreter.

During the final 2 weeks of the field visit, it became possible to travel independently on some occasions, at which point a non-WEDA English-speaking friend from the Mission area accompanied the researcher to conduct interviews. It was also possible during the final weeks to travel with a female WEDA staff-member. Although responses were found to be more extensive in these circumstances from both female and male respondents, the issues raised remained the same.

Triangulation of data was possible where multiple-interviews were conducted, and where informal discussions were held at a given source, and through direct observation by the researcher. Wider triangulation through observations and informal discussions across the District was also made, and support the findings from formal interviewees presented below. This suggests that the data gathered is consistent and representative of the issues at each source type.

With these limitations in mind, let us turn to the trends indicated by the data gathered.

4. Results and Analysis

The following Chapter examines the data collected for each source type as it applies to access, water-quality, reliability, management and cost. It also considers user reception of the different approaches, and other benefits inherent to each approach.

4.1 Access:

It was found that where water holes or open springs exist, these are generally used for certain domestic activities, such as washing, watering animals, making bricks, and sometimes cooking, while drinking-water is collected from distant boreholes, except in cases where this distance is too great, or the borehole breaks down. In this latter case, people will resort to the traditional sources for all of their water consumption, unless they have access to a bicycle allowing them to collect water from distant improved sources.

The construction of conventionally improved sources, whether by an NGO or by the District, is generally done taking into consideration the presence of other improved sources in a given area. Consequently, these sources are often ‘the only source around’, thus increasing access through reducing the need of locals to travel long distances to find safe water, or of locals to drink from open sources. Although these logical benefits are supported by interviewees at all 6 boreholes and 5 shallow wells, the spatial dispersed nature of the demography means that large numbers of users in the area will continue to travel considerable distances to reach the improved source.

Communities with an upgraded self-supply source were generally at considerable distance from the nearest conventional improved water source (1+km). Communal self-supply sources are almost invariably located down-slope nearby the swamp areas. While the upgrades have improved the quality of locally-available water, water must still be collected from the source which is often at considerable distance for a large proportion of the community. Only 3 of 10 respondents noted that time and effort for water collection has been reduced by cutting out trips to a borehole for drinking-water. In addition, only 2 of 10 respondents have increased water consumption following the upgrade. Informal discussions suggest that those living nearby the source continue to consume considerably more water than those living at a distance.

In contrast, private self-supply sources tend to be in close proximity to user-households. Universally, since their construction, fewer trips are made to the borehole for drinking-water, while all other water is taken from the private source by either women or children. At all private sources in use, this has led to a decrease in time and effort spent fetching the water, and also in an increase in water used in the home. This increase in water quantity is due to having water 'just nearby' and the subsequent time and effort saved. Consequently, WEDA's refocus towards private self-supply upgrades holds considerable potential to improving water access and quantity used, at a household or neighbourhood level.

It should be highlighted that the access improvements of self-supply and upgraded sources is not exclusive to the private-owner. At all self-supply sources in use, all neighbouring households have access to the source. At private sources that are being upgraded or are yet to be completed the stated intention of the owner - corroborated by neighbours who are contributing to the process - is that the source will be free to all to use so that all may 'have safe water right by the home'. This is further reinforced by an agreement that owners must sign with WEDA prior to the upgrade, specifically stating that the source will be open to all for use, a copy of which is left with the LC1, the WUC, the Sub-County, and WEDA.

Analysis:
With regards access to water, both upgraded communal self-supply and conventionally improved sources increase access to safe water at a communal level. The community's spatially dispersed nature mean that many users will continue to travel considerable distances to access this safe water.

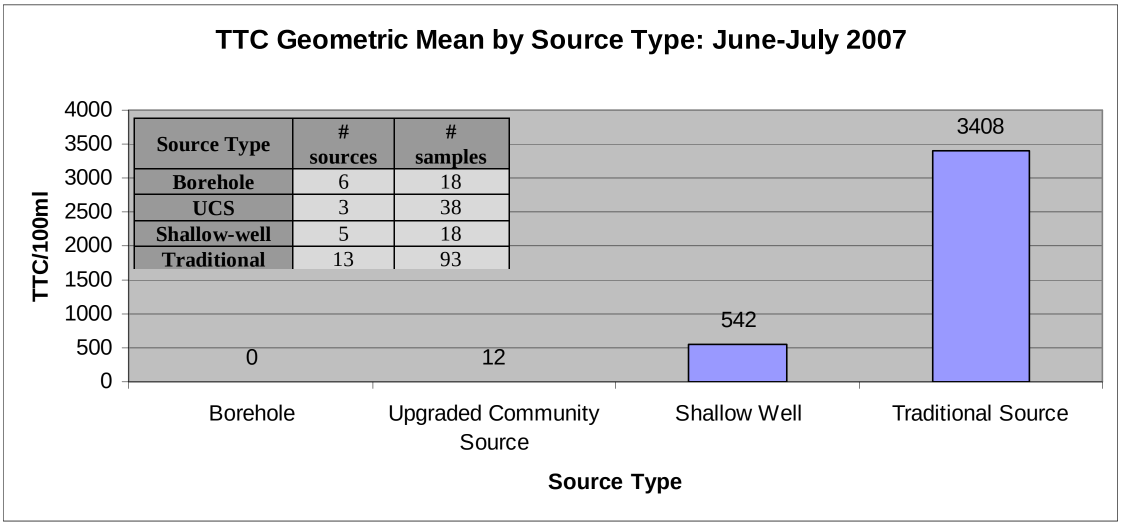
Conversely, private self-supply sources increase water access at the household level, and there is considerable potential to further increase access should upgrades achieve drinking-water standards, negating the need to collect drinking water from a distance.

Even if the water quality can not be brought to Government standards, experiences suggest that the quantity of water used within the household will increase, and considerable time and effort will be saved in collecting water from nearby boreholes. Presumably, this will also have the added benefit of relieving congestion and user-strain at existing boreholes.

4.2 Water Quality:

Of the various technological approaches tested it was found that overall boreholes provide the best water quality in terms of TTCs, as seen in Figure 2 below[18].

Figure 4: Comparison of TTC levels by technology



Of the 6 boreholes tested, 4 achieved WHO standards of 0 TTCs/100ml, and the remaining 2 achieved an average of less than 4 TTCs/100ml. This is to be expected, as the boreholes are drawing water from well below the easily contaminated top-soils. Nevertheless, this mean value represents one-off samples at a limited number of sources, and may not be representative of the situation across the District.

The 5 shallow-wells tested were found to be significantly above Government standards of 50 TTC/100ml. This may reflect poor design, poor environmental sanitation, or the impact of the rains. Most shallow-wells are generally located towards the swamp areas

[18] Frequency distribution graphs by source type can be found in Annex G. The complete data-set from which this summary is derived can be found in Annex H.

or near existing atans, putting them down-slope from any contamination from village latrines and animals. Nevertheless, this mean value is not necessarily representative of the wider situation.

The upgraded communal sources were found to achieve TTC levels well within Government standards. Of the 3 upgraded sources only one has TTC levels above 50/100ml. This is likely to be due potential sources of contamination in its immediate environment, of which the WUC and LC1 are aware and have clear plans to resolve.

Despite reservations as to the representivity of the borehole and shallow-well mean values (being one-off samples of a limited number of sources) what is strikingly evident is that all approaches offer significant improvement over traditional open sources.

Private Self-Supply:

With regards the impact of WEDA-upgrades private self-supply sources, it was not possible to compare the before and after situations, nevertheless, water quality tests during the process of upgrading clearly demonstrate significant improvements, as illustrated in Figures 3 and 4 below.

Figure 5: Impact of the upgrade process on TTC levels at private self-supply sources

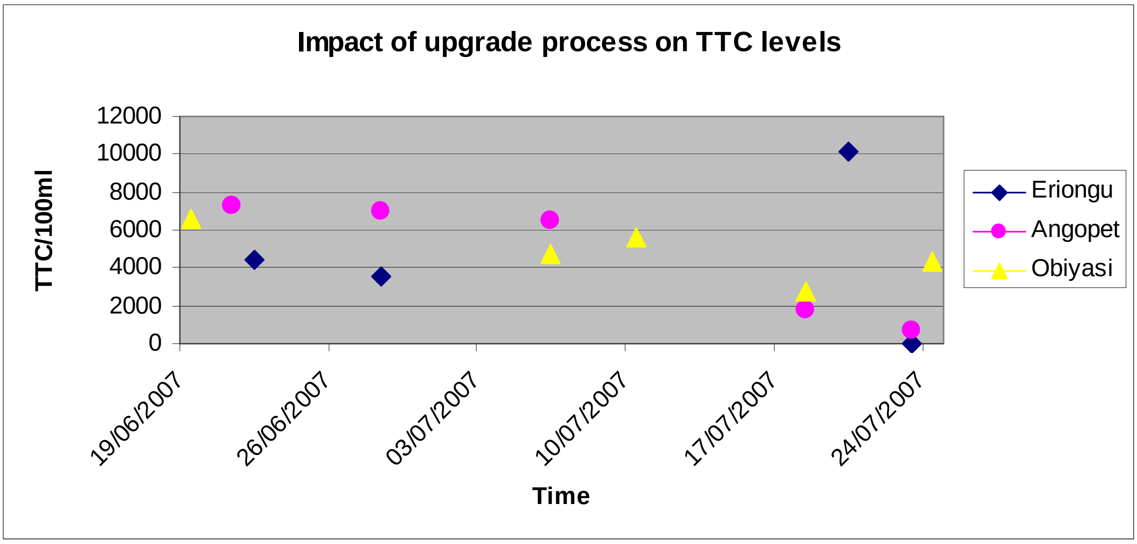
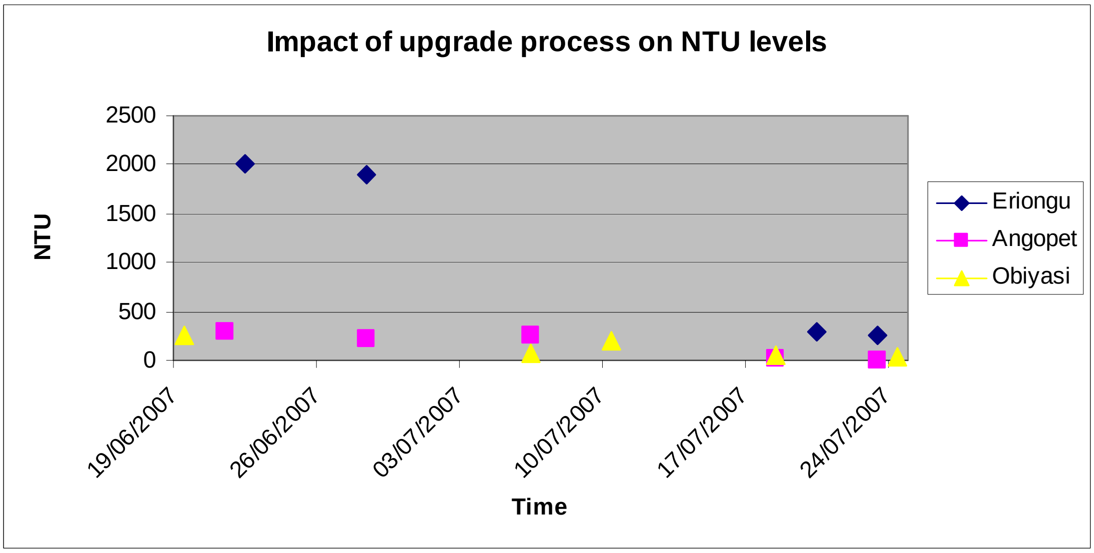


Figure 6: impact of the upgrade process on TU levels at private self-supply sources



The drastic reductions in TTC and NTU levels provide a strong indication of the improvements that might be expected from private source upgrades. They have been achieved through the construction of a headwall, and lining the well down to the hard formation. However, longer-term monitoring is needed to determine the extent of these improvements and whether they can be maintained.

Water Quality Perceptions:

Amongst communities identified within the self-supply programme, the *principal* concern found was and is with covering and protecting the source. At the three functioning upgraded sources, water is considered to be of good quality because the source is now covered. At a fourth upgraded source no longer in use, respondents blamed this on the fact that the source was not covered, allowing animals to jump in (According to WEDA the source was swallowed by the swamp when the rains began).

Similarly at ten of the eleven private self-supply sources (the eleventh is already covered), the main aspiration is to cover or seal the source, in order to prevent pollution and animals entering the source. Uncovered sources are not considered safe for drinking given that people ‘don’t know what could fall in it’, because it becomes ‘cloudy’ during the rains, and because ‘all the rubbish is washed in’ during the rains. Three private sources are currently unused due to such concerns; drowned animals were mentioned on one occasion, along with visible organisms ranging from ‘hook worms’ to snakes.

Another factor found at three private sources refers to the movement of water: a flowing spring is preferred over a water hole as it does not remain ‘stagnant’.

The same theme is again reflected at conventionally improved sources. At all six boreholes visited, water was deemed safe as it came from deep underground and was ‘covered and so could not be infected’.

In a variation on the same theme, at all five shallow-wells visited a major issue of concern was the fact that when it rained the water became more turbid. At one of the wells, the water is no longer used for drinking given the presence of visible organisms - ‘hook worms’ or ‘round worms’ – in the water. Similarly at two private sources water is sometimes used for drinking when the water ‘settles’ and ‘becomes clearer’.

Analysis:

The data collected suggests that upgraded self-supply sources have considerable potential to achieve Government bacteriological standards for rural drinking water.

What is clear from the above and from numerous informal discussions is that good water quality is primarily a factor of its visible clarity and its degree of protection from surface contamination. Two key points can be drawn. Firstly, the clarity and protection of the source, even if it is not used for drinking, will determine the extent it is used for other domestic purposes. The data collected suggests that self-supply upgrades can contribute to this increased usage through reducing NTU and TTC levels, and through covering of the source.

However, although clear water may be perceived to be clean, this does not mean it is safe to drink. Further study needs to be made into longer-term impacts of upgrades on water quality – and the impact of any new hygiene and sanitation approach for private sources – and water-usage patterns post-upgrade.

4.3 Reliability:

Seasonal reliability:

A key concern found almost universally amongst respondents and informal discussions is a source's seasonal reliability.

At four of the private self-supply sources, the fact that the source never dries was mentioned as a key attribute, and at five other sources owners hope to deepening the well further so that it does not dry. It was found that at most private water holes visited, they were dug to a little below the depth of the water table. Digging to deeper levels is made difficult by a lack of dewatering equipment – although jerry cans on ropes are used. Another factor is a fear by diggers of breaking through and falling into the 'lake under the ground' from which water is drawn, which was mentioned as an issue at three sources. Assistance to be provided by WEDA in dewatering to allow further deepening thus has the potential to further increase the reliability of private self-supply sources.

At the three upgraded and functioning communal self-supply sources, the fact that the source never dries was noted by respondents as a key attribute of the well both before and after the upgrade. It was also noted as a key attribute at Odoon centre where the source was being upgraded during the field visit.

At two of the five shallow-wells visited, a major issue was the fact that both wells dry during the dry season. When this happens, people must return to a traditional source that does not dry, and which has not been protected. As most people in the area fall back on the same source, congestion is a serious problem, requiring an overnight stay if a trip is made late in the afternoon. At both locations, during construction locals had requested that the implementing-NGO dig the well deeper, however, this was not done.

At three of the six boreholes in use, several respondents commented on the fact that the boreholes provide safe water even during dry season. Similarly the year-round reliability of boreholes was a clear attribute of the three boreholes around the Mission area, as determined through informal discussions.

Yields:

At the upgraded communal self-supply sources in use, despite a reported increase in users, the yield of the source was not raised as an issue.

At private self-supply sources, of the four that reportedly never dry, it was noted that their level reduces during dry season, although they remain sufficient for domestic uses.

At the two shallow-wells that dry, as the dry season approached, the yield would reduce. During this period, at Atekwa well respondents report that if one forces the pump, ants would be drawn up along with the water. At Ogwang, the well is locked during the day, and pumping is allowed only in the early morning until it runs dry. At two other shallow-wells water became more difficult to pump during dry season, and would sometimes dry when over-pumped.

Seasonal variations were not noted as an issue at the six boreholes in use, however, yield was an issue at two boreholes in the sense that pumping was difficult. At these two boreholes, it was observed that users are predominantly those living in close proximity to the source, while other users prefer the easily-pumped borehole unless highly congested (all three boreholes were in relative proximity to each other within a 500m radius[19]). In addition, on numerous occasions during discussions at self-supply sources the fact that one had to pump 'for a long time' to get water was commented on as a negative attribute of the borehole used, however, it was not possible to triangulate the number of boreholes in question. It is also difficult to determine whether low-yield boreholes are a result of poor location, or other factors, be they physical, chemical, microbial, operational or structural (Howsam, 1990).

Congestion:

Congestion was not found to be an issue at the self-supply or upgraded sources visited, despite an increase in users at the latter.

[19] This concentration is reportedly due to the existence of a displacement camp in the Mission area following the LRA incursion.

Congestion was mentioned as an issue at four of the six boreholes in use, with yield-issues limiting the use of the other two. Being 'the only source around' suggests that a large population use and rely on the borehole for all or part of their domestic water consumption. Congestion was also an issue at four of the five shallow wells visited.

Informal discussions and formal interviews suggest that congestion is responsible for several negative practices. In some cases users return to unsafe sources to save time, while in others users will travel to a more distant source to collect water. In other cases, congestion results in considerable 'pushing and shoving' during collection.

While the issue was raised only at conventionally improved sources, it must be recognised that the number of users at upgraded communal self-supply sources has also increased. However, the number of households in question[20] is still lower than those sources where congestion was an issue. In addition, the practice of water storage in the households may play a role, and has been further encouraged through accompanying hygiene and sanitation activities which includes the safe storage of water in the household.

Breakdowns:

Of the communal self-supply sources visited, all have been constructed in 2006 or 2007 and have not had any breakdowns.

Of the five shallow-wells visited, none have experienced any breakdowns, although at Ogwang source there are concerns about its structural integrity, attributed to poor construction, and they fear its collapse in the near future. One well mentioned during an interview at Atubakinai was discontinued following a breakdown, although this may also be due to the construction of a borehole in the vicinity of the well prior to its breakdown. WaterAid's 2007 functionality survey indicates that of 119 shallow-wells in Amuria, 50 are abandoned or mal-functioning (See Annex D).

[20] Around 60 households for Orisa source, 30 at Atubame, and 2 villages at Osurit

The issue of breakdowns or non-functioning boreholes is of considerable concern to the DWO (personal communication). However, at the 6 boreholes in use – and others noted during interviews at self-supply sources – breakdowns are generally resolved within a period of two weeks to one month. Only at one borehole visited had a breakdown resulted in its abandonment, and further discussions with users suggest that the abandonment was due more to the high iron content of the water, rather than the breakdown itself. WaterAid data indicate that of 347 boreholes, 50 have been abandoned or are malfunctioning, a functionality rate of 83.6%.

User fees:

It was found that at all conventional and upgraded sources users must contribute a small fee. It was found that this fee is on a monthly basis, between UGX 500 – 1000, and on a household-basis. At conventional sources user-fees are one of several Government requirements, and are crucial for continued maintenance and functioning of a source given the nature of the technology and the intensity of use.

This requirement has been adopted by WEDA; before assistance is given in upgrading a self-supply source, be it communal or private in nature, a WUC is established, one of whose tasks is to gather contributions. The amount and frequency of such contributions is for the WUC to decide in conjunction with the community.

User-fees can lead to negative practices and tensions. On one occasion, the author encountered a group of women drawing water from an open source in a village where a borehole existed (St. Michael’s area by the Mission). When asked, the women responded that they were trying to avoid having to make the monthly payment of UGX 1000 to use the borehole. Similarly, at Odoon Centre, two interviewees reported that the traditional self-supply source was used by surrounding households for two key reasons: it was nearer than the borehole (1km distance); and due to the UGX 1000/month fee attributed to the fact that the borehole ‘kept breaking down’. These suggest that user-fees can potentially undermine safe-water consumption where alternative sources exist.

However, the Odoon respondents stated that a monthly fee once the self-supply source was upgraded would be 'ok, so long as it was collectively decided', suggesting that participation may be a factor, as at both boreholes in question user-fees were unilaterally set by the WUC[21]. Nevertheless, interviews and discussions with other water users suggest that generally people will use the conventional source, but when the time comes to pay, they will try to avoid it - indicating a persistent challenge and the need for strong management to be successful.

A second related challenge was explicitly encountered at Abdullah shallow-well. Being the only source around in a large area, it is used by the expansive village, and also by all neighbouring villages – over 135 households in total. Difficulty in collecting contributions from neighbouring villages was creating considerable grievances within Apule, as locals questioned why they should pay if others did not.

User-fees were not an issue at two of the three upgraded self-supply sources in use, however, they have been in operation for only a short period. At the third upgraded source, the fee-system has already been relaxed, not due to collection-problems, but confusion in the WUC as to what the fees are for. The intention of the contribution system is to ensure funds for continued maintenance and operation of the source. It is well-suited for technologies with many moving parts which are more vulnerable to wear-and-tear, and a different approach might be explored for the self-supply upgrade technologies used.

Analysis:

Reliability was found to be an issue of considerable importance at all sources visited, further corroborated by informal discussions. Its importance is rooted in the availability or access to water. Issues of yield, breakdowns, user-fees and congestion can all impact the ability to access water. Where such problems exist, the collection of water can be more costly in terms of time – due to queuing, pumping time, or distance travelled - but also in effort – again due to pumping or distance. Although no such difficulties were encountered at upgraded communal self-supply sources, they are not immune to such

[21] This emerged in relation to these two sources, but was not raised as an issue at other conventional sources, thus no figures are provided as to how fees are collected at the other conventional sources.

problems, and will have to be evaluated again at a later stage. Similarly, upgraded private self-supply sources will have to be examined once operational.

Effective response to any serious breakdown will require the availability of funds. This is particularly due to the nature of the technology used at each source. Although the shallow wells and upgraded communal self-supply sources are simpler in their nature than boreholes, they would likely require outside expertise to repair any serious malfunction of either the pump or the structure. Nevertheless, they are less susceptible to frequent breakdowns than boreholes, and an alternative approach for management and fund-raising for repairs might be investigated for upgraded self-supply sources.

This is particularly relevant for private self-supply upgrades; the technological approach being used is more easily replicable and repairable by a local mason, and even if Canzee pumps are introduced as planned - including a local production centre - the simple technology and easy availability of the relevant pump materials minimises the need for regular fee-contributions (See Annex B).

4.4 Management:

It is standard practice at all water sources encountered in Amuria for the implementing institution to hand-over the completed source to the user-community, and this approach is being encouraged nationally. Although technical water staff may be called on at the District level, payments for repairs are the responsibility of the using community. Prior to hand-over the election of a WUC is organised for each source, typically including a Chairman, Vice-Chairman, Secretary, Treasurer, and two Caretakers. Responsibilities typically include regular maintenance and cleaning of the source area, collection of user fees, enforcement of by-laws, and hygiene promotion.

A WUC is a requirement of WEDA for any self-supply upgrade, both at communal and private sources.

Conventional sources:
At the boreholes and shallow-wells visited, two management structures were found: management by an institution; and management by a WUC, the latter being the most common.

At institution-managed sources, it was found that a sense of ownership by users is lacking, despite efforts to include and mobilise them. Nevertheless, any breakdown tends to be promptly dealt with by the institution, dependent upon the availability of funds. The institutions (the Catholic Mission, and the Mission Health Centre) are relatively permanent in nature, and have successfully managed the two sources (a shallow-well and borehole respectively) for over a decade. Despite the continued functioning of the two sources, a lack of water expertise within the institutions has meant that there are hygiene issues around the source, which lack fencing, and have neglected soak-aways.

At most sources a WUC is in place at the time of hand-over of the source, and usually receive training in basic maintenance and financial management. However, should there be any serious breakdown of the source, outside assistance is required to determine and fix the problem. A maintenance network is gradually being put into place at the District level[22], and most breakdowns will reportedly be dealt with within two to four weeks. Nevertheless, there are instances when a breakdown leads to a collapse of the WUC, as in the case of the Takum school source, and others raised during informal discussions.

Management issues were noted at 5 of 9 functioning community-managed conventional sources visited. These include the collapse of user-fee collection in two cases, and growing difficulties regarding community user-fees due to the use of the source by non-paying neighbouring villages in another case. In addition, in three other cases, basic cleaning and maintenance of the source and its environs has collapsed due to difficulties to organise major cleanups amongst the community in one case, and sense of grievance and lack of recognition by the caretaker, and a failure to organise a solution within the community, in the other cases.

[22] Egangu, Bernard. Personal communication, 2007.

Upgraded communal self-supply sources:

At the upgraded sources, a WUC is elected and provided training with regards its responsibilities.

The technologies currently used in the upgrade process can be prohibitive should there be any serious breakdown; outside assistance may be needed. It should be noted that all of these sources have been constructed and organised in 2006/2007 and have yet to address any problems with the source itself. Consequently it is not yet possible to assess the ease of independent management of these sources.

Nevertheless, a more incremental approach to the upgrade process may make longer-term maintenance easier to address and manage. In addition, alternative management structures, capitalising on the private ownership of the land and source, have yet to be explored.

Private self-supply sources:

At private sources, the upgrade process of water holes involves digging down to the hard formation around the source in order to be able to construct a brick-lined headwork, upon which a covering slab is set. A future intention is to install cheap and simple handpumps constructed locally from locally available materials. The technology is simple, uses local materials, and is within the capacities of local masons.

The simplicity of the technology suggests that the technology will be able to be independently managed by the WUC. Furthermore, from what the author observed the close ties and degree of cooperation and interaction that exist between neighbouring households, and the presence and participation of neighbours during all WEDA visits, suggest these smaller management units, formed naturally around a neighbourhood source, will make management and collection issues will be easier to address. Further efforts might also be made to explore alternative management structures that capitalise on this local context.

Analysis:

From what was learned through interviews, observation and informal discussions, the more conventional sources and upgraded communal self-supply sources are generally beyond the technological capacities of local management bodies, and successful management will require outside assistance should a breakdown occur. A strong support network at the District level does not yet exist, although efforts are being made to establish one.

In addition, the management issues found at 5 of 9 community-managed conventional sources indicates that the WUC approach is not without issues. More research might be conducted in this regard, nevertheless, common elements found by the author in each of the five cases are: a large and dispersed community; and a lack of strong leadership within the community. Upgraded community sources are relatively new, and the communities are characterised by strong and proactive leadership – it remains to be seen whether they are sustainable managerially.

The advantage of the approach adopted at private self-supply sources is that the simple technology can be easily repaired by local masons and collective labour, and are organised on a smaller neighbourhood basis, which are characterised by strong ties between households. It remains to be seen whether these can be managed independently, and alternative management structures should be explored.

It is also hoped that such simple and cheap technology and naturally-formed management groups will lead to easy replication without outside assistance on a household or neighbourhood basis.

4.5 Cost:

It was found that the costs involved for each approach and each technology vary considerably. Below a table summarises the average costs of several interventions for each type of source visited, as quoted by WEDA (See Annex C).

Table 10: Summary of costs by technology type

	Total Average Cost (UGX)	NGO Average Costs (UGX)	Community Average Costs (UGX)	Community : Total Cost Ratio (%)	Community : NGO Cost Ratio (%)	Estimated Total Per Capita Cost[23] (UGX)
Borehole	15,110,627	14,910,627	200000	1.32	1.34	50,369
Shallow Well[24]	1,100,000	800,000	300,000	27	37	4,400
Community Upgrade	981,500	707500	274000	28	39	3,926
Private Upgrade	856,180	365,180	491,000	57	134	5,281

Conventional Sources:

As is evident from the above table, boreholes are by far the most expensive technology of the four, both in total and per capita costs. This is due to the high costs involved in the hydro-geological survey, the drilling itself, and the casting and installation costs.

Shallow wells are constructed at a far cheaper average cost, and far smaller per-capita cost. However, they remain beyond the reach of the majority of the population. The only four instances of privately constructed shallow-wells encountered involved financing from an urban-based relative. However, in two cases (Atubakinai and Olelia), the well was not lined nor covered, and at the Mission area digging was not completed. In the final case, although the well was lined and covered, it was not sealed and relied on a bucket and rope to lift water.

[23] Based on the same estimated numbers of users per source type as used by the MWE and WaterAid: 300 per borehole; 250 per shallow well; 150 per protected spring. For private upgrades, an estimate of 150 persons is used, based on the average number of user households and an average household size.
[24] Based on a verbal estimate by the WEDA Finance Officer and Technical Officer.

Upgraded communal self-supply sources:

Although considerably lower in cost than a borehole, they are on par with shallow-wells, given that a similar technology was used at these communal sources. The costs to the community are estimated pricings for local materials and labour provided by the community rather than financial costs.

Nevertheless, as noted above, this technology remains largely elusive for communities or individuals given the high costs, and the need for external support. Should private well-constructors be engaged costs would likely be much higher, and there are few private contractors in the District.

Should more emphasis be placed on upgrading using incremental steps, this may serve to reduce or to spread the costs over several seasons. Depending on the incremental steps identified, they may also serve to bring the process within the capacities of local masons.

Upgraded private self-supply sources:

The approach used at private sources is on par with the overall cost of a communal upgrade, however, the per capita cost tend to be higher given a smaller user-group. Like the community upgrades, the costs borne by the community reflect locally obtainable materials and labour, and food for the mason, which have been priced for means of comparison only - direct financial cost per household is minimal.

Nevertheless, the approach is potentially replicable independently by households or small groups, as it draws on locally available capacities. In addition, should further incremental steps be identified, these can serve to spread the cost over several cultivation seasons.

Analysis:

The costs of conventional or upgraded community sources are restrictively high, and are difficult to undertake without the support of an outside organisation or funding from an urban investor.

However, should a larger number of private shallow-well contractors develop in the District, this may make such technologies more accessible to local communities. In addition, if an incremental upgrade process is further developed, this will serve to spread the costs of improvements over time.

The technology employed for private self-supply upgrades holds the potential to be locally adopted, as it is within the capacities of local masons. Although per capita costs are higher than those of shallow-wells and community upgrades, an incremental approach to improvements could serve to spread these costs to fit with user schedules. In addition, data from private-source upgrades suggests that a greater proportion of total costs can be covered by motivated self-supply communities. It remains to be seen whether a conducive environment can be encouraged in the District.

4.6 Reception:

During formal interviews at the various water sources it was found that the actual approach employed in constructing the water source was not considered of great importance. This can be summed up in the following statement that: 'The most important thing is to get water – the approach is not so important'.

Similarly, other comments by respondents suggests that 'the approach is ok – since we now have good water', and the recommendation that 'any community should accept any conditions for a water source because it is for their own good'.

The only clear statement in favour of the self-supply approach over more conventional approaches was made by Steven Alex, LC1 of Asamuk-Moru: 'WEDA is easier, faster and cheaper than the Government – and it remains ours!' According to the DWO (personal communication), Government-supported improved sources take considerable time to request and construct due to limited resources and capacities at the District-level.

Analysis:

The above suggests that the only issue of concern *for water-users* is that safe water is achieved. As noted earlier it is widely considered crucial to seal and protect a source from surface contamination, and to install some form of pump such that water is easy to collect by anyone.

It also suggests that any improvements are generally considered beyond the reach of water-users themselves. This is also supported by numerous informal discussions and requests for assistance made to the author from which suggest that there is a perception that any source improvement requires external assistance.

In addition, it confirms that the District is unable to meet demand for improved water sources in the District.

In this sense the simple and low-cost approach used at private self-supply sources has considerable potential in surmounting these barriers. Through such simple technology and small management structures, there is potential for water-users to meet their primary concerns with little or no external assistance, and at a much wider scale than is currently done in areas of shallow-groundwater.

4.7 Other Impacts:

Benefits:

At the four upgraded, and being upgraded, communal self-supply sources, run-off feeds watering holes for animals that are used in the dry season. In addition, at one source (Orisa) source run-off is used to irrigate crops along the discharge zone, and there are plans at two other sources (Osurit and Atubame) to plant tree-crops along the discharge channels. There are also plans at two sources (Atubame and Odoon) to pursue the construction of a fish pond using the discharge. It was unclear from the interviews which households would benefit from these initiatives, and whether they would be undertaken privately by the land-owner, or communally.

Respondents at five of the private self-supply sources are, or hope to, water animals from the source, and respondents at 6 of the sources are, or hope to, irrigate tree-crops or vegetable gardens during the dry season.

Analysis:

Although a limited number of sources have been visited, these income-generating or nutrition-enhancing activities and aspirations were encountered only at the self-supply sources. This may be due to the proactive attitude characterising the self-supply households and communities.

However, these activities and the span of their benefits are also a function of the proximity of the source and the nature of management, and should be further analysed as they materialise. If such trends are found to characterise future upgrades, they serves as an additional factor for the support of self-supply initiatives.

4.8 Summary:

Conventionally improved sources:

More conventional improved sources – boreholes and shallow wells – do increase access at a communal level, though at a household level, users may still have to travel considerable distances to fetch water due to the dispersed nature of the population in the study area. Boreholes have been found to achieve water-quality in line with WHO standards of 0 TTC/100ml, although shallow-wells have been found to have coliform-levels exceeding the Government standard of 50 TTC/100ml. Boreholes are reported to provide a reliable supply across the seasons, although issues of breakdown time and low-yields affect reliability of supply. Shallow-wells have been found to be affected by seasonal variations. Congestion and low-yields are noted as a causing long collection times and difficulty in pumping in some cases.

These technologies are cost-intensive, and although private constructors do exist, these are beyond the reach of local communities without the support of either the District authorities or an NGO. In addition, although routine preventive maintenance can be conducted by the community, any serious breakdown of the source will require external support to fix and will tend to be costly. Resource restrictions are limiting the ability of the District to meet demand, and a maintenance support network is still being developed in Amuria.

Communal management has been found to be problematic at 5 of 9 communally-managed sources. Poorly functioning WUC, difficulties in collecting user-contributions, and tensions arising due to contribution issues have all been noted.

Communal self-supply:

Communal self-supply has been found to hold some of the features of more conventional approaches. Access is improved, but only at the communal level. Water-quality improvements were found to be significant, and generally within the Government standard. At each of the functioning sources reliability was not an issue. Each source was constructed on an existing traditional spring valued for its yearlong provision of water, and thus far the upgraded sources do not dry.

Upgraded communal sources also face similar issues to more conventional approaches. The cost of the intervention remains high, and although a larger proportion of the cost is borne by the community in question, their construction has required external support. Any serious breakdown will likely require external assistance. Communal management has not yet encountered any serious problems, although it must be recognised that these communities are characterised by strong leadership, and that the management structures have been in place for only a relatively short period.

There remains potential to improve on these issues by exploring possible incremental steps in improving communal self-supply sources, which might reduce or spread the costs, and bring the improvements within the capacity of local masons. In addition, alternative management structures might be explored, and the need for user-fees revisited.

Private self-supply:

Private self-supply upgrades are intrinsically different from the above. Access is improved at a household-level, and the approach has potential to be further replicated – as evidenced at least two private sources dug specifically to take advantage of the programme, and two persons' stated intention to dig a new source for themselves and their neighbours.

The data gathered is insufficient to determine the technology's impact on water-quality over time, though it indicates that both NTU and coliform levels can be expected to improve. The current technology used is sufficient to address user-concerns for source protection and safety. Further monitoring will be required over time to determine water-usage patterns post-construction, and to determine whether the sources achieve the Government standard for drinking water.

WEDA's intention to deepen the five private sources that dry during the dry-season is expected to improve reliability and yield, though this should be monitored. Should the sources continue to dry, some further evidence regarding the benefits of partial supply might be gathered.

Although the per capita cost of private upgrades is higher than communal upgrades or shallow-wells, these are largely in-kind rather than financial, and might be spread over time through the use of additional incremental steps. The approach has the added advantage of being directly accessible by households or small groups as the technology used is simple and well within the capacities of local masons. These same characteristics suggest that breakdowns could be managed without external support, and without a WUC and user-fees *per se*. This technical knowledge could be made more easily available through an expanded capacity-building programme for local masons.

Demand clearly exists for supported self-supply, although further monitoring may be required to clarify the issues raised above before any attempt to scale-up within the District.

5. Discussion

5.1 Conceptual Framework:

The thesis has compared the different approaches in terms of five parameters: access, quality, reliability, management and cost, and has thus highlighted key features of each approach as explored above. Using the scoring system proposed by Carter (2006), the following scores may be awarded to each source and approach[25]:

Table 11: Score summary by source type

	Access	Quality	Reliability	Cost	Management	Total
Borehole	1	1	1	0	1	4
Shallow well	1	1	0	1	1	4
Communal self-supply	1	1	2	1	1	6
Private self-supply[26]	1	1	1	2	2	7
Traditional	1	0	1	0	2	4

As indicated by the scoring exercise, reflecting the findings above, a self-supply approach has the potential to achieve a better balance of the five aspects than more conventional approaches, and consequently has the potential to surmount some of the challenges affecting rural water-supply services in Amuria.

If we consider the framework itself, it breaks the improved/unimproved duality by examining water-sources in terms of characteristics important to both water-professionals and water-users. If we consider the sustainability issues outlined in the Introduction we see that they fall, to a greater or lesser extent, within the proposed framework, though it also becomes evident that the framework is limited in focus to the source itself. Thus external factors may alter the source scores, for example, should private shallow-well constructors become more numerous in the District, the shallow-well management score may increase. Nevertheless, within the specific and time-bound context of this thesis, the framework is adequate to highlight differences in impact of different approaches and highlights possible areas of further improvement.

[25] The basis for these scores is found in Annex F.
[26] This refers to the *potential* score for upgraded private self-supply, as discussed in the Results.

5.2 Features of the approaches:

While the framework provides a means to compare the impact of different approaches in a given context, the thesis has also sought to identify the characteristic features of the self-supply approach in Amuria. Below, the different features of the approach are presented in contrast with the conventional approaches[27].

Table 12: Features of the different approaches

Conventional approach	Communal self-supply	Private self-supply
Suited to cohesive communities with good leadership	Suited to cohesive communities with good leadership and existing sources	Suited to private households or small neighbourhood groups with existing sources
Technologies are costly and require outside expertise	Technologies are lower in cost, and potentially do not require outside expertise	Technologies are lower in cost and can draw on locally available expertise
Siting is relatively flexible	Siting depends on existing sources often located near the swamps	Siting depends on existing sources often located in proximity to households
Generally provides safe water, but often at a distance from many users	Provides safe water but often at a distance from many users	Provides potentially safe water in close proximity to households
Serves large numbers of persons, who may or not form a community	Serve a potentially large population, who may or not form a single community	Serve a smaller neighbourhood group, which is itself a natural management unit
Requires a large initial investment, and a large proportion of external subsidy (>95%)	Requires a lower initial investment, with a smaller proportion of external subsidy (70%)	Requires a lower initial investment, with a much lower proportion of external subsidy (40%)
Safety of water is assumed to be good with little monitoring	Significant improvements in water quality have been found, comparable to more conventional technologies	There is potential for significant improvements in water quality, comparable to more conventional technologies
Generally promoted for health impacts and achievements of national targets. No initiatives leading to spin-off benefits were noted.	Can contribute to health-benefits and coverage targets. Income-generation and nutrition-enhancing activities also occur	Have potential to contribute to health and coverage improvements. Income-generation and nutrition-enhancing activities also occur
Rapid construction, following a longer application process	Rapid construction, with the potential to be undertaken independently	Rapid construction, with the potential to be undertaken independently
Longer-term maintenance is costly and requires external support and equipment	Longer-term maintenance is less-costly, but may require external support and equipment	Longer-term maintenance is low-cost and can be carried out by local masons
Often donor-driven	Potentially demand-driven	Potentially demand-driven
High post-construction standards, but low sustainability	Potentially undertaken incrementally, with higher potential for sustainability	Potentially undertaken incrementally, with high potential for sustainability
Depends on strong WUC management which may take time to develop	Potential for alternative management structures built on existing structures	Potential for alternative management structures within a natural management unit

[27] An adaptation of the table presented in the Literature Review (Sutton, 2004b), informed by the findings of the research.

5.3 Further areas of study:

During the field visit, only 4 communal self-supply sources had been completed, with work underway to upgrade 1 other communal source and 4 private self-supply sources, with 7 others identified for future upgrade. Thus the data indicate the *potential* impact and features of the self-supply approach[28].

Further study of the approach will need to be undertaken upon completion of these and other upgrades in order to confirm the findings of this thesis. Several key areas are highlighted:

1. ***Water-quality impacts:*** although the technology achieves the JMP definitions of an improved source, it remains to be seen whether the technology employed is able to achieve water-quality within Government standards over time. In addition, some investigation as to how quality improvements affect water-usage patterns is needed.
2. ***Access:*** even if self-supply upgrades do not achieve year-round reliability or safe drinking water, further evidence of the benefits of partial-supply should be gathered, to provide a strong case to water-professionals.
3. ***Hygiene and sanitation:*** a focus on private self-supply sources creates new contamination challenges with the water source located in close proximity to the household. A new approach needs to be developed, and its impact assessed.
4. ***Technology:*** the current approach is limited in terms of incremental steps – which could serve to spread the costs of improvements over several seasons. While the technology currently used meets the demands of water-users, it remains to be seen whether additional steps can be included, and whether this facilitates private uptake.
5. ***Cost-effectiveness:*** given that less materials and labour are involved in private-source upgrades than for communal upgrades, the actual costs post-construction should be examined.
6. ***Management:*** it remains to be seen whether the smaller management units and simple technology are able to increase sustainability. Further work is needed in

[28] Data limitations have been noted in the Methodology.

investigating management structures other than the WUC, and their impact on source use and sustainability. In addition, the need for user-fees should be reassessed.

7. ***Extra-benefits:*** further investigation into the nature of extra-benefits, and their impact on source upkeep is needed.

5.4 Considerations for scaling-up:

While the data gathered strongly indicates the potential of the approach, there is a danger that any scaling-up of the approach focuses on the technological aspects rather than supporting and building upon local initiatives and demand. As implied in the literature review, there is a tendency within national conventional approaches to focus on physical outputs over software aspects which have had a negative impact on sustainability, according to the DWO (personal communication) this situation also exists in Amuria.

Initial difficulties by the implementing NGOs and other stakeholders to grasp the concepts of self-supply were noted by WEDA staff and the Technical Advisors, though it is hoped that their experiences will inform any future scale-up. Several key aspects should be considered in any systematic self-supply support, and might be further adopted within the current pilot.

1. ***Private or communal:*** Two issues can be noted here. Firstly, in no case was a ‘private’ self-supply source found to be for the exclusive use of the owner. Consequently, a case can be made to support private individuals in what is in fact communal water-supply. Secondly, the distinction between private and communal self-supply sources needs to be clarified; private and communal self-supply tend to differ only in the sense of the source type and the population served rather than in ownership as the terms might imply.
2. ***Scheduling:*** Efforts should be made to fit the upgrade within the users’ schedule. In terms of incremental steps, this will allow costs to be spread over several agricultural seasons. In terms of the practicalities of any construction, it is easier

to mobilise labour outside of the cultivation period. Further, it leaves the process within the hands of the self-supply initiators. Given the limited period of the pilot and delays in the release of funding, it was not possible for WEDA to integrate such considerations. There is a danger that such a schedule will not fit with NGO or District timetables, which may undermine some of the strengths of self-supply.

3. ***Context-specific support:*** Any support to self-supply is necessarily context specific, and does not fit well with a national or sectoral programme of implementation. Support must be geared towards the specificities of local self-supply, and at its best to the specificities of a given source. WEDA programme is geared to the nature of self-supply sources in the District, yet even here the technology used could be more imaginatively adapted to the specific needs and aspirations of the users at a given location.
4. ***Private sector:*** The first two points indicate the value of building the capacities of private contractors in the area. Capacity-building should be geared to the prevailing self-supply sources in the area, ground-water protection around the source (if relevant), and to relevant additions that may be requested at a given source, and which may lead to other benefits (irrigation, animal water-point). Such a network could place control of upgrades in the hands of the initiator.
5. ***Roles and responsibilities:*** Finally any scale-up will necessarily involve different stakeholders at different levels, whose roles must be clarified. Some research has been conducted into the opportunities and barriers to different stakeholders involvement (Mills, 2006), but more must be done, and roles and responsibilities agreed before any major scale-up.

6. Conclusions and Recommendations

6.1 Conclusions:

The thesis has highlighted challenges in achieving sustainable rural water supply in Uganda, and suggests that conventional solutions to these challenges are not sufficient in themselves. It has used a new conceptual framework to examine the impact of different approaches to rural-water supply, demonstrating that numerous factors must be considered beyond the achievement of safe water quality alone.

Despite limitation, the data collected strongly indicates that professionals in the sector would do well not to ignore existing local initiatives for self-supply - rather approaches should be explored that capitalise on local resourcefulness. The experience of WEDA in implementing the pilot project has shown that such approaches have the potential to be more cost-effective and sustainable than conventional approaches. Also, by building on local enterprise such an approach can have other important effects that exceed conventional conceptions of water-supply in terms of health-impacts.

Thus, not only can the approach assist the Government in achieving its national and international targets for rural-water supply, it can also impact on wider development. By building on local capacities, initiatives and plans, the approach has the potential of placing local people in control of the development of their own water resources and water-usage.

Nevertheless, there are limitations and challenges to the approach that have been highlighted by the pilot project, and which have been discussed above. Further studies must be carried out to determine the longer-term impact of the approach with regards water quality and environmental sanitation, sustainable management, and the uptake of incremental technology by local masons and private users.

6.2 Recommendations:

In addition to those made above, the following recommendations are made to the various pilot stakeholders should the approach be expanded across the District:

To the District:

1. Efforts must be made to build a clear understanding of the concepts and principles of self-supply amongst implementers.
2. A clear distinction must be made between communities and users, in order to perceive the multiple ways in which sources and water are used at a household level.
3. Efforts will be needed to develop the technological capacities of private contractors.
4. There is a need to move away from project schedules, in order to accommodate and maximise on the schedule of self-supply initiators.

To the Steering Committee:

1. Efforts will be needed in building NGO capacities regarding the concepts and principles of self-supply.
2. Further studies will be needed to present evidence-based arguments to water-sector professionals with regards self-supply.
3. A supporting network for institutions engaging in self-supply is needed in order to draw-out and share experiences and lessons-learned.

To WEDA:

1. Ownership is developed by the process, rather than solely by beneficiary contributions, and this must be better emphasised in future upgrades to capitalise on the pool of initiative that exists around self-supply sources.
2. Greater adaptation to the interests of water-users at a given source is needed, in order to maximise the knock-on benefits of an upgrade.
3. An innovative way of including hygiene and sanitation issues at private upgrades is needed, which might best be approached by building on user-interests in terms of protecting the source.

4. Additional incremental steps should be explored in order to reduce and spread the costs of improving a source.
5. Alternative management structures should be explored, building on existing structures or ideas at a given source. In addition, upgraded sources should be monitored to identify any management or ownership issues that may arise.

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Annex A: OXFAM DelAgua Kit Standard Procedures

Materials

Preparation of the culture:

38.1g of Membrane Lauryl Sulphate Broth were added to a sterilised 500ml bottle of distilled water of a pH of 7. The powder was fully dissolved within the liquid.

This bottle was then boiled for 20 minutes and left to stand for 24hrs in a cool dark place. The process was repeated 3 times in order to tyndallise the medium.

The tyndallised culture medium was then poured into several sterilised sample bottles for daily use. Bottles not in use were left sealed in a cool dark place, and monitored for any signs of deterioration prior to use.

Absorbent pads:

Absorbent pads were kept at the Mission, and dispensed only when preparing the samples.

Petri-dishes:

Petri-dishes were sterilised by boiling after each use, and sealed and stored in a sterile bag.

Measurements

pH:

pH was measured on site using a comparator. The comparator was rinsed three times with water from the relevant source. The comparator cell was then filled with the sample water and a Phenol Red tablet dropped into the cell. The lid was then sealed and the comparator repeatedly inverted until the tablet was dissolved. The comparator was then held up to day light to match the developed colour with the standard colour scale, and the results recorded.

NTU:

Nephelometric turbidity was measured on site using the calibrated turbidity tubes. Water from the source was poured into the tubes until the black circle just disappeared when viewed at a glance from the top of the tube in normal daylight.

Bacteriological analysis:

Water samples were analysed for thermo-tolerant coliforms (TTCs) by passing a determined volume of water through a sterile membrane filter. Bacteria in the water are thus caught on the filter, which is then placed on an absorbent pad in a petri-dish soaked in the liquid growth medium which feeds coliform bacteria, but inhibits the growth of other bacteria.

The petri-dish is then incubated at 44C in order to ensure only thermo-tolerant coliforms can multiply. The samples were incubated for a 16-18hr period. The multiplication of bacteria forms colonies which can be seen by eye. Thermo-tolerant coliforms produce a colour change becoming yellow in the culture medium at 44C. These colonies were subsequently counted and recorded as the Coliform-Forming Units per 100ml of water.

Sterilisation of equipment

Efforts were made to keep all kit-components free from contamination. In between samples, the filtration apparatus was sterilised by burning methanol in the sample cup and inverting the filter funnel to expose it to the gases released. In addition, Petri-dishes were boiled and closed prior to use to ensure that the internal surface is sterile. Absorbent pads were kept stored within their container.

In between all samples, the tweezers used to handle the membrane filters and absorbent pads were held in an open flame for several seconds, allowed to cool, and kept out of contact of any other objects.

Where a sample cup was used to collect the water samples, this was sterilised by burning methanol inside in between collections.

Annex B: Canzee Pump

The following has been taken from the SWS Filtration website:

These brief notes describe a pump, invented and developed by a colleague of ours in New Zealand. It uses a very simple pumping principle made possible by the availability of strong lightweight PVC pipes. It can be placed on a well to lift water from depths of at least 8 metres.

Below ground the pump consists of two pipes, one slightly larger than the other. At the bottom of each pipe is a simple non-return valve. An up and down movement of the handle raises and lowers the inner pipe or plunger. The outer pipe remains still. As the plunger is raised it lifts a column of water within it and more enters the outer pipe through its non-return valve. Each time the plunger is pushed down, more water is forced into it from below. Continued movement of the plunger drives water to the top of the inner pipe where it runs out through the pump spout. The pump is self-priming and easy to maintain. The valve seals are flat rubber discs which may be cut from old tyre inner tubes. As long as these discs are in good condition the pump holds its prime and yields water immediately. No piston seals are needed.

We believe that this pump has an important role to play where small scattered communities have access to numerous shallow wells. Although in trials one pump was run continuously for nearly 10 million cycles without any problems, we see this as a family pump for use by just a few compounds rather than one for very large villages where pumps have to be engineered to withstand very heavy use and abuse.

The pump is very easy to assemble and maintain using the minimum of tools. It lends itself to local manufacture.

Annex C: WEDA Cost Tables (unedited)

Summary of borehole costs - Financial year 2006/2007

Name of water source	Sub-county	Parish	Drilled by	Hydrogeology study & drilling supervision	Drilling costs	Casting & installation costs	VAT on drilling	Total cost per borehole	WAU Contribution	Community contribution	W-tax	Retention fees
Dodos	Abarilela	Katine	Acav	1,798,057	12,308,500	2,200,000	-	16,306,557	16,106,557	200,000	-	1,230,850
Katine	Abarilela	Dodos	Royal Techno Industries	1,798,057	9,697,700	2,200,000	1,745,586	15,441,343	15,241,343	200,000		
Akare	Abarilela	Dodos	Royal Techno Industries	1,798,057	9,697,700	2,200,000	1,745,586	15,441,343	15,241,343	200,000		
Acedapel	Acowa	Akum	Royal Techno Industries	1,798,057	9,697,700	2,200,000	1,745,586	15,441,343	15,241,343	200,000		
Otitingo	Acowa	Kobuin	Acav	1,798,057	9,942,880	2,200,000	-	13,940,937	13,740,937	200,000	-	994,288
Amusia	Acowa		Acav	1,798,057	10,914,700	2,200,000	-	14,912,757	14,712,757	200,000	-	1,091,470
Akworo	Acowa		E-plus					13,440,000	13,440,000	-		
Ongatunyo-Agule	Toroma	Ominya	Acav	1,798,057	12,339,750	2,200,000	-	16,337,807	16,137,807	200,000	-	1,233,975
Asinge	Toroma	Aputon	Acav	1,798,057	10,735,500	2,200,000	-	14,733,557	14,533,557	200,000	-	1,073,550
				14,384,456	**85,334,430**	**17,600,000**	**5,236,758**	**135,995,644**	**134,395,644**	**1,600,000**	**-**	**5,624,133**

Estimated cost of four upgraded communal sources					
Item	**Unit**	**Quantity**	**Unit cost**	**Cost**	**Provided by**
WEDA staff(time and allowances)	Allowances				
WEDA staff transport					
Materials					
Cement	Bags	7	18,500	**129,500**	**NGO**
Metallic poles	Pc	2	20,000	**40,000**	**NGO**
Rope and bucket	Pc		16,000	**16,000**	**NGO**
Re-bars	Pc	4	13,000	**52,000**	**NGO**
Sand	Trip	1	15,000	15,000	Community
aggregate	Trip		55,000	55,000	Community
Stones	Trip	1	45,000	45,000	Community
Bricks	No	200	75	15,000	Community
Hand-pump	Pc			200,000	Un specified
Transport of materials	Lump sum	1	160,000	**160,000**	**NGO**
Feeding	Meals	6	6000	36,000	Community
Fuel for pump	Litres	20	2500	**50,000**	**NGO**
Unskilled labour	Man days	36	3,000	108,000	Community
Skilled labour	Man days	6	10,000	**60,000**	**NGO**

ESTIMATED COST FOR THE 5 PRIVATE WELLS									
Item	**Unit**	**Qty**						**Unit cost**	**Cost**
Materials		**WELL 1(moru cuck**	**WELL 2(dokolo moru**	**WELL 3(otitingo**	**WELL 4(dokoro wera**	**WELL 5(acwila**	**TOTAL QTY**		
Cement	Bags	10	9	8	9	8	44	19,500	**858,000**
Fuel for pump	Ltres	16	21	10	15	20	82	2,200	**180,400**
Re-bars	Pc	2	2	1.5	2	1.5	9	16,500	**148,500**
Binding wire	Kg	1	1.5	1	1.5	1	6	3500	**21,000**
Sand	Trip	1	1	1	1	1	5	20,000	100,000
aggregate	Trip	1	1	1	1	1	5	45,000	225,000
Hardcore	Trip	1	1	1	1	1	5	45,000	225,000
Bricks	No	600	300	500	150	200	1500	100	150,000
									0
Rower pump/Twiddle pump/canzee pump	Pc						5		**0**
transport of cement	Lump sum					1	1	100000	**100,000**
Transport of local materials	Lump sum					1	1	320,000	**320,000**
Feeding	Meals	22	20	22	20	21	105	2000	210,000
excavation of the pit	ft	15	21	17	14	20	87	14000	1,218,000
Unskilled labour	Man days(6pplex14days)	19	26	21	18	25	109	3,000	327,000
Skilled labour	Man days	4	5	4	4	5	22	9,000	**198,000**
total for materials									**1,825,900**

Annex D: WaterAid Coverage and Functionality Data (unedited)

SUMMARY OF WATER COVERAGE BY VILLAGE IN AMURIA/KATAKWI DISTRICTS AS AT MARCH 2007											
				Investment per technology				Abandoned/Malfunctioning sources			
County	Sub-county	Population 2002	Projected Population June 2007	Boreholes	Shallow wells	Springs	Rain Water Tanks	Boreholes	Shallow wells	Springs	Rain Water Tanks
Amuria	Abarilela	17,699	23,451	38	19	0	2	5	15	-	-
	Asamuk	24,223	32,095	42	9	19	2	6	3	1	
	Kuju	22,720	30,104	30	10	18	-	5	2	5	
	Morungatung	21,532	28,530	38	21	18	-	5	3	6	
	Orungo	18,522	24,542	27	10	19	-	6	2	12	
	Wera	17,390	23,042	31	17	0		3	7	-	
Kapelebyong	Acowa	32,346	42,858	47	10	0		7	3	-	
	Kapelebyong	11,102	14,710	38	8	0		5	4		
	Obalanga	18,283	24,225	56	15			6	11		
		183,817	**243,558**	**347**	**119**	**74**	**4**	**48**	**50**	**24**	**-**
Usuk	Kapujan	9,292	12,312	21	14	1	1	1	3	1	
	Katakwi	27,259	36,118	41	37	0	2	5	18	-	1
	KTC	7,295	9,666	12	6	0	1	2	2	-	1
	Magoro	11,265	14,926	34	0	0	5	5			
	Ngariam	17,983	23,827	57	0	0	3	9			
	Omodoi	11,436	15,153	37	6	0	4	2	1	-	
	Ongongoja	9,428	12,492	38	2	0	-	7	1		
	Toroma	9,756	12,927	26	2	0	4	5	-		
	Usuk	19,501	25,839	36	5	0	-	3	5		
Katakwi District		**123,215**	**163,260**	**302**	**72**	**1**	**20**	**39**	**30**	**1**	**2**

Functioning sources				Estimated no people served					
Boreholes	Shallow wells	Springs	Rain Water Tanks	Boreholes	Shallow wells	Springs	Rain Water Tanks	Totals	**% Coverage**
33	4	-	2	9,900	1,000	0	300	11200	48
36	6	18	2	10,800	1,500	2700	300	15300	48
25	8	13	-	7,500	2,000	1950	0	11450	38
33	18	12	-	9,900	4,500	1800	0	16200	57
21	8	7	-	6,300	2,000	1050	0	9350	38
28	10	-	-	8,400	2,500	0	0	10900	47
40	7	-	-	12,000	1,750	0	0	13750	32
33	4	-	-	9,900	1,000	0	0	10900	74
50	4	-	-	15,000	1,000	0	0	16000	66
299	**69**	**50**	**4**	**89,700**	**17,250**	**7,500**	**600**	**115,050**	**47**
20	11	-	1	6,000	2,750	0	150	8900	72
36	19	-	1	10,800	4,750	0	150	15700	43
10	4	-	-	3,000	1,000	0	0	4000	41
29	-	-	5	8,700	-	0	750	9450	63
48	-	-	3	14,400	-	0	450	14850	62
35	5	-	4	10,500	1,250	0	600	12350	82
31	1	-	-	9,300	250	0	0	9550	76
21	2	-	4	6,300	500	0	600	7400	57
33	-	-	-	9,900	-	0	0	9900	38
263	**42**	**-**	**18**	**78,900**	**10,500**	**-**	**2,700**	**92,100**	**56**

Note:

1. Boreholes is estimated to serve 300 people, shallow well 250, spring 150 and rain water tank 150 people of seasons
2. Sub-counties with less than 50% are taken as priority
3. Amuria Town Council is being taken as part of Kuju sub-county
4. Population projections is at annual growth rate of 6.5 as per UBOS report of 2002

Annex E: Sanitary Survey Template

Source/Village name:	Parish:	Sub-County:
Source Type:		GPS Coordinates:

Date	Time	Code	Pictures	Antecedent Conditions		Turbidity (NTU)	pH	EC	Temp	TDS	Discharge (l/s)	Thermotolerant Coliforms		
				Previous week	Last 24 hrs							Vol filtered (ml)	No. colonies	TTC per 100 ml

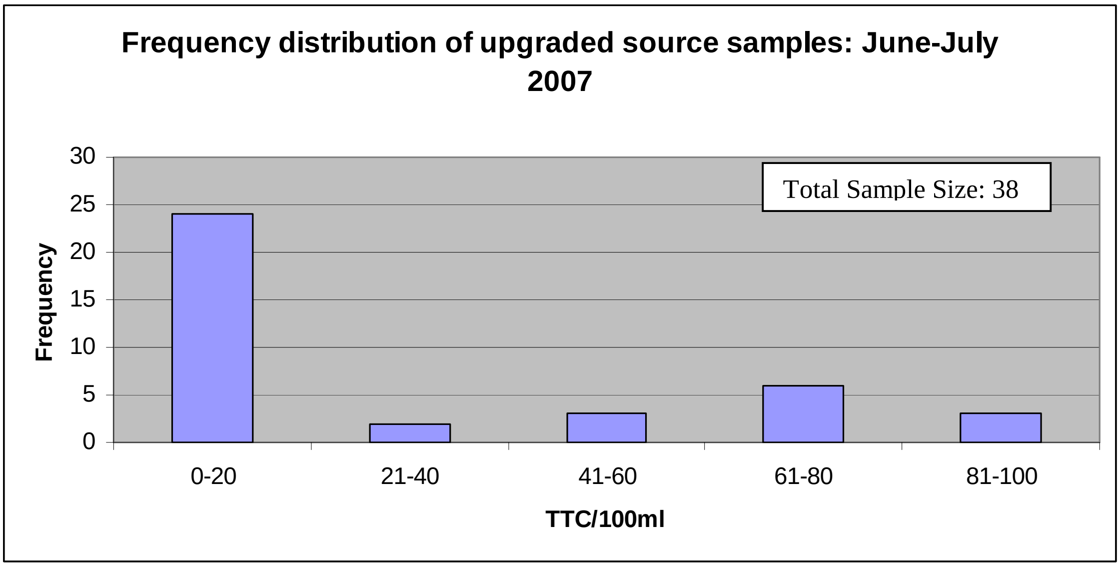
Sanitary Survey			
Specific potential risks to water quality	Y/N	Barriers	Description/Comments
Latrine < 10m from source?			
Latrine within 30m / uphill from source?			
Other source of pollution within 30m?			
Animal access close to source?			
Organisms visibly present in source?			
Protected from surface water contamination?			
Surface water ponding uphill/in vicinity of source?			
Sufficient drainage away from source?			
Concrete apron/retaining wall/well head in good condition?			
Discharge point in sanitary state?			
Method of collection potentially contaminating source water?			

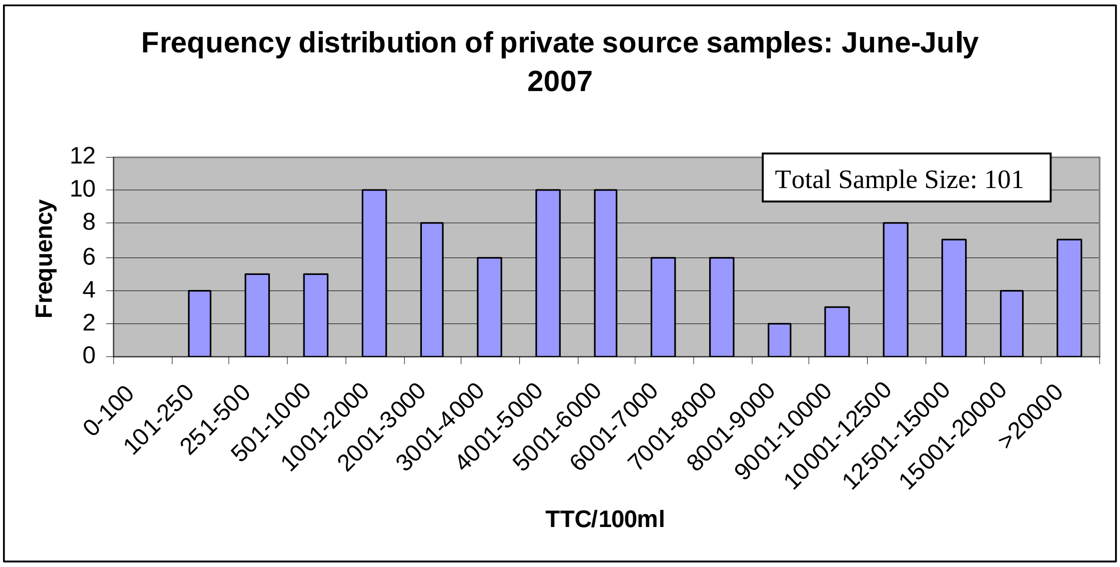
Additional Comments (obvious issues with source):
Significant Risk areas highlighted:
Catchment description (geology, hydrology, soil type, vegetation, landuse and practices):

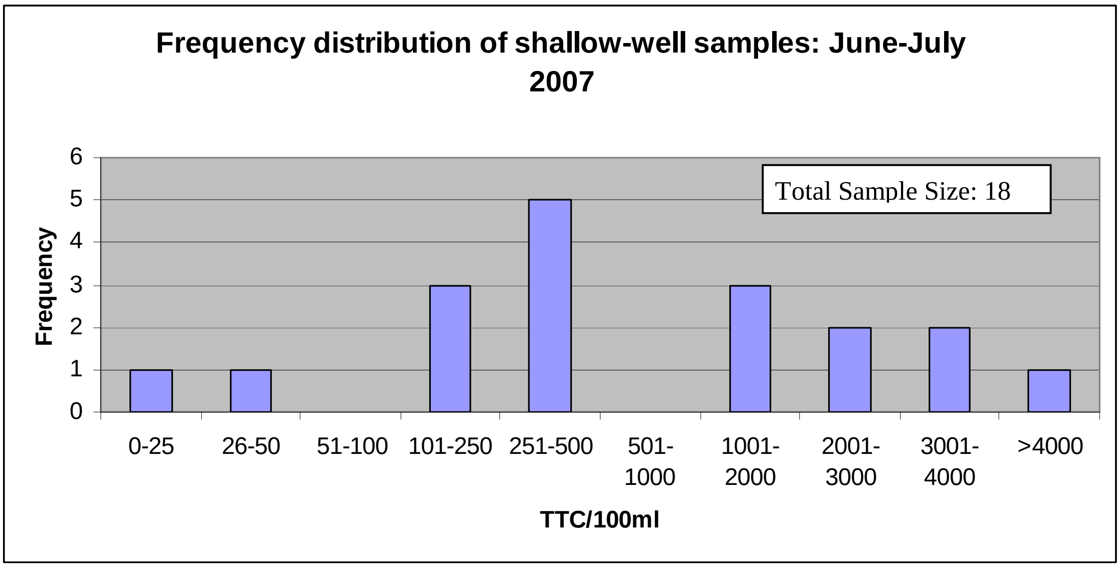
Annex F: Scoring Table Justification

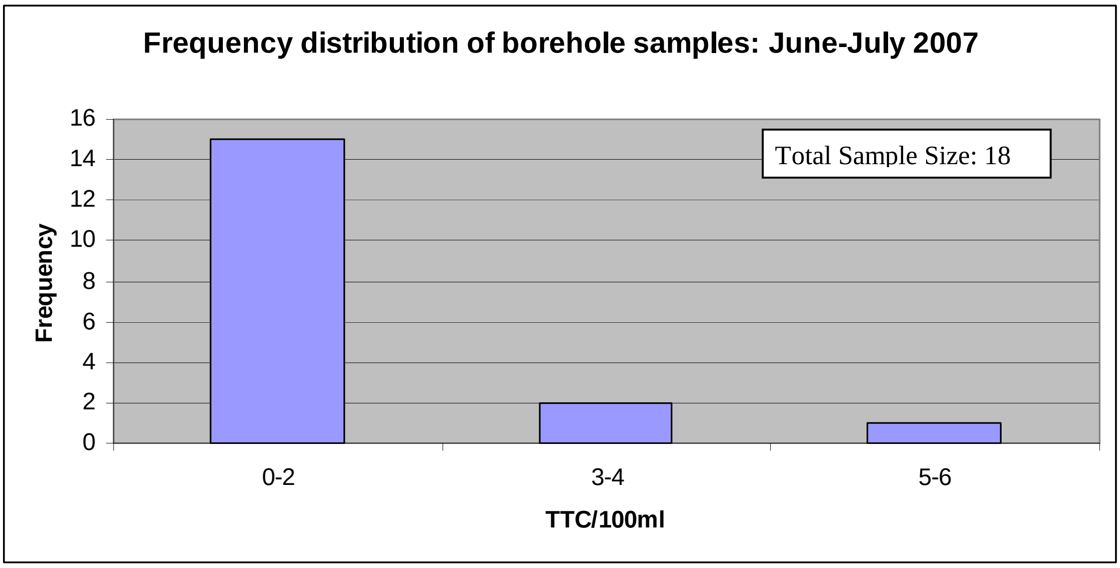
	Access	Quality	Reliability	Cost	Management	Total
Borehole	1 – water is within 1.5km of most users, but still must be carried home	1 – source is protected but untreated	1 – user-demands can nearly always be met	0 – cost is high, and can only be covered with external support	1 – longer-term external support is needed for management to function	4
Shallow well	1 – water is within 1.5km of most users, but still must be carried home	1 – source is protected but untreated	0 – source performance fluctuates with season	1 – users contribute a significant proportion of the capital costs	1 – longer-term external support is needed for management to function	4
Communal self-supply	1 – water is within 1.5km of most users, but still must be carried home	1 – source is protected but untreated	2 – water is available on demand, and can supply over 20 litres/ person/ day	1 – users contribute a significant proportion of the capital costs	1 – longer-term external support is needed for management to function	6
Private self-supply	1 – water is within 1.5km of most users, but still must be carried home	1 – source is protected but untreated	1 – user-demands can nearly always be met	2 – users contribute over 50% of capital costs, and user fees for operation and maintenance are potentially negligible	2 – the source can be managed and maintained by users without external support	7
Traditional	1 – water is within 1.5km of most users, but still must be carried home	0 – water is obviously polluted and at risk of contamination from livestock and other causes	1 – user-demands can nearly always be met	0 – human cost is potentially high in terms of ill-health	2 – the source can be managed and maintained by users without external support	4

Annex G: Frequency Distribution Tables






Frequency distribution of shallow-well samples: June-July 2007
Total Sample Size: 18
Frequency
6
5
4
3
2
1
0
0-25
26-50
51-100
101-250
251-500
501-1000
1001-2000
2001-3000
3001-4000
>4000
TTC/100ml


Frequency distribution of borehole samples: June-July 2007
Total Sample Size: 18
Frequency
16
14
12
10
8
6
4
2
0
0-2
3-4
5-6
TTC/100ml