Uganda

Water Sector and

Domestic Rainwater Harvesting

Sub-Sector Analysis

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Kerstin Danert and Nigel Motts

Catching the rain at your home saves you from following the run-off down the hill.

Contact for additional information:
Jon Naugle
EnterpriseWorks/VITA
nauglej@enterpriseworks.org

Executive Summary

Enterprise Works/VITA (EWV) is interested in large scale, market-based promotion of domestic rain water harvesting (DRWH) as one way to meet the domestic water consumption needs of lower income families in developing countries. This report presents the findings of a study which assessed the potential for promoting DRWH production and distribution chains on a commercial basis in rural Uganda. The report provides recommendations on how this might be achieved.

Two consultants undertook a literature review of DRWH and the wider water sector in Uganda combined with three weeks of in country field work. The latter comprised interviews and group discussions with over 100 stakeholders and observations in areas where there are already considerable DRWH activities taking place as well as discussions with users, masons, shop owners, NGO staff and government officials.

Two-thirds of Uganda receives rainfall in excess of 1200 mm per year, which is primarily bimodal in nature, with the heaviest rains from April to November. The rainfall amount and pattern coupled with the fact that almost two thirds of Ugandans now have galvanized iron roofed homes makes most of rural Uganda ideal for tapping the rain and storing it at their homes through DRWH.

Entitlement to clean and safe water is enshrined in the Ugandan constitution. The Government of Uganda and numerous NGOs have supported the construction of community (i.e. communal) improved water supplies in rural Uganda. An estimated 63% of the rural population now have access to an improved water source, although there is wide variation in access throughout the country. Nationally, 24% of the rural population use deep boreholes fitted with hand pumps, 15% use shallow wells fitted with hand pumps and 17% use protected springs. Only 6% of the rural population use piped water supplies.

Although access to improved water supplies has risen significantly from about 20% in 1990, it has stagnated at around 61% to 63% since 2001. Analysis of the trend shows that this level will not increase in the future unless there is a massive increase in investment or a significant change in approach. One way to address this formidable challenge is to stimulate investment by the users themselves, where possible. A market-led approach to DRWH or other technologies (such as hand dug wells) which are affordable by householders and lend themselves to incremental improvements could leverage householder investment. Relatively small investments by many households could thus add up to the massive investment needed.

There are seasonal variations in water sources used in rural Uganda and many households use more than one source. A national survey by the Uganda Bureau of Statistics (UBOS) in 2004 found that 18.4% of rural households used rainwater for drinking in the wet season compared to 0.5% in the dry season. In some parts of the country, over 70% of the rural population practice some form of DRWH. DRWH can provide a high level of service because the water is available at the home, thus reducing the long distances that women and children travel to fetch water. DRWH is ideally suited to the scattered settlement patterns of rural Uganda. Where storage volumes are small, owners are limited to exploiting DRWH during rainy days or rainy weeks rather than for most of the year. In the case of very large DWRH tanks (10m^3 and above), people use the water throughout the year for most of their

domestic needs and even manage to water animals or use limited amounts on crops, seedlings or for pesticide application.

Since the early 1990s, several NGOs have been promoting DRWH in Uganda and its popularity continues to grow. The Government of Uganda (GOU) now considers DRWH as an improved water supply, and includes it in access statistics. The GOU is currently in the process of developing a new strategy for rainwater harvesting in Uganda. However, the relatively high per capita cost compared to other community technologies means that DRWH is not an attractive option for Government (or NGO) investment if it is fully, or even 50% subsidised through external support. This adds more weight to the case for promoting DRWH in a manner that leverages investment from water users themselves wherever possible.

Although NGOs and Government started to promote DRWH with 100% subsidises, this approach is gradually changing. Construction of demonstration facilities for self-help groups, training of local masons and encouragement of pooled group savings (merry go-round system) provide catalysts for increasing uptake of DRWH.

The field work undertaken for this study specifically sought out private investment in DRWH and found the following:

- Widespread opportunistic use of DRWH in all areas visited. Households were storing rain in relatively small volume containers, which is in line with findings from UBOS and other studies.
- Privately financed underground tanks (10 to 30m^3 in volume), lined with plastic sheets were found in Masaka district. The two masons who have constructed these facilities claim that they have built about 200 and some of the owners were selling water.
- Up to 1,000 partially below ground tanks have been constructed for private owners in Isingiro district.
- In Kabale district there are cases of people upgrading from small (10 litre) pots to 420 litre cement rainwater jars with their own investment (an estimated 300 in Muko sub-county). Other families are paying for the construction of larger storage facilities (4 to 10m^3).

In Uganda an extensive range of DRWH storage facilities are in use. The study identified about 30 distinct DRWH storage products which include: 20-litre jerry cans; 50 and 100-litre blow moulded plastic drums: 200-litre steel drums; 420 to 1,500-litre cement jars; plastic tanks (Aquatank and Polytank) from 220 litres to 15,000 litres; above-ground plastic-lined tanks (3,000 litres); below ground plastic-lined tanks (10,000 litres and above); ferro-cement tanks (4,000 to 10,000 litres); partially below ground cement lined tanks (6,000 to 10,000 litres) and brick tanks (10,000 litres). Broadly these can be categorised as either manufactured or built-in-place rainwater harvesting storage products.

Manufactured rainwater storage products of capacity 250 litres or less are widely available from the major towns to the end of graded dirt roads. Capacities of 500 litres and up are only available in the major towns. Lower sales volumes, lack of transportation by rural shops and high price relative to household income mean that the latter are rarely available in the rural areas. Small capacity built-in-place rainwater storage products (420 to 1,500 litres) are only available in places where they have been promoted by NGOs. They are available on a commercial basis (i.e. by artisans) in some of these places. Large capacity, built-in-place rainwater storage products are mainly available in areas where there has been NGO promotion and they appear to be only selectively available on a fully commercial basis. This is because NGO promotion methods have not been designed to facilitate widespread private sector participation and construction has tended to be heavily subsidised over a number of years, discouraging purchase at full cost from a local artisan.

Although adoption of DRWH is growing in Uganda, consumers tend to only know about two or three rainwater storage product options. Even where masons have been trained in the construction of a wide range of DRWH technologies, they have tended to only build one or two different types of facilities. Despite the enormous potential of DRWH in Uganda, especially in areas where there is a cash income, the adoption rate of the technology is low. Current efforts to train masons, subsidise some households, and demonstrate a limited range of storage options is simply not enough to release the massive pent up demand for DRWH. More strategic interventions by Government, NGOs and the private sector are needed to accelerate growth in DRWH investment by households.

The examples of private investment in built-in-place rainwater storage products observed during the study were encouraging and suggest that in locations where income levels are sufficiently high, consumers are willing to invest in large capacity storage tanks. It is likely that such investments will continue to gradually expand to adjacent locations without external intervention. Unfortunately the diffusion rate will be slow and limited to small geographic areas relative to national need. With modest and targeted external support it is believed that the diffusion of built-in-place rainwater storage products could be taken to scale.

With the exception of the below-ground, plastic-lined tank, affordable rainwater storage product choices, between 250 and 4,000 litres, are very limited. The introduction of a storage product of 750 to 1500 litres capacity at an installed price of UGX 80,000 or less by Enterprise Works/VITA (EWV) appears to be a compelling value proposition to budget-minded, low income consumers.

Potential supply chains for a new storage product are closely correlated with the current building materials supply chain, which also caters for the materials used for built-in-place storage tanks. The building materials supply chain is characterised by intense, price based competition amongst competing re-sellers at each point in the chain including the "last point of supply" trading centres.

The market segments for rainwater storage products are likely to be determined by income levels. Households having lower incomes are more likely to invest in an affordable low-cost product. In contrast, consumers with higher incomes will tend to maximise their storage capacity.

The 'felt need' by consumers is for convenience, saving time and reducing labour burdens (of fetching water from distant points) and reliable water supply. Thus, consumers' top priorities are generally to obtain the maximum volume of on-site water storage capacity that they can afford. Water quality and safety is a secondary concern.

There is, without doubt, widespread pent up consumer demand for DRWH in Uganda. Although 63% of the rural population are considered as having access, improved water supplies are often distant.

The opportunity to purchase an affordable rainwater storage product is likely to interest practically all rural households with a galvanised iron, or tiled roof. It is estimated that the potential market for rainwater storage product in the country is conservatively 1.8 million households (11 million people). This assumes that 70% of rural households with hard roofs would be interested in one of the rainwater storage products.

Transportation economics in Uganda involves the transport of agricultural goods from rural areas to large towns and Kampala and backhaul loads in the other direction. Retailers and wholesalers use these truckers to ship goods from Kampala to their shops. Transportation costs (for a 7 to 12 metric ton truckload) from Kampala are very economical relative to the potential value of goods shipped. It ranges from as low as UGX 100,000 (Kampala to Masaka) to about UGX 500,000 (Kampala to Kabale). 'Last mile' retailers in more distant locations tend to procure from intermediary re-sellers situated along arterial roads. Product choice for rainwater storage products in these locations is partial at best and access to transport is frequently a problem. The absence of product choice at the 'last mile' retail level, combined with limited access to information about the range of DRWH choices elsewhere, prevents rural consumers from investing in DRWH suited to their needs.

In terms of credit for DRWH, FINCA provides credit for Crestanks storage products and the NGO ACORD has triggered a local Savings and Credit Cooperative Organisation (SACCO) to provide credit for above ground ferro-cement tanks. There are also a number of other local SACCOs who reportedly support DRWH. Overall, importing incurs import duties and potentially excise tax. VAT at 18% is payable (on the final retail price).

The policy context and market conditions in Uganda are highly favourable for a market-led approach to DRWH. Government is sensitive to its own limitations in relation to achieving universal access to water and appears poised to widen its approach and also embrace a 'self supply' strategy that seems likely to be supportive of market-based solutions. At the level of markets, distribution and sale of commodities is highly competitive and cost efficient, these conditions implying strong scope for ensuring that distribution and sale of appropriate rainwater storage products by the private sector is likely to prove cost-effective and aggressive.

In conclusion there is no doubt that there is enormous potential for promoting domestic rainwater harvesting (DRWH) production and distribution chains on a commercial basis in rural Uganda. DRWH is a highly suitable technology for increasing access to safe water in the country. This reality has been recognised by the Government and many NGOs, not to mention the numerous households which are already investing in their own DRWH facilities from small, improvised collection and storage facilities to larger volumes. Although there have been efforts to encourage commercial uptake of DRWH, they are still fairly small in relation to the country as a whole. Most rural people are simply not aware of the wide range of options available. Efforts to improve knowledge and skills of what already exists in Uganda could significantly increase the adoption of DRWH. The availability of a much cheaper rainwater storage product as proposed by EWV could enable widespread uptake of the technology even by relatively low income households. Such a two-pronged approach could bring about the massive investment increase that Uganda needs to increase access to improved water supplies.

EnterpriseWorks/VITA
nauglej@enterpriseworks.org

A project by EWV should engage with the stakeholders already involved in rural water supply in Uganda through the existing coordination bodies from the outset. This will enable the project to learn from past and current initiatives and set the foundation for influencing policy change. In addition, it will stimulate others to engage in supporting a new approach that can harness the potential of the private sector, utilise the strength of the market and stimulate widespread investment by households in improving their water supplies.

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Abbreviations

AfDB	African Development Bank
DRWH	Domestic Rainwater Harvesting
DWSCG	District Water and Sanitation Conditional Grant
MWE	Ministry of Water and Environment
GFS	Gravity Flow Scheme
URWA	Uganda Rainwater Association
MWE	Ministry of Water and Environment (MWE),
UWASNET	Uganda Water and Sanitation NGO Network
WESWG	Water and Environment Sector Working Group

1 Introduction

In Africa and Asia there are currently over 900 million people without access to adequate water for domestic purposes. Wide variations in climate and geography require access to a range of options and a clear articulation of the costs, advantages and constraints for the consumer. In order to address the huge challenge all viable technologies should be considered.

Domestic rainwater harvesting (DRWH) refers to the collection, storage and use of rainwater at household level for drinking, cooking, cleaning, small-scale agriculture and livestock rearing. It can be the sole water source, or a supplementary supply. DRWH dates back to the third millennium BC in India and was utilized extensively in the Mediterranean and Middle East[1]. Collection can be from any suitable surface. Storage ranges extensively in terms of size, materials and whether above or below ground, in a vessel or within the sub-surface formation itself. The term "domestic" alludes to the fact that the facilities are located at (or extremely near to) the user's home, thus minimizing the distance of carrying water. The problem of distant water sources not only imposes an enormous time- and energy-expenditure burden on women and children, but the physical burden of carrying water over long distances can also lead to curved spines, pelvic deformations and numerous other injuries in women and children[2] who are the primary water carriers.

DRWH has proven successful over the millennia, but less than 1% of the world's population takes full advantage and perhaps only 5% take even partial advantage of this technology. The nature of rainfall as a widely distributed resource matches the widely dispersed needs, especially in rural areas. Given the fact that tapping the rain could have such a positive impact on people's lives, an enormous opportunity is being missed. Fortunately recognition of the potential for DRWH is growing, with numerous non-governmental organizations (NGOs) and Governmental agencies now promoting it, and increasingly national and international associations and networks are being established.

This paper presents the findings of a study which set out to assess the potential for promoting DRWH production and distribution chains on a commercial basis in Uganda, given competing sources of household water supplies. Two consultants (Nigel Motts of MEDA and Kerstin Danert of SKAT) spent three weeks in Uganda undertaking the study (17th Jan to 7th Feb 2009). They were joined by Jon Naugle of EWV for one week.

In order to select sites for field work, emphasis was placed on visiting areas with good potential for a successful market-led approach to DRWH. This was defined as areas where there are already considerable DRWH activities taking place. Just under 50% of the consultant's time was spent in discussion with key stakeholders in Kampala, with the remainder of the visit spent in the six Districts of Kapchorwa, Masaka, Rakai, Mbarara, Isingiro, Bushenyi and Kabale (Figure 1.1). Population and

[1] Smet, J. 2003. WELL FACTSHEET: Domestic Rainwater Harvesting http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/drh.htm

[2] WaterAid. *Women and WaterAid*. Issue Sheet. http://www.wateraid.org/documents/women_and_wateraid_2006.pdf viewed on 19th October 2007; Curtis, V (1986) Women and the Transport of Water. IT Publications, UK.

water coverage data for these Districts is set out in Table 1.1. For details on how coverage is calculated, see Box 2.1.

Figure 1.1 Map of Districts Visited (marked with *)

Table 1.1 Key Data for Districts Visited (Source: MWE, 2008)

District/Sub-County	Water Supply Coverage (%)[3]	Rural Population
Kapchorwa	65%	168,938
Masaka	74%	725,328
Mbarara	59%	343,142
Bushenyi	80%	778,148
Isingiro	30%	371,230
Kabale	92%	436,603
National	**63%**	**26,237,442**

[3] See Box 2.1 for details on how coverage is calculated.

At national level, discussions were held with a wide range of stakeholders from central Government, the private sector (mainly suppliers), NGOs and donor organisations. The consultants focused on rural areas for their observation of existing DRWH and discussion with potential customers where about 85% of Uganda's population resides. Property rental is more common in urban areas, which renders investment in DRWH facilities less attractive.

The primary method of data collection involved key informant interviews (one to one as well as small groups) and observation of DRWH practices. In addition, Kerstin Danert participated in a 3 day meeting entitled "*Workshop on best practices and experiences in rainwater harvesting and dissemination of the AfDB Rainwater Harvesting Handbook*" in Masaka and a one-day meeting on *self supply* in Mbale. The Masaka meeting was attended by about 30 people, representing local Government (both political and administration), the Ministry of Water and Environment (MWE), several NGOs as well as rainwater harvesting associations in Kenya and Ethiopia. The Mbale meeting, of about 30 people, comprised District Water Offices and NGOs from the East of the country.

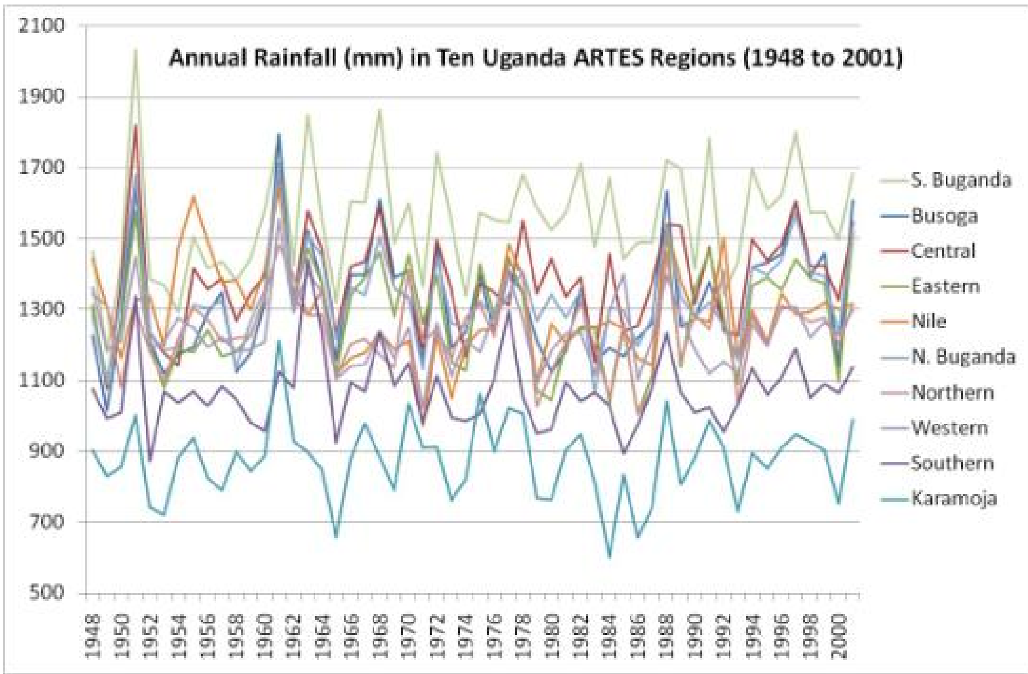
2 Overview of Household Water Sector

2.1 Environmental Context

2.1.1 Rainfall

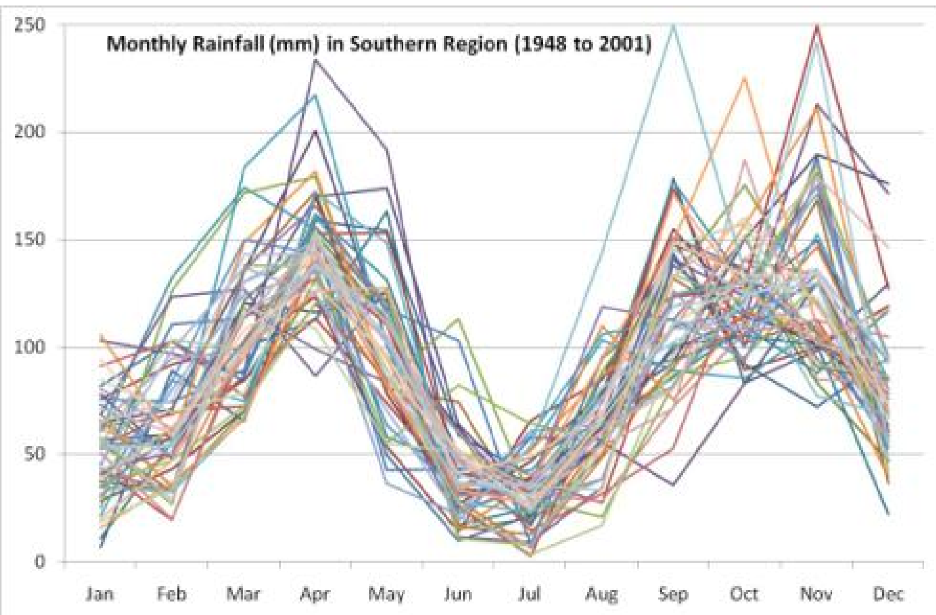
The African Rainfall and Temperature Evaluation System (ARTES) have monthly rainfall for ten regions of Uganda from 1948 to 2001 (World Bank, 2003). Figure 2.1 shows that the annual rainfall has varied from 659mm (Karamoja in 1984) to 2034 mm (central in 1951). In seven of the ARTES regions, rainfall has tended to be between 1100 and 1700 mm per annum. Karamoja and Southern region have tended to receive lower rainfall (54-year average of 875mm and 1070mm respectively) whereas South Buganda has tended to received higher rainfall (average of 1552mm over 54 years). According to Obote (2008), two-thirds of Uganda receives rainfall in excess of 1200mm per year.

Figure 2.1 Annual Rainfall for Ten Uganda ARTES Regions (1948 to 2001)



In most of Uganda, rainfall is bimodal in nature. The heaviest rains tend to fall in April and November, and the drier months are June to August and December to February (e.g. Figure 2.2). Analysis of all 6,480 data points (i.e. monthly data for ten regions, over 54 years) shows that less than 10 mm of rain fell in 3% of months; less than 30 mm in 10% of months and less than 50mm in 19% of months. A rainfall of 50mm on a roof area of 15m^2 would provide 600 litres of water (assuming runoff efficiency of 80%).

Figure 2.2 Monthly Rainfall (mm) in Southern Region (1948 to 2001)



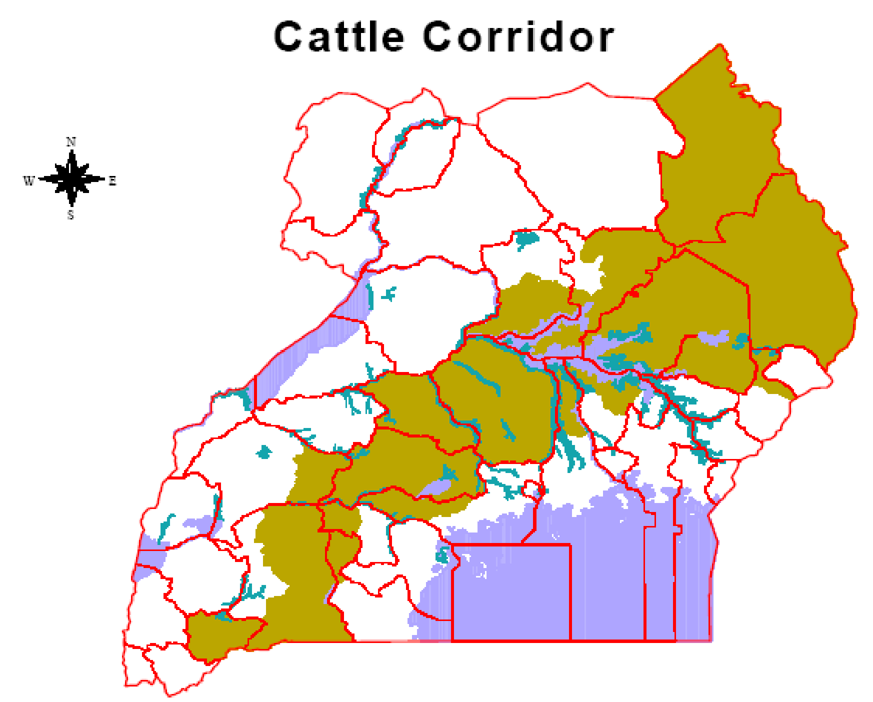
2.1.2 Environmental Factors Impacting on Household Water Supply

Most of Uganda lies at an altitude of over 1000m, and topography is generally rolling, with the exception of the Rwenzori Mountains in the west, the Kigezi region in the southwest, the Virunga range in the south and Mount Elgon in the East. Almost 17% of the country is covered by water; 12% comprises forest reserves and national parks. Although Uganda is blessed with abundant water supplies, they are not evenly distributed through the country or throughout the year. In some places, such as parts of Sembabule and Isingiro, women and children can walk 5km (one way) to their nearest water source.

There is increasing concern about the effects of deforestation on seasonal flows. Over the years, and particularly in response to population pressures, the upper hills in many parts of the country are being cleared of forest cover for farm land. According to the Forestry Outlook Studies in Africa for Uganda (FAO, 2001) forestry cover shrunk from 45% of the total land area in 1890 to 20.3 % in 2001. In 1995 it was estimated that the rate of deforestation was about 1% per annum. As an example of concerns voiced during the study from the District Chairperson, District Water Officer, Kaproron Primary Health Care (KPHC) staff and water users in Kapchorwa District claim that rivers in the District are more polluted and silt laden than they were in the past. They state that as a result, surface water that used to be suitable for drinking water is no longer considered safe for consumption without some form of treatment. A case in point is a typhoid outbreak which killed 9 people in the district in 2008.

Figure 2.3 shows the *cattle corridor,* the popular name for the belt of Uganda with less rainfall and a more variable pattern than other parts of the country. It supports a large population of cattle (hence its name) (Gwage, 2008). Access to improved water supplies (defined in box 2.2) tends to be lower in the districts that fall largely in the cattle corridor.

Figure 2.3 Map Showing Cattle Corridor (Gwage, 2008; Ministry of Water and Environment, 2008)



District	Access to Improved Water
Kotido	29%
Moroto	51%
Soroti	79%
Nakapiripirit	42%
Abim	32%
Lira	61%
Katakwi	71%
Mubende	37%
Lyantonde	48%
Isingiro	30%
Kiruhura	31%
Sembabule	52%
Nakasongola	70%
Ntungamo	69%

Climate change is a much discussed topic in Uganda, with some citing the floods of 2007 in Northeast Uganda as evidence of more extreme weather events. The Intergovernmental Panel on Climate Change predicts higher temperatures and more erratic rainfall for the region, but as with the rest of sub-Saharan Africa countries, the jury is still out in predicting in more detail what the effects are likely to be.

2.1.3 Manmade Impacts on the Environment

In Uganda, the terms "access" and "coverage" refer to the percentage of people with access to an improved water source. Box 2.1 sets out the service criteria used to estimate access for rural water supplies. Data from District local Governments is used to generate the access figures. An estimated 63% of the rural population currently have access to an improved water source although there is wide variation throughout the country.

According to MWE (2008) data, over 80,000 improved water supplies have been constructed in rural Uganda (Table 2.1) although it should be noted that an estimated 18% of these supplies are not functioning. Spring protection, handpumps and rainwater harvesting are localised solutions – providing water at origin. In the case of gravity fed schemes (GFS) and other small piped schemes, the spring, groundwater or surface water is piped from the source to the water users. Piped water supplies (an estimated 65 small schemes in rural areas) serve 6% of the rural population (Figure 2.4).

Box 2.1 Service criteria used to estimate access to safe water supplies in Uganda (MWE, 2008)

Improved water sources (i.e.: protected springs, deep boreholes and shallow wells fitted with handpumps, rainwater harvesting facilities and piped water supplies) are defined as safe.

Rural water supplies assumes the following number of users per source:

- Protected springs – 200;
- Shallow well with handpump – 300;
- Deep borehole with handpump – 300;
- Gravity flow scheme, or other piped water supply tap – 150.
- Coverage based on rain water harvesting is captured based on an approach developed in 2006 which relates a tank volume to a number of users.

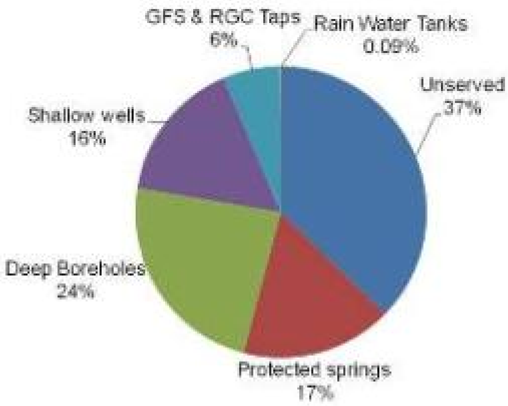
Tank size (l)	<10,000	>10,000
Estimated no. of users	3	6

The 'total number of people served by all the improved sources' is divided by the 'total population' (based on UBOS projections). The final step of the calculation process, as currently applied, involves an adjustment or a "capping" of the figures to ensure that no sub-county is reported to serve more people than its total population. If the calculation formula returns more than 95% coverage for a particular sub-county, the figure is adjusted to 95% and only 95% of the total sub-county population is reported to be served.

Table 2.1 Breakdown of Improved Water Supplies in Rural Areas

Source	Number
Protected springs	24,593
Deep borehole with handpump	22,961
Shallow well with handpump	15,474
Gravity flow scheme (GFS) Tap/Standpipe	10,191
Piped water supply in rural growth centre tap	2,186
Rainwater harvesting facility (volume <10m^3)	6,074
Rainwater harvesting facility (volume >10m^3)	1,344
Total	**82,823**

Figure 2.4 Proportion of Rural Population Accessing Different Sources of Water (MWE, 2008)



The urban setting is defined as 182 town councils and municipalities (total population of 4.4 million). Of these, 136 have functional piped water supplies (using pumped borehole and treated surface water). Uganda's major dam is Owen Falls Dam on the Nile near Jinja, which provides electricity for most of the country, generating some 200 MW. In addition, there are two small dams at Kasesse (Kassesse Cobalt Co.; Kilembe mines) and Micro dams at Kagando Hospital (Kasese), Kasizi (Rukunjiri) and Kuluva Hospital (Kulungiri) (Zachary, 2008). Construction of the Bujagali dam, also on the Nile just outside Jinja is currently underway.

The Ugandan Water and Sector Reports from 2005 to 2008 draw attention to the inadequate treatment of wastewater from the 23 major towns in Uganda resulting in the pollution of lakes and swamps. MWE is hampered by weak regulation in this regard.

Ugandan Government Agencies (Ministry of Agriculture, Animal Industry and Fisheries; Ministry of Water and Environment; District Local Governments) have been involved in the construction of valley tanks and dams to provide year round supplies of water for livestock as well as for domestic use (Figure 2.5). MWE has recognised that there are major problems with respect to the operation and maintenance of these facilities (MWE, 2008), as well as challenges to actually pumping sufficient water for large herds of cattle. Discussions are ongoing with respect to the implementation of a new strategy of bulk water supply. It is intended that water will be conveyed from places of plenty to places of scarcity through pumping or by gravity.

Figure 2.5 Valley Tank with Handpump in Masaka District

2.2 Policy Context and Programme Implementation

2.2.1 Water Rights

The Ugandan Constitution states that: every person is entitled to clean and safe water. The Water Statute (1995: section 5 to 8) states that "*all rights to investigate, control, protect and manage water in Uganda for any use, is vested in the Government...no person shall sink any well...without a permit to undertake works or a water permit...a person may while temporarily at any place; or being the occupier of or a resident on any land, where there is a natural source of water, use the water for domestic use, fighting fire or irrigating a subsistence garden.*" It also states that the "*The Minister [may] temporarily or permanently prohibit the use of water from a given source on public health grounds*".

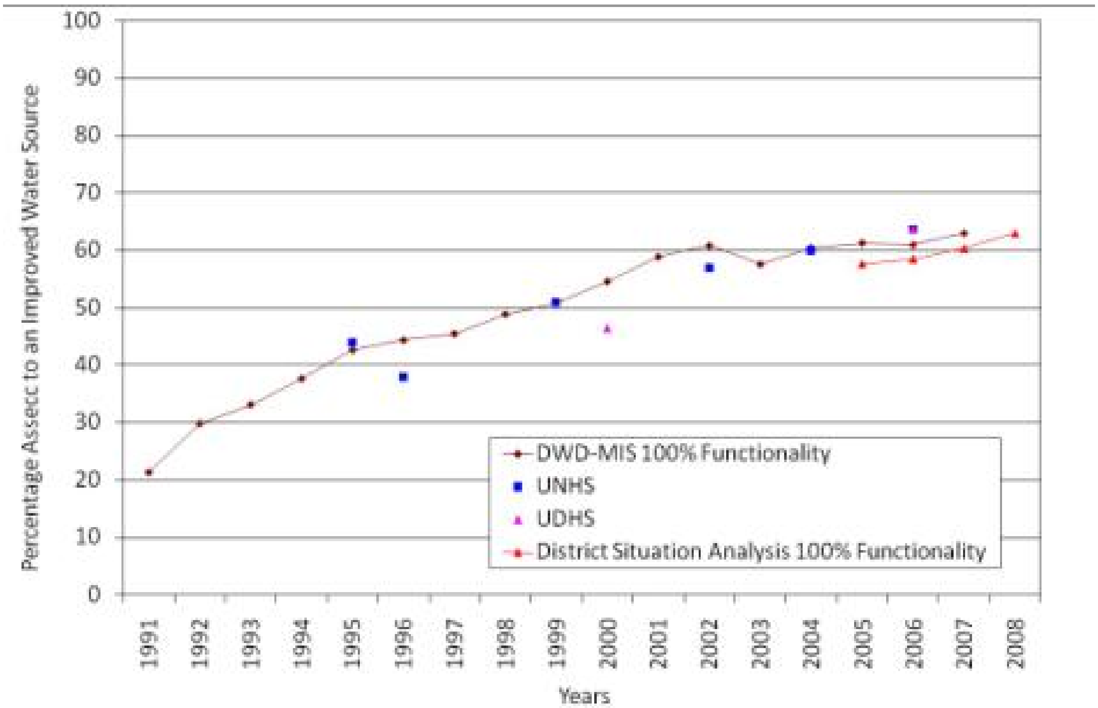
The Government's stated policy objective in the water supply and sanitation sector, as stated in the Water Policy (Ministry of Water and Environment, 1999) is the "*Sustainable provision of safe water within easy reach...based on management responsibility and ownership by the users*". The definition of access to safe water in Uganda is currently defined as living within 1.5km (in rural areas) and 0.2 km (in urban areas) of an improved water supply (i.e. protected spring, drilled or dug well with handpump, piped system or rainwater harvesting).

Over the last 30 years, the GOU has supported the construction of community (i.e. communal) water supplies, which are generally accepted as belonging to the community. However, as the water and sanitation committee does not have legal status, the ownership issue remains somewhat nebulous. The District Implementation Manual (MWE, 2007) included the settlement of land and ownership conflicts as one of the six critical requirements to ensure sustainable operation of water and sanitation facilities: "*communities shall be required to satisfactorily prove (e.g. with written agreements, land titles) that all potential and foreseeable land access and ownership issues have been resolved beforehand"*. The extent to which this requirement is adhered to is not well documented. In some regions (particularly the north), land ownership is customary, so there are not land titles to be held.

2.2.2 Costs and Benefits of DRWH

Figure 2.6 shows that improvements in the percentage of people with access to improved water supplies in rural areas have essentially stagnated since 2001 at around 61%. Given current population growth, and per capita costs, rural coverage will not increase over the next few years unless there is a significant change in approach or considerable increase in investment[4]. One of the problems faced by the Government is that many of the cheaper technical options (in particular protected springs) have already been utilised. This means that the more expensive options due to remoteness and limited technology alternatives remain to be undertaken. One way to address this challenge is to stimulate investment by the users themselves where possible. A market-led approach to DRWH or other technologies which lend themselves to incremental and affordable improvements by householders could leverage householder investment. Relatively small investments by many individual households could result in a massive investment overall.

Figure 2.6 Trends in Access to Improved Water Supply (1991 to 2008)



[4] e.g. budget of UGX 5 billion in 2009/10 for Rural Water Supplies and Sanitation and Water for Production.

The Government of Uganda considers *Domestic Roofwater Harvesting* as an improved water supply. The Minister of State for Water, while launching the ADB workshop on Best Practices in Domestic Roofwater Harvesting in January 2009 gave a compelling speech in favour of the technology, particularly given that almost two thirds of Ugandans now have galvanized iron roofed homes. A well understood and additional advantage of DRWH is that it can provide a much higher service level than a distant source by being available within the home. However, given the relatively high current per capita cost of DRWH compared to other technologies (i.e. shallow wells, springs and boreholes) DRWH is not an attractive option if it is fully, or even 50% subsidised by Government. In order for DRWH to be financially viable to Government in improving water supplies, strategic investments have to made which leverage finance from water users themselves.

In the six year period between 2002/3 and 2007/8 approximately US$ 4.5 million was spent by District Local Governments on the construction of rainwater harvesting facilities (Ministry of Water and Environment, 2008b). This represents about 7% of the DWSGC expenditure (Figure 10). Prior to 2007/8 expenditure was mainly for schools, institutions and communities (Figure 2.8) as well as homes for training purposes. From 2007/8 onwards the emphasis has been on domestic rather than institutional or community facilities.

Figure 2.7 shows projections for future rural water supply coverage in Uganda based on four different scenarios (using existing MWE assumptions of $10m^3$ of storage serving three people and UBOS population projections). Rural water supply financing has been projected from MWE FY 2008/9 figures increasing annually at 7%. Per capita investment costs have been projected from MWE 2008/9 to 20014/15 targets, subsequently increasing annually by 5% respectively. This is likely to be a low estimate because per capita investment costs actually increased more than this over the past three fiscal years (13%, 9% and 16%).

The base scenario assumes negligible household investment in DRWH, i.e. continuation of the status quo. Scenarios 2, 3 and 4 are based on assumptions of different levels of household investment in a growing market for DRWH (growing at 75%, 150% and 175% per annum from an initial investment of US$ 90,000 in 2009). Facilities are assumed to cost US$ 100 for $1m^3$ of storage from 2009 to 2012, rising at 5% per year from 2013 onwards.

Figure 2.7 shows that in the base scenario, Government investments in conventional technologies are only just able to keep up with population growth. In scenarios 3 and 4 DRWH only makes a significant impact on coverage from 2017. At this point the annual household investment in DRWH is projected to be US$ 137 million and US$294 million respectively., equivalent to 0.34% and 0.74% of a the 2004 Gross Domestic Product of US$ 40 billion. There clearly needs to be a massive increase in household investment in DRWH to make a significant impact on coverage, but this is limited by the poverty of the country.

Figure 2.7 Projected % Access to Safe Water in Rural Areas for Four Scenarios (details given above).

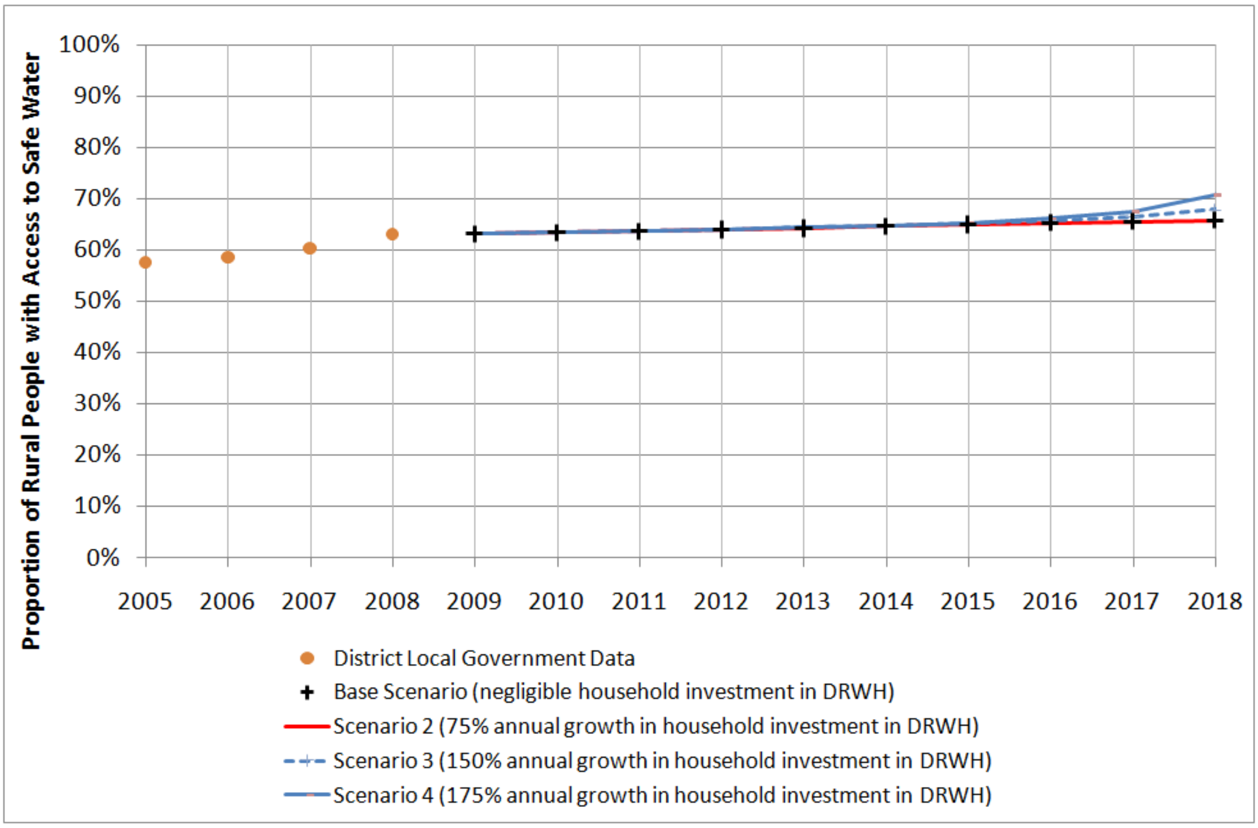


Figure 2.8 Community Rainwater Harvesting Facility in Masaka District

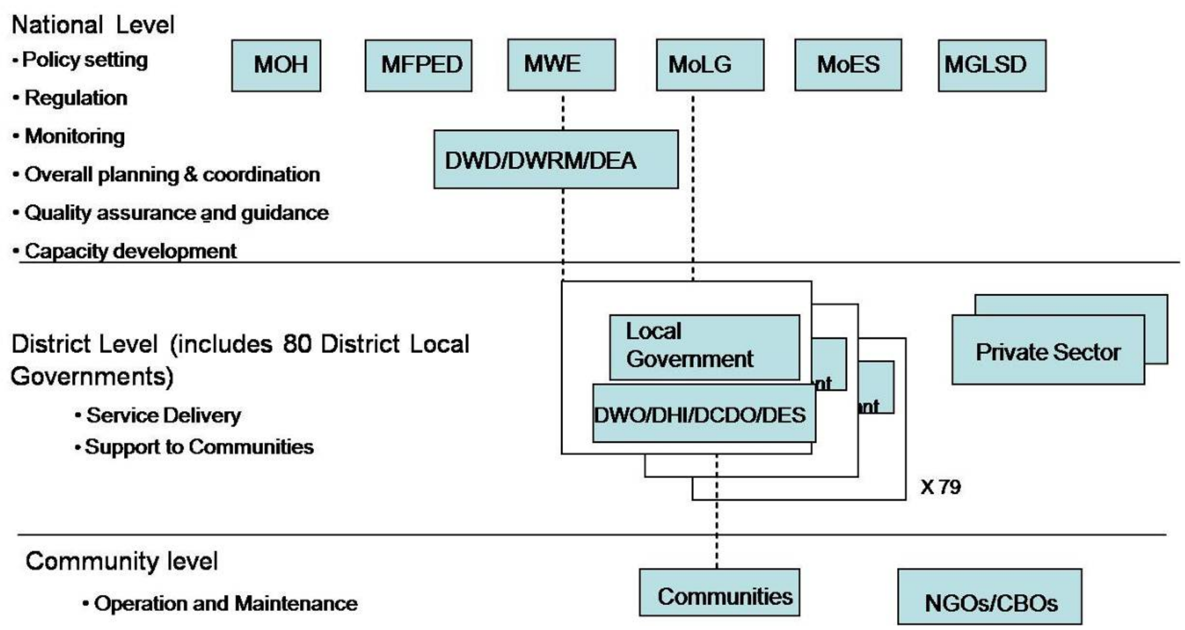
The acting commissioner for rural water supply and sanitation is extremely positive regarding household financed DRWH as a mechanism for increasing access to improved water supplies in Uganda. He could see no policy issue or hindrance to an approach which involves the private sector selling DRWH facilities to consumers. Discussions held with other key informants at MWE and the development partners also showed a considerable enthusiasm for such an approach. The only concern, raised by one development partner, was whether such an approach would really be able to raise access for the poorest of the poor.

2.2.3 Water Supply Programmes and Initiatives

In September 2002, the water and sanitation sector adopted a sector-wide approach (SWAP) framework, whereby Government, civil society and development partners support a single policy, development plan and expenditure programme which is under Government leadership and follows a common approach. There is thus less emphasis on donor-specific project funding and more on general budget support in the sector. Rural Water Supply and Sanitation is the most advanced sub-sector in terms of SWAP implementation. Funds, in the form of a District Water and Sanitation Conditional Grant (DWSCG) are channelled through the Ministry of Finance, Planning and Economic Development to District Local Governments, who are responsible for implementation in line with annual guidelines issued by MWE.

Figure 2.9 provides an overview of the institutional framework for the water and sanitation sector. The Ministry of Water and Environment (MWE) sets Government policies and undertakes regulation, monitoring, overall planning and coordination, capacity development as well as undertaking quality assurance and providing guidance to sector stakeholders. District local government and private operators provide services to communities. NGOs provide services to communities in the form of physical and social infrastructure development. The Water and Environmental Sector Working Group (WESWG), which is chaired by MWE and included donor as well as NGO representation provides policy and technical guidance playing a central role in influencing the perspectives, positions and practices of government, donors and NGOs involved in the water sub-sector and DRWH specifically.

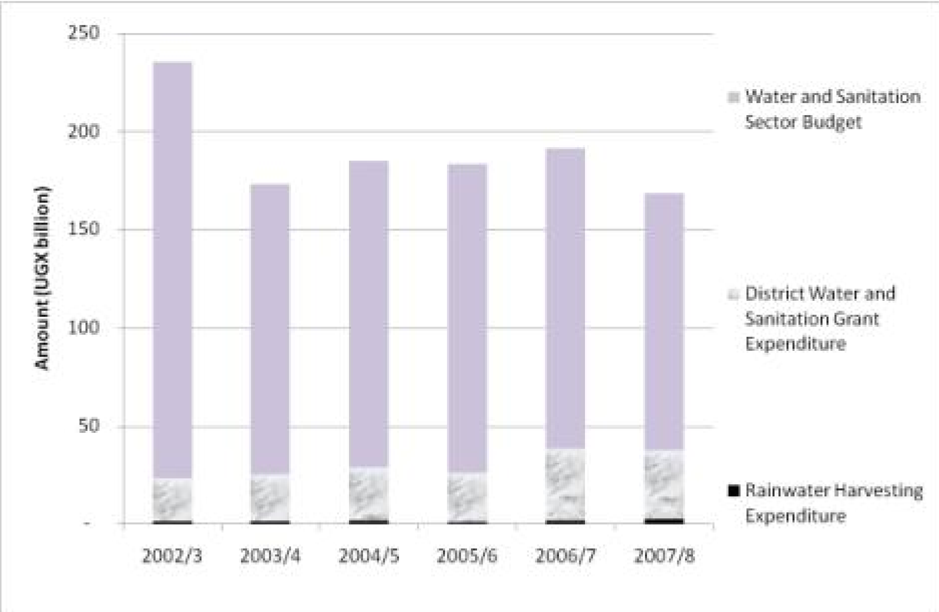
Figure 2.9 Water and Sanitation Sector Institutional Framework



The DWSCG is administered by the 79 District Local Governments, who respond to requests from communities for improved water supply facilities. Each District Local Government (through the District Water Office) has the responsibility of mobilising communities and training water user committees on water source management as well as operation and maintenance. Construction of facilities (drilled wells, hand dug wells, protected springs and piped water supplies) is contracted out to the private sector, which competes for work through a competitive tendering process. In the case of DRWH facilities, responsibility is handed down to the next level of local Government, the sub-county, which contracts out the work to local companies, artisans and women's groups.

Figure 2.10 shows the total water and sanitation sector budget over the last six financial years, as well as expenditure through the DWSCG and on rainwater harvesting in particular. In FY 2007/8, UGX 35 billion (US$ 20.6 million[5]) of Government and donor funding for rural water supply and sanitation was channelled though the DWSCG (MWE, 2008). Of this, UGX 25.5 billion (US$ 15 million) was spent on infrastructure. A total of 7% of the DWSCG supported DRWH in the manner set out in 2.3.2.

Figure 2.10 Water and Sanitation Sector Budget and DWSCG and DRWH Expenditure (MWE, 2008)



In addition to the investments set out in Figure 2.10, there are approximately 200 NGOs and CBOs undertaking work in the sector, mainly in rural areas. The 2008 Sector Performance Report states that out of these 200, a total of 62 NGOs and CBOs reported that they invested UGX 5.8 billion in water supplies between January and December 2007. Further, 28 out of 50 members of the WASH cluster reported that they spent UGX 30 billion in FY 2007/8.

Currently, there is no comprehensive data available on private investment in improving water supplies in rural or urban settings. However, a study carried out in 2005 (Carter, 2006) found numerous examples of local-level or private initiatives to improve or construct new water supplies using their own financial and human resources, referred to as self-supply. In response to this study, MWE commissioned two pilot projects in East and Northeast Uganda to learn more about households and communities could be encouraged to improve their own water supplies, covering the majority of the cost themselves. Following the success of the pilot projects, efforts by MWE to

[5] At an exchange rate of US$1 = 1700.

sensitise District Water Office staff and NGOs about the concept of self supply are underway. A stakeholder workshop was held in Mbale on 5th February 2008 in this regard. The participants who attended prepared action plans to raise further awareness among District stakeholders and to commence with baseline surveys of existing self-supply facilities. Section 4.4.3 provides an overview of the household investment in DRWH that was observed by the study team.

2.2.4 Competition from Rainwater Harvesting

In rural areas, there is no doubt that DRWH would complement existing improved and non-improved supplies rather than compete with them. Even where piped water supplies exist, they do not provide water at the majority of people's homes.

There has been considerable investment into improving urban water supplies through the construction of piped water systems. Clearly it is in the interest of the National Water and Sewerage Corporation as well as the Water Authorities that households connect to these facilities and pay for their water. However discussions with the Water Authorities Division in MWE suggested that DRWH storage facilities (e.g. tanks) may provide a mechanism for improving the reliability of water supplies, particularly for people connected to a network with irregular supplies. DRWH could be perceived as competing with piped supplies, although concerns about excessive flooding in urban areas have set people thinking about encouraging people to collect the rain and thus reduce runoff.

2.2.5 Incidence of Diarrhoea

Increasing access to safe water supply is intended to result in improved health outcomes in the form of reduced cases of water-borne diseases such as dysentery and cholera (UBOS, 2006). As noted in section 2.2.2, access to safe water in Uganda has stagnated for the last 7 years. In line with this, there has been no significant change in the incidence of diarrhoea[6] among children under-five in Uganda. In surveys carried out in 2003/4 and 2005/6; in 2005/6, 26% of all children under five had diarrhoea while 6% had diarrhoea with blood (UBOS 2003, UBOS 2006).

The National Demographic and Health Survey (UDHS) showed that a total of 25.2% of under-fives who used an **improved** source as their main source of drinking water had diarrhoea whereas the equivalent for those **without an improved** source was 26.7% (a difference of only 1.5 percentage points). Diarrhoea is more common among children who live in households with a non-improved toilet facility (26.2%) than among children who live in households with improved, not shared facilities (21.1%). This suggests that improved sanitation has a more significant impact on reducing the incidence of diarrhoea than improved water supplies. The extent to which DRWH facilities have an impact on the reduction of diarrhoea is not an area which has been extensively researched. However, the above findings would suggest that good sanitation and hygiene practices would be required in conjunction with DRWH to have a significant impact on reducing the incidence of diarrhoea.

[6] i.e. Percentage of children under five years who were sick with diarrhoea in the two weeks preceding the survey.

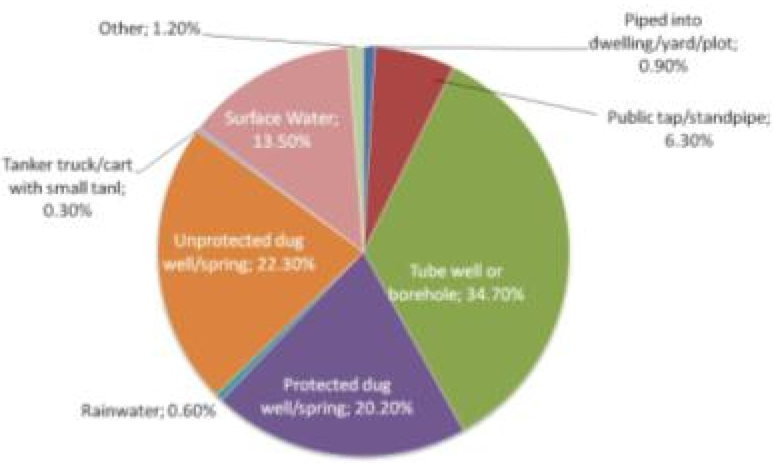
3 Household Water Supply Options and Usage Practices

3.1 Water Supply Options

Figure 2.6 presents MWE and UBOS data on access to improved water supplies. The MWE data is based on an assumed number of users for the infrastructure in place (based on District Local Government Reports). UBOS data is based on household surveys[7].

The UDHS (UBOS, 2006), which is the most recent survey data, states that: 63% of rural households (representing 64% of the rural population) use an improved water source their drinking water. Figure 3.1 presets the breakdown of this data, and shows that tube wells and protected dug wells and springs provide 55% of Ugandan rural households with drinking water. There are seasonal differences in water consumption patterns. Throughout the country some springs and shallow wells run dry during certain parts of the year. This results in people walking further to collect their water, or make more use of all year round traditional water supplies. During the rainy season, there are cases of springs and shallow wells that become contaminated.

Figure 3.1 Distribution of Rural Households by Drinking Water (UBOS, 2006)



The UDHS also found that the 67% of rural households take more than 30 minutes to make a round trip to and from the drinking water source. Only 2.2% have drinking water available on their premises. The earlier Uganda National Household Survey (2005/6) raised concerns that the quality of water from an improved source, when it is finally consumed is frequently diminished as a result of poor hygiene practices in maintaining a safe water chain. According to the UNHS (2005/6), a total of 72% of households have their main sources of drinking water within a kilometre from the dwelling while for 28% of households it is situated 1 to 5km away. In 68% of households, it is the adult females who usually collect drinking water (UDHS, 2006).

3.2 Water Supply Use

Research in Amuria District (Alford, 2007) found that where water holes or open springs exist, they tend to be used for washing, watering animals, making bricks and sometimes cooking. Drinking water is collected from distant boreholes, except in cases where this distance is too great, or the borehole breaks down when they will tend to resort to the traditional sources for all of their water

[7] Uganda National Household Survey (UNHS); Uganda Demographic Health surveys (UDHS);Uganda National Service Delivery Survey (UDHS)

consumption. Observations made during this study showed that people often use a variety of water sources.

The UDHS found that only 1.6% of the urban population and a negligible proportion of the rural population drink bottled water.

3.3 Community Perceptions

Interviews with key informants during the study suggest that consumers prioritise a source based upon convenience (in terms of close proximity) and reliability more than considerations of whether the source is "safe" (i.e. improved). Table 6.1 (section 6.3) provides a more detailed discussion with respect to consumer preference.

However, it is important to note that user perceptions of the importance of water quality or distance vary. Attitudes will be influenced by the extent to which they have heard and internalised messages about public health, as well as just how poor the water quality is at a particular source. For example research in Bugiri District (Tillet, 2007) found that water quality was cited as a problem in 90% of the interviews held at 34 water sources (i.e. 'yellowing' of the source water following rainfall and soil erosion and bad smell and taste). Interviewees stated concerns about water being open to contamination. 65% of interviewees identified the water source as impacting on their own, or their family's health.

The Self-Supply Study (Carter, 2005) proposed "*a new way of conceptualising water supply services that recognises a spectrum from unimproved traditional sources through to a full in-home on-demand service. This approach scores any individual source on a scale of 0 (poor), 1 (medium) or 2 (good) against each of five characteristics:* ***access, water quality, reliability, cost and management.*** *In this way a source can score anything from 0 to 10*". It is likely that this scoring mechanism will be a key component of baseline surveys to be carried out on traditional water supplies.

Improved community sources are communally managed by a water and sanitation committee comprising five to seven members. They are elected (or selected) by the community, and are responsible for operation and maintenance of the facility. Despite the establishment of an operation and maintenance framework for rural water supplies, poor functionality still remains a problem, with an estimated 18% of improved water sources not functional. In recognition of this problem, MWE is currently in the process of trying to identify improved measures to raise functionality rates.

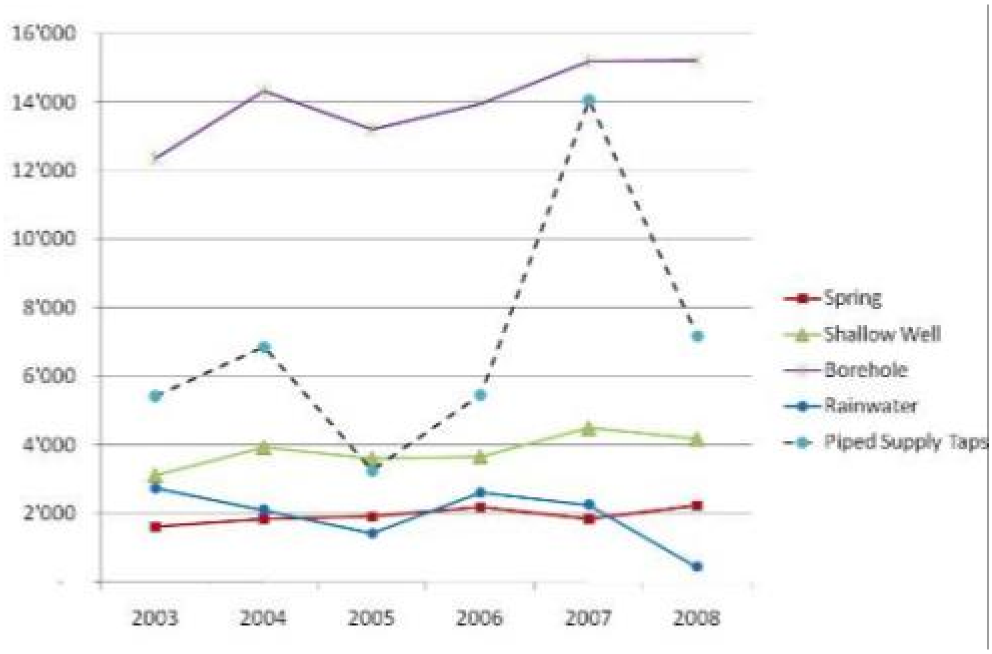
Professionals in Uganda widely believe that DRWH facilities would provide an alternative water supply option which would be maintained by users, as they would actually own the facilities and would not need complex community management structures.

Interviews and observations undertaken during this study, as well as previous work in Uganda suggests that people with DRWH storage facilities above a certain size (say $0.5m^3$) will tend to freely share the water with their friends and neighbours during the rainy season, but will be more restrictive in the dry season. It is common to see padlocks on built in place facilities of $1.5m^3$ and above. In some cases, people even sell their water. The study found three cases (two rural; one in very small trading centre) of people selling rainwater stored in plastic lined tanks (at UGX 200 and UGX 300 per jerry can).

3.4 Payment and Willingness to Pay

Figure 3.2 sets out the average real[8] unit costs for different improved water supply technologies (2003 base year) as provided through the DWSCG. There was a significant change with respect to rainwater over the last year. In FY 2007/8, water users at household level contributed 40% of the total cost of the DRWH system, hence the fall in the unit cost paid by Government. Unit cost of taps varies widely due to anomalies in reporting (multi-year construction). Although DRWH has a relatively low unit cost compared to shallow wells, taps and boreholes, the per capita cost is considered to be high. A DRWH unit of up to 10m^3 is only counted as serving up to 6 people, whereas the other sources are considered as serving 150 to 300 people. DRWH provides a higher service level in terms of a shorter distance to the source than a spring or handpump supply. However this is not factored in when calculating per capita cost as emphasis is placed on the provision of 20 litres of water from a safe source. MWE thus takes the worst case scenario that the DRWH facility has to be able to provide 20 litres/person/day for a ninety day dry period. Thus a 10m^3 tank is considered to serve no more than six people. The reality is that such a facility can provide 5 litres/person/day of drinking water for 22 people for 90 days, or more in the rainy season.

Figure 3.2 Average Real Unit Costs for Technology Options ('000 UGX)



Government policy demands that water users contribute cash towards the construction of improved community water supplies. The amount is specified in the Water and Sanitation Sector Schedules (Table 3.1). In reality, consultations with District Local Governments by MWE have shown that these are not always made. As the grant is often released late, District Government can be hard pressed to mobilise communities and ensure that the contributions are made prior to construction. It is not uncommon for politicians to undermine efforts to collect contributions by informing them that water is free, or that the politician is bringing them water. Although NGOs have been made aware of this

[8] i.e. costs discounted for inflation, with 2002/3 as the base year.

requirement (through UWASNET as well as the District Water and Sanitation Coordination Committees), there appears to still be considerable variation in approach.

Table 3.1 Amount of funds to be contributed by the community (Ministry of Water and Environment, 2008c)

Type of Technology	Community Cash Contribution per Source (UGX)
Springs.	
Small.	**45,000**
Medium.	**45,000**
Ex- Large	**100,000**
Deep borehole	**200,000**
Shallow well (motor drilled/hand augured/hand dug)	**100,000**
Borehole rehabilitation	**90,000**
Gravity Flow Scheme	**45,000 per tap.**
Valley Tanks and Dams	**Not specified - Determined by situation.**

In the rural context, water users are expected to raise funds for the operation and maintenance of their improved water supplies. This can be through a monthly or annual fee, ad hoc collection when a problem arises, or payment according to the amount of water consumed. The amounts collected vary considerably.

In the urban context, the NWSC tariffs for a public standpipe and domestic connection are 748 UGX/m^3 and UGX 1,213 UGX/m^3 respectively. There is some variation in the tariffs for the piped water in small towns (appears to range 100 UGX/m^3 to over 2,000 UGX/m^3)[9]. However, only 31 out of 69 small towns were able to recover their operating costs from revenue (MWE, 2008).

The reality is, however, that the urban poor (who either buy the water at the standpipe or another vendor) pay significantly more than this. Prices are known to range from UGX 25 to UGX 300 per jerry can (1,250 UGX/m^3 to 15,000 UGX/m^3).

Household consumers can, and do pay for reliable, high quality DRWH-based water supplies where there is a cash economy, if families are above a certain income level and prioritise DRWH. Section 4.3.3 provides examples of this from the field work.

[9] As calculated from MWE (2008b) – dividing the total bills (UGX) by the total volume of water sold (m^3).

4 The Domestic Rainwater Harvesting Subsector

4.1 History

Tapping rainwater with banana stems and diverting it into containers has a long tradition in Uganda. It was during the colonial period that larger storage systems (cisterns and reservoirs) were constructed and used, particularly at administrative buildings. In the mid 1980's Government and NGOs started to promote institutional rainwater facilities (Figure 2.8) at schools and health centres in areas where other technologies had failed. Institutional rainwater harvesting (particularly at schools) was promoted in the North of Uganda from 1997. Rainwater harvesting tanks (brick, ferrocement and plastic) were provided and the institutions were left to provide the gutters. Unfortunately many never did, and numerous facilities were simply not utilised. Out of 40 tanks surveyed in Gulu, Amuru and Oyam Districts 2006, only three were functional (AAH, 2006). The most common problems resulted from poor technical design and poor capacity (or willingness) of the institutions to maintain the systems. In some cases, the container volumes were so small (e.g. 10m3) that they could not possibly serve the entire school.

With recognition of the difficulties involved with management of these communal and institutional facilities, increasingly emphasis was placed on the promotion of rainwater harvesting at household level. In the late 1990's, a women's group in Rakai was the first to be trained in the construction of DRWH tanks, following an inspirational visit to Kenya, where DRWH was more advanced than in Uganda at the time. In the mid 1990s Kigezi Diocese Water and Sanitation Programme introduced DRWH. ACORD (Agency for Cooperation and Research in Development) in Mbarara also began promoting DRWH around the same time. Other NGOs have subsequently also become involved in the promotion of DRWH throughout the country (Table 4.1).

As part of the rural water supply and sanitation sub-reform study of 2003/4, Government prepared a strategy for rainwater harvesting in the country. The two key recommendations were to build research and development capacity for low cost technologies and to develop a suitable "*delivery mode for rainwater harvesting services*". Delivery modes were categorised into two:

(i) NGO mode - promotion and community capacity building;
(ii) Private sector mode – enterprise development around rainwater harvesting service delivery. (Obote, 2008).

As part of their commitment to DRWH, MWE has supported pilot projects through NGOs in five Districts (Kabale, Mbarara/Isingiro, Bushenyi and Kamuli) through the Joint Partnership Fund (JPF). It has also invested in the construction of the *Appropriate Technology Reference and Development Centre i*n Mukono District. The centre, which is not yet operational, is intended to demonstrate existing technologies as well as undertake research and further development of DRWH.

As discussed in section 2.2.2, District Local Governments have invested some US$ 4.5 million in rainwater harvesting (institutional, community and domestic) over the last six years. The Districts of

Rakai and Isingiro are among those that have included rainwater harvesting in their development plans, targeting the particularly water-stressed areas with very low safe water coverage. Whereas Rakai has focused on community rainwater facilities, Isingiro has targeted domestic facilities at household level. Masaka District plans to support DRWH in Kyazanga and Ndagwe sub-counties by contracting artisans trained under a previous programme.

Increasingly, NGOs (such as Kigezi Diocese Water and Sanitation Programme, URWA and ACORD Mbarara) have been training artisans and women's groups to construct built-in-place DRWH facilities (jars, ferrocement tanks and brick tanks). In most cases, some demonstration facilities have been constructed, with the concept that the trained artisans and women will continue to construct more facilities afterwards, with finance leveraged from householders themselves. In 2008, Kigezi Diocese Water and Sanitation Programme opened a rainwater harvesting training centre, which, to date has trained 82 masons in the eight districts of Southwest Uganda.

AfDB has also increased its interest in DRHW, supporting NGO implemented projects, a study on rainwater harvesting in Uganda (see Obote, 2008) and workshop to exchange best practices. Currently, MWE is in the process of preparing a new strategy for rainwater harvesting in Uganda. This is clearly a growing area of interest in the country.

4.2 Current Use of Domestic Rainwater Harvesting

MWE included rainwater harvesting facilities in calculating access to improved water supplies in financial year 2005/6 (SPR 2006). According to MWE, 0.09% of the population were estimated to use rainwater harvesting as an improved water supply in 2008. Currently, MWE assumes that a tank of less than $10m^3$ tank serves 3 people with 20 l/p/d all year round (given a three-month period without any rainfall) and that a tank greater than $10m^3$ in capacity served 6 people (MWE, 2008). The estimation method has been simplified in line with current Government reporting formats and is likely to provide a very conservative approximation. In addition, District Local Government data does not always include rainwater facilities installed by other organisations (such as NGOs), or by households themselves, further underestimating the use of rainwater harvesting.

The UDHS (UBOS, 2006) found that 0.6% of the population use rainwater as their source of drinking water (Figure 3.1). This figure for rainwater usage is six times higher than the comparable figure by MWE (Figure 2.4). However, the UDHS focuses on drinking water only rather than sole source supply, which allows for a DRWH facility to serve more people.

Opportunistic collection of rainwater during the rains takes place in many, if not most homes with a metal roof (e.g. Figure 4.5), with water being diverted into whatever containers are available. Observations in Kapchorwa, Masaka, Mbarara and Isongiro Districts show that countless households are practicing some form of domestic rainwater harvesting. These initiatives include a stick guiding roofwater into a jerry can or pot; small iron gutters supported by sticks delivering water to containers of various sizes (Figure 6.1); short gutters on roofs and even below-ground, plastic lined tanks (Figure 4.6 and Figure 4.7). The 2004 Uganda National Service Delivery Survey (UBOS, 2004) noted a very sharp increase in the percetage of households using rainwater as the main source of drinking water in the wet season (rural 18.4%; urban 13.2%) compared to the dry season (rural 0.5%; urban 0.3%). This shows the significance of DRWH as a seasonal water source.

Obote (2008) states that 98% of households in Muko and 72% in Rubaya sub-counties (Kabale District) were practicing some form of DRWH in 2006.

The use of DRWH as a sole source or to complement other sources is a function of the volume of the DRWH storage facility (and the size of the family). Where storage is small, owners have no option but to complement it with water from other sources. In the case of very large tanks (e.g. $10m^3$ and above), people use the water for most of their domestic needs and even manage to water animals or use limited amounts on crops, seedlings or for pesticide application. There appears to be considerable variety in how rainwater is used; e.g. one woman in Kapchorwa explained that she uses the protected spring for drinking and rainwater (collected in a 100 litre drum) for washing. Another woman in Isingiro explained that she uses her DRWH for drinking water and collects water from a nearby spring for her other needs.

4.3 Domestic Rainwater Harvesting Players and Programmes

It is estimated that there are somewhere in the order of 50 organisations which are actively involved in the promotion and construction of DRWH facilities. A description of the involvement of selected key organisations is given in Table 4.1 and Figure 4.2.

Table 4.1 Summary of organisations involved in the promotion of DRWH in Uganda

Organisation	Description
ACORD Mbarara	ACORD Mbarara has been promoting DRWH since the mid 1990s (through Masons and Women's groups) and the authors estimate that they have directly supported the construction of a several hundred of facilities.
Busoga Trust	
CIDI	CIDI are undertaking DRWH projects in Kampala and Rakai.
Crest Tanks	Private company which sells roto-moulded tanks in Uganda.
District Local Governments	Use of the DWSCG to contract private companies and artisans to construct subsidised facilities for demonstration purpose.
Jesse	Jesse (based in Fort Portal) is currently implementing a DRWH project in Bugiri District in partnership with NETWAS (funded by the African Water Facility).
Kigezi Diocese Water & Sanitation Programme (KDWSP)	Promotion of DRWH since the mid 1990s. To date an estimate 9,000 jars and 802 FC tanks have been constructed, mainly in Kabale District.
Kyera Farm	DRWH research and development project was based at Kyera farm in about 2002. Demonstration 13000-litre partially below ground tanks with a simple and pump were constructed, and masons were trained. The current status of DRWH activities from the farm is not known.
Ministry of Water and Environment (MWE)	Appropriate Technology Reference and Development Centre (will include research on low-cost technology) is planned. Land has been bought and buildings put up in Mukono District but centre not yet running.
Netwas	Netwas are currently implementing a DRWH project (funded by the African Development Bank through the African Water Facility). Work is in Kyenjojo, Bugiri and Rakai and includes partnership with the NGOs UMURDA and Jesse.
Rakai Association of Women's Groups	Association of Women's groups undertaking DRWH in Rakai District.
SNV	SNV, provides technical assistance to Government and NGOs in Western Uganda and West Nile. They have trained groups in rainwater harvesting construction (through URWA). SNV are currently encouraging landlords in Arua to construct DRWH facilities on their properties to make them more attractive for rental. They are in discussion with the town council in Koboko regarding private investment in rainwater facilities on the building and sale of the water.
TWAN	Association of Women's self-help groups in Kabale District. Received support for the construction of over 200 DRWH facilities (ferrocement tanks) over a five year period.
Uganda Rainwater Harvesting Association (URWA)	URWA is a membership organisation, with 134 members (individuals, suppliers, NGOs and CBOs). Their mandate is to promote DRWH for domestic use (involvement with water for productive is very limited). URWA has undertaken project implementation (World Bank Development Marketplace funding to develop enterprises in Masaka and Rakai) and has a history of working with women's groups throughout (e.g. Rakai, Kabale, Mbale and Isingiro). URWA plans to have completed its new strategic plan by early March.
UMURDA	UMURDA are currently implementing a DRWH project in Bugiri District partnership with NETWAS (funded by the African Water Facility). Artisans and women's groups construct.
UNICEF	Supply of Crestanks to schools in northern Uganda. Construction of tanks....70% not working. Plastic tanks??
Wera Development Association (WEDA)	WEDA are implementing DRWH projects with WaterAid and Semavi funds. WEDA are planning to set up a DRWH training centre in Amuria District.
WaterAid	Have recently started to invest funds into DRWH.

Figure 4.2 Map of Known Current DRWH Promotion in Uganda by NGOs and the Private Sector

Arua – NGO DRWH project

Kyenjojo - NGO DRWH project

Mbarara – Masons constructing plastic lined tanks; women constructing FC tanks. Masons constructing jars. NGO DRWH projects.

Bushenyi – Masons & women groups constructing FC tanks. . NGO DRWH projects.

Isingiro – Masons constructing partially below ground tanks; women constructing FC tanks. . NGO DRWH projects.

Kisoro – women's groups constructing FC tanks (Govt and Private Funded)

Kabale –Masons and women constructing FC in tanks and jars. DRWH training centre. . NGO DRWH projects.

Masaka and Rakai – Masons constructing partially below ground tanks; women constructing FC tanks

Amuria – NGO DRWH project

Kamuli – NGO DRWH project

Kapchorwa – NGO DRWH project

Bugiri - NGO DRWH project

Masaka and Rakai – Masons constructing plastic lined tanks;; women constructing FC tanks

4.4 How Consumers Participate in DRWH

4.4.1 Government Programmes

Domestic Roofwater Harvesting is being promoted by District Local Governments (DLGs), using funds from the District Water and Sanitation Conditional Grant (DWSCG). However, MWE faces a question with respect to the use of public resources to finance individuals to improve their own water supplies. The current mechanism allows DLGs to subsidise DRWH facilities by up to 40% for individual households. In general, ferro-cement tanks of volume $4m^3$ and above are being constructed. Figure 4.3 shows a DRWH facility built in Bushenyi District. The DWSCG paid UGX 500,000 (US$ 250) towards the construction cost. Development partners and some within MWE are raising concerns with respect to the high per-capita investment cost of this technology relative to other sources as well as whether the beneficiaries are actually in need of the subsidy. A case in point is the home in Figure 4.3, which suggests a family who could well afford to pay for the full cost of this facility.

Figure 4.3 DRWH Facility Constructed with Support from the DWSCG in Bushenyi District Local Government

Attitudes regarding the extent to which water users are able to pay for DRWH facilities vary enormously. One District Chairman will inform you that the "*people are too poor*", while another will explain that the constituents could do much for themselves "*if only they knew how*". One key issue to bear in mind is that both local and national politicians use the promise of free water to leverage support from their constituents.

4.4.2 NGO Programmes

Most of the NGO programmes which have included DRWH started as give-away programmes with facilities either entirely financed by the NGO, or with a small token contribution from the beneficiaries. Kigezi Diocese Water and Sanitation Programme for example provided 420 litre rainwater jars for the "poor and needy" in the steep hills of Kabale for many years. Kaproron Primary Health Care in Kabale District is subsidising 4m^3 tanks at 50% of the construction cost, and 1.5m^3 jars (Figure 4.4) at 95%. URWA's rainwater harvesting project involved in the construction of 820 DRWH facilities with a 30% subsidy, and about 320 tanks at a subsidy of less than 30%.

Figure 4.4 DRWH Jar Constructed by NGO in Kapchorwa District

Over time, NGOs have started to realise the potential to leverage investment from customers (rather than beneficiaries) and there have been several initiatives to train women's groups, who initially obtain support with demonstration facilities from the NGO before building more facilities for themselves at full cost over subsequent months and years. A women's group of 20 to 70 people would typically initially receive five to ten demonstration tanks from the NGO.

There are increasingly more initiatives whereby NGOs train artisans, give them work for a number of tanks and then expect them to find work for themselves. There appears to be an increasing acknowledgement among the organisations consulted that private financed, private constructed DRWH is the future. However, this is tempered by a strong belief that many customers will still not be able to afford to pay for the facilities.

4.4.3 Privately Financed

The field visits undertaken for this study focused almost entirely on seeking out examples of fully privately financed DRWH. This section draws primarily on the findings from these visits, which were particularly encouraging, even if they did highlight some of the weaknesses with the current NGO and Government approaches.

From Kapchora in the east to Kabale in the west, most rural dwellers seem to collect rain when they can, even if it is only stored in a small container such as a jetty can, pot, or small drum such as shown in Figure 4.5.

Figure 4.5 Collection of Rainwater in a 100 litre drum in Kapchorwa

In Bigasa Sub-County in Masaka Districts, two masons have constructed about 200 plastic lined pits which hold rainwater collected either as surface runoff or from the roof (Figure 4.6). Olive Nyakazi even managed to raise UGX 3 million for the construction of such a facility in Kigangazi trading centre, which she uses to generate income by selling water at UGX 300 per 20-litre jerry can (Figure 4.7).

Figure 4.6 Plastic lined Pit

Figure 4.7 Commercial Rainwater Harvesting Facility in Kigangazi Trading Centre, Masaka District


Interviews with householders and masons in Kabishah Parish, Masha Sub-county, Isingiro District revealed that about 50 masons have constructed up to 1,000 partially below ground rainwater tanks (Figure 4.8) in the area over the last few years. Payment is by households themselves. This technology was introduced as part of a research project in 2002.

Figure 4.8 Partially below ground tanks in Isingiro District

In Bushenyi, where two women have been trained in DRWH construction at the training centre in Kabale, the ten demonstration tanks (government subsidised) have already been followed by the construction of three more privately funded facilities, with many more on the order books. Unfortunately only one type of facility (the ferrocement tank) has been demonstrated in the District.

Joweria Murezi and her colleague can actually construct a range of different facilities but the people in the area are not aware of them.

In Kabale, the District with the steadiest investments in DRWH, people living in the steep hills of Muko sub-county are paying for their own facilities. Figure 4.9 shows a woman who is in the process of upgrading from her clay pot to a 420 litre cement jar, at her own cost. Stephen, the mason undertaking the work, and the other trained mason in the parish have apparently constructed over 300 jars over the last few years.

Figure 4.9 Upgrading from a Clay Pot to a Ferrocement Jar in Kabale District

Discussions with a women's group further up the road in Muko, Kabale revealed that since their training, not only have they constructed brick masonry and ferrocement tanks subsidised by Kigezi Diocese Water and Sanitation Programme but also 150 private tanks such as the one in Figure 4.10. The women informed us that they have also trained another women's group in Kisoro District, who have subsequently constructed 20 tanks with subsidies from the District Local Government, and another 32 fully private facilities.

Figure 4.10 Facilities upgraded from a 420 litre jar to a 4m3 tank in Muko, Kabale District

4.5 Enabling Conditions for Domestic Rainwater Harvesting

Over the last 15 years in Uganda, domestic rainwater harvesting has been receiving increased recognition in Uganda. It is perceived as a viable option for improving water supplies by many sector professionals in Government and the NGOs, as well as politicians and development partners. In line with this, more and more organisations are financing the construction of rainwater harvesting infrastructure at household level as well as undertaking promotion efforts.

As already stated in section 2.1, rainfall in most of Uganda is ideal for DRWH, with dry spells lasting only two (to a maximum of four) months, and rainfall more than adequate at over 1,200 mm per year in 2/3 of the country. There has been an increase in use of iron sheets in rural areas from 52% to 59% to 60% from 1999/00 to 2002/3 to 2005/6, respectively (UNHS - UBOS, 2003; UBOS, 2006). The percentage of the population occupied their own houses remained steady at 78% between 2002/3 and 2005/6. National surveys do not measure roof sizes. Thomas et al (2004) who undertook a survey of 49 households in the two districts of Mbarara and Gulu found that roof sizes ranged from $7m^2$ to $120m^2$ with an average of $48m^2$ but that 34% of the hard roofs were less than $30m^2$. A survey in Rubaya and Muko sub-countries of Kabale in 2006 found that the all roofs were tin, with average roof sizes of $39m^2$ and $50m^2$ respectively (Obote, 2008). Observations undertaken during the field work found that roof sizes varied considerably, from less than $10m^2$ to the homes of the wealthy at more than $80m^2$.

Given the enthusiasm of professionals and water users in DRWH, ideal rainfall patterns, 60% galvanised iron roofs and high levels of home ownership in rural areas; and as more rural dwellers become aware of the technology options, and more skills are available, uptake of DRWH will continue to grow in Uganda. However, more strategic interventions by Government NGOs, and the private sector as discussed in chapter 9 could accelerate this growth considerably.

5 DRWH products currently available in the locations visited

5.1 Definition of a DRWH storage product:

For this assignment, a DRWH storage product is defined as any container that is used by a rural (and typically a farming) household for the direct purpose of containing rain water. This assignment is NOT concerned about the devices used to capture rainwater and direct it into a DRWH storage container. This investigation considered two types of potential domestic rainwater storage products of interest to EWV: a low-cost manufactured storage container of 500 to 1500 litres capacity and a built-in-place option of 1500 litres and larger capacity.

At the household level rainwater may be captured from two sources, corrugated iron sheet roofs and rain water flowing across the ground ('ground-flow'). This assignment focuses on DRWH and storage from metal roofs, the quality of water sourced from such surfaces being closer to matching the 'water safe for human consumption' policy standard set by various stakeholders and of interest to EWV.[10]

Field work revealed that rural farming households may consider untreated rain water harvested from ground-flow or from a roof and directed into a below ground or partly below ground storage facility to be of high enough quality to be consumed.[11] This reflects a common consumer perspective that: ***CONVENIENT ACCESS to a LARGE QUANTITY of water for multi-purpose use is a higher priority than the QUALITY of that water for human consumption purposes.***

The physical attributes of the water source and/or of the rainwater storage products used by rural households may not be of a sufficiently high standard to satisfy the 'water safe for human consumption' policy standard. But, since such solutions may well be quite satisfactory solutions in the eyes of consumers, such alternatives must be regarded as potential 'product substitutes' for other rainwater storage product options that do satisfy this policy standard. This potential 'substitute-ability' may be important factor that influences consumers' willingness to invest in rainwater storage products that meet the policy standard. This issue is discussed further in section 6.4.

5.2 The range of rainwater storage products in Uganda

Table 5.1 lists rainwater storage products found to be in use or for sale in the field locations visited or indicated by the manufacturer as being available for distribution to these locations. Given the

[10] Stakeholders: Government of Uganda Department of Water and Environment; influential multilateral bodies such as the World Bank' bilateral donor agencies that fund water sector activities; international and national NGOs who follow the direction set by the aforementioned.

11 e.g.: the quality of such water is, from their point of view, as either equivalent to or better than water available from other common sources OR is of adequate quality (poses minimal health risk) in relation to other, more highly valued attributes (such as convenience, labour effort and time).

product substitution concern raised above, Table 5.1 includes both ‘policy compliant’ and ‘policy non-compliant’ rainwater storage product options identified.

Table 5.1 Range of rainwater storage products in Uganda

Capacity litres	Type and source	Safe drinking water' policy compliant?	Retail price range, UGX		Retail price range, US$		Price/litre (low price)	
			low	high	low	high	UGX	US$
20	plastic blow moulded 'jerry can'	can be	5,000		2.94		250	0.12
50	Blow moulded plastic	can be	10,000		5.13	-	200	0.10
100	Blow moulded plastic	can be	15,000	18,000	7.69	9.23	150	0.08
120	Victoria Nile, blow moulded plastic drum	can be	22,000		11.28	-	183	0.09
200	Steel drum, used, no lid	no	35,000		17.95	-	175	0.09
200	Steel drum, used, with lid	possibly	60,000	70,000	30.77	35.90	300	0.15
210	Plastic drum, heavy duty, used	possibly	45,000	65,000	23.08	33.33	214	0.11
220	Victoria Nile, blow moulded plastic drum	can be	42,000	45,000	21.54	23.08	191	0.10
250	Polytank Uganda, roto-moulded plastic drum	can be	110,000		56.41	-	440	0.23
420	cement jars	can be	80,000	95,000	41.03	48.72	190	0.10
500	Polytank Uganda, roto-moulded plastic drum	can be	173,000		88.72	-	346	0.18
500	CV50C Aquatank	can be	150,450	177,000	77.15	90.77	301	0.15
750	CV75C Aquatank	can be	225,675	265,500	115.73	136.15	301	0.15
1,000	Polytank Uganda, rotomolded plastic drum	can be	317,000		162.56	-	317	0.16
1,000	CV100C Aquatank	can be	275,825	324,500	141.45	166.41	276	0.14
1,500	cement jars	can be	280,000	350,000	143.59	179.49	187	0.10
1,500	CV150C Aquatank	can be	376,125	442,500	192.88	226.92	251	0.13
2,000	CV200C Aquatank	can be	476,425	560,500	244.32	287.44	238	0.12
3,000	Above ground tarpaulin lined tank, mud & wattle wall, plastic lined natural roof	no	80,000	100,000	41.03	51.28	27	0.01
3,000	Above ground tarp lined tank with mud & wattle wall, CI roof	Difficult, possible with pump	180,000	220,000	92.31	112.82	60	0.03
4,000	Above ground ferro cement tank	can be	1,000,000		512.82	-	250	0.13
5,000	Above ground ferro cement tank	can be	550,000		282.05	-	110	0.06

Capacity litres	Type and source	Safe drinking water' policy compliant?	Retail price range, UGX		Retail price range, US$		Price/litre (low price)	
			low	high	low	high	UGX	US$
6,000	Above ground ferro cement tank	can be	700,000	950,000	358.97	487.18	117	0.06
6,000	Partially-below ground cement plastered tank	difficult	400,000	500,000	205.13	256.41	67	0.03
10,000	Above ground ferro cement tank	can be			-	-	-	-
10,000	pit tank, plastic lined, no CI roof or mosquito netting	no	450,000	500,000	230.77	256.41	45	0.02
10,000	pit tank, plastic lined, with CI roof, brick knee wall surround & mosquito netting	Difficult, possible with pump	1,000,000		512.82	-	100	0.05
10,000	brick tank	can be	800,000		410.26	-	80	0.04
10,000	Partially-below ground cement lined tank	can be if pump equipped	450,000	1,000,000	230.77	512.82	45	0.02

The pricing information reflected in Table 5.1 for rainwater storage products is indicative of the range of pricing and/or cost information provided by various key informants in the locations visited. Actual costs in any given location for 'built-in place' rainwater storage products such as ferro-cement tanks are substantially influenced by the costs of (a) conveying sand from the nearest source to the building site, (b) buying and bringing cement and iron reinforcing to the building site, (c) whether there is labour price competition amongst masons available to build the tank at a fair labour price.

5.3 Rainwater Storage Product Availability

Manufactured rainwater storage products of 250 litres capacity or less are generally widely available (e.g.: sold retail along main roads at most major towns (population 10,000 – 50,000) and smaller 'last point of supply' rural towns and villages (population <10,000) at significant rural road intersections or situated at the end of graded dirt roads.[12]

Manufactured rainwater storage products of higher capacities (500 litres and up) are generally available in most major towns but tend to not to be stocked in smaller towns. Their limited presence in smaller towns and rare presence in the most rural locations visited may be explained by three main factors:

a) Low sales volume potential and high cost mean that such products are not attractive for rural retailers to stock (e.g.: not the best use of their limited working capital compared to stocking other less costly but faster selling products);
b) Rural shops generally lack their own transportation and so cannot deliver large, bulky items to a rural customer who, if s/he must rent a vehicle anyway to obtain the product, can economically go and buy the product concerned from a major town at a lower net price; and,
c) High prices for products that are unaffordable for low income households which may make up the large majority of potential consumer in many locations.

Small capacity built-in-place rainwater storage products, i.e. 420 litre and $1.5m^3$ above ground jars appear to be only available in certain areas where they have been promoted by NGOs. They are available on a commercial basis in some of these areas, particularly Kabale and Masaka. Large capacity built-in-place rainwater storage tanks, both above and below ground, appear to be only selectively available on a fully commercially-supplied basis when compared to manufactured products in the locations visited. This may be explained by a number of factors:

a) Despite some years of promotion of large capacity DRWH tanks (ferro-cement tanks of 4,000 litres and up) by NGOs and government, the methods applied may not have been intended to result in widespread private sector participation to expand supply;
b) Heavy levels of public subsidization of construction costs which were only recently reduced to a still very high 40%. This combined with a public expectation of continuing access to such subsidies year after year may have discouraged consumers from soliciting such products at full cost from the private sector in some 'demonstration' locations (e.g. potential buyers, short of cash, may prefer to wait and try to access a future subsidized tank rather than to buy a tank now at full cost from a local artisan);
c) In some cases, government has chosen 'demonstration' locations in areas where consumer incomes are not high enough to afford to either save or pay for the substantial investment cost of a 6,000 litre capacity built-in-place rainwater storage tank (e.g. limited to zero commercial market potential for such products in these locales);

[12] This supply is 100% private sector, 0% government promotion and 0% government subsidization.

d) The total value of government spending on DRWH remains modest in relation to the scale of need; and,
e) NGOs active in the DRWH subsector have limited access to funding so their promotion efforts (augmenting that of government) are necessarily ‘location’ selective (whether the methods applied are more conducive to wider commercially-based diffusion of not.

Several very encouraging and mainly private-sector based rainwater storage product initiatives (see Text Box 1 below) were found during field work. These are encouraging for two key reasons:

f) Private initiative is driving diffusion and scale-up, albeit still on a small scale in relation to total need, with little or no supplementary assistance from government or NGOs; and,
g) Some consumers are taking advantage of any construction cost subsidies available from government for built-in-place rainwater storage products (ferro-cement tanks) but the presence of such subsidization is NOT stopping wider uptake by other consumers who are choosing to pay the full cost of the product (preferring not to wait and try to get a government subsidy). This behaviour may possibly be explained by a combination of consumers’ pressing desire for water storage sooner rather than later, potentially low expectation of being able to access a subsidy in the near future or possibly the existence of some form of local ‘subsidy redistribution’ tradition[13].

These trends suggest that, in locations with strong ‘cash crop economies’ where income levels are sufficiently high (relative to the cost of the built-in-place rainwater storage product), consumers are very willing and prefer to invest in large capacity built-in-place rainwater storage products. It appears that these initiatives will continue to slowly extend coverage to adjacent locations over time without external intervention.

The main development policy concerns associated with these private sector based initiatives are the slow pace of built-in-place rainwater storage product diffusion and the fact that these scalable (viably expandable) initiatives are currently limited to small geographic areas relative to total national need. The key intervention challenges relating to deepening and broadening geographically the uptake of these built-in-place rainwater storage products seem to be:

a) Government’s current DRWH subsector policy position does not consider the water quality of below ground or partially below ground options to be ‘safe’ (e.g. satisfying the ‘safe for human consumption’ standard), so it is difficult for government to promote or to support these options in any way[14];

[13] Groups of up to 20 women have formed to pay for and build tanks for each member of their group. A subsidy may be available from government for just one or two tanks. Consistent with local mutual aid traditions, these groups may well have decided to distribute the value of this subsidy equally amongst the group as part of the group-based rotating savings financing method they apply to pay for the construction of each tank (e.g.: effectively ensuring all members benefit from a smaller subsidy and reduced cost of tank construction).

[14] Relevant policy issues are discussed in section 2.2.2. PBG rainwater storage products cost roughly 50% of an above-ground BIP rainwater storage product of equivalent capacity. Access to a suitably affordable and reliable pump to abstract water from PBG rainwater storage products would enable these to satisfy government’s safe water quality standard and so be eligible to be promoted by government and, due to its lower cost, potentially enjoy more rapid diffusion than above-ground built-in-place rainwater storage products.

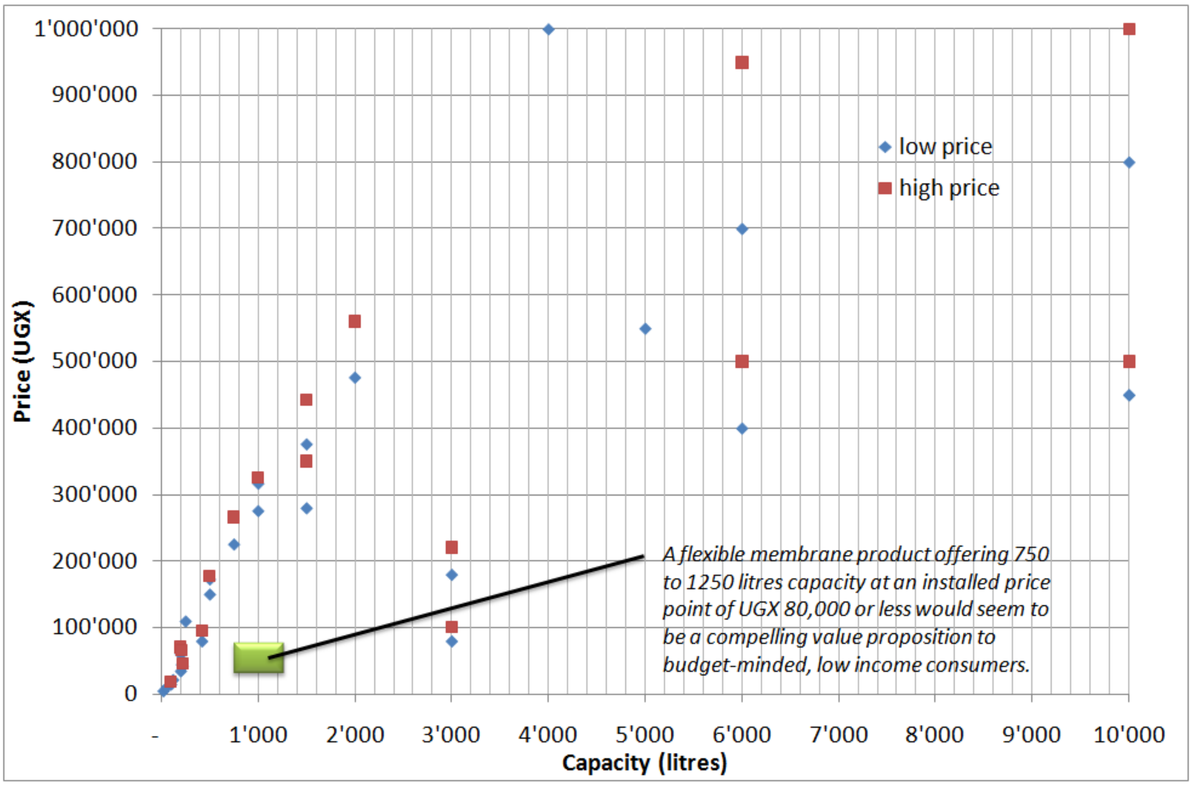
b) These initiatives are 'artisanal' based, relying on builders who find it difficult (lack of time and means) to serve consumers in more distant locations and/or to introduce their built-in-place rainwater storage products to other potential artisans in other locations;
c) Other facilitating agencies – such as NGOs and churches – seem not to have (thus far) well-appreciated that, with modest additional investment in indirect support (networking, training, design and duplication of construction guidelines, exchange visits), the pace of diffusion may be accelerated considerably.

This provides a built-in-place rainwater storage product promotion and diffusion opportunity for EWV that, with modest external support, has strong potential to be taken to scale.

5.4 A Low-Cost Rainwater Storage 'gap' of interest to EWV

Figure 5.1 reveals that with the exception of the 3,000 m^3 tarpaulin-lined tank, affordable rainwater storage product choices between 250 litres (the upper limit of low cost rainwater storage products) and 4,000 litres (the lower limit of costlier built-in-place rainwater storage products) are very limited[15].

Figure 5.1 Rainwater Storage Product Range



Rainwater storage products up to 250 litres are manufactured and retail for under UGX 70,000. Those indicated in the 500 to 1500 litre range are the lowest priced manufactured rainwater storage products potentially available, noting that actual availability is widely variable (as is price) along with the 1500 litre built-in-place ferro-cement jar (lowest cost UGX cited). The 3000 litre rainwater storage

[15] Figure 5.1 is based on data cited in Table 5.1.

products showing are plastic lined pit tanks that fall far short of the safe water quality standard. The cheapest built-in-place rainwater storage products above 3000 litres are partially below ground built-in-place products that, though costing as little as UGX 400,000, also do not meet the safe water quality standard. So, consumers essentially have a choice between low cost, low capacity value propositions or high capacity but substantially higher cost value propositions. A significant gap lies between these that might potentially be filled by a low-cost rainwater storage product introduced by EWV.

EWV suggested an initial value proposition of US$20 retail (UGX 40,000) for a 500 litre storage product. Rough estimations of manufacturing costs based on fairly complex design requirements (needed to satisfy the safe water quality standard) coupled with low income consumers' strong price sensitivity and their equally strong desire to get the most storage capacity that their money can buy, leads to the following insights:

a) A 500 litre capacity storage product is both too small and seems likely to cost somewhat more than the US$20 retail price target (UGX 40,000) installed (even if manufactured offshore and imported);
b) The incremental manufacturing costs of a larger 1000 litre storage product would be marginal and would support an installed price point in the range of UGX 80,000, the nearest potentially available manufactured rainwater storage product substitutes being priced at 300% - 400% higher for comparable capacity;
c) A UGX 80,000 price point buying 1000 litres of capacity is a very compelling value proposition for cash-poor, low income consumers when compared against the capacities of the closest priced alternatives (200 – 250 litre containers) and provides enough scope to support attractive mark-ups in the distribution chain; and,
d) The design allows compact (inventory) storage and easy, low cost shipping through the distribution chain to the consumer (avoiding the problems associated with holding and shipping the alternative rigid bulk containers.[16])

[16] Aquatank, manufactured by Crestank in Kampala, is the only manufactured rainwater storage product on the market that has been designed (tapered drum, removable lid) to 'nest' and economize on storage space and reduce shipping costs. But, Aquatanks are not being aggressively marketing so their availability is highly limited and, even were this to occur, the lowest likely price point on 750 – 1250 litre Aquatanks would fall substantially higher than a 1000 litre UGX 80,000 FM product.

6 Potential Market Share for DRWH products

6.1 Current Rural Market Demand

The current rural market demand for rainwater storage products is defined by three main factors:

- Rainwater storage product choice. Rainwater storage product choice is determined by the actions of government, NGOs and the private sector which offer and promote a variety of water storage devices. (Section 5.2)
- Consumer incomes. Consumer income levels are, generally speaking, linked to the local economic base. As most rural households are farmers, the existence (or not) of a cash crop economy and the area of productive land on household farms largely determine income levels and thus, the capacity to invest in more costly rainwater storage products.
- Consumers' views concerning the costs and benefits, or 'value proposition' offered by a specific rainwater storage product. Consumers' preferences regarding which rainwater storage product they individually may purchase are substantially influenced by their appreciation and valuation of a blend of potential benefits and costs (See Section 6.5).

6.2 Penetration of DRWH products in rural markets.

Evidence of DRWH practices were very frequently seen in all of the locations visited. It would appear that the majority of rural households store harvested rain water in some manner. This may be as simple and low cost as using a curved section of banana stem to collect and direct rain water from a roof and into a 20 litre plastic jerry can, or a piece of sheet metal directing water into a pot (Figure 6.1) . Slightly more sophisticated but still very low cost, many households also install short strips of scrap galvanized iron (GI) roofing bent into a 'V' shape or an upturned GI ridge cap as gutters to direct rain water into low cost tanks as large as 220 litres below. Governmental and NGO funded DRWH initiatives are having small scale impacts in selected areas, amounting to a few thousand units cumulatively, over the last five years. These programs are promoting initially subsidized consumer investment in larger capacity storage built-in-place cement jars (420 and 1500 litre) and above-ground built-in-place ferro-cement tanks ($4m^3$ – $10m^3$). Beyond these efforts, a few private-sector based DRWH initiatives were identified (section 4.4.3). These efforts are also small scale, estimated at no more than 3,000 units installed to date and geographically very limited to certain areas in specific Districts.

Figure 6.1 Opportunistic Rainwater Harvesting in Masaka District

6.3 Consumer perspectives and DRWH investment decision making

Table 6.1 summarizes general pattern of priorities concerning their water needs as indicated by the key informant consumers (and others) interviewed.[17]

Table 6.1 Consumer water supply preferences

Attribute	Key issues
Convenience over Quality and Safety	Consumers place a high premium on a CONVENIENTLY AVAILABLE and RELIABLE source of water. They are highly motivated to reduce the amount of time, physical effort and exposure to physical risk associated with procuring water from a public source. Time is a function of distance to the water source, its reliability (flowing or not, flow rate) and any need to wait in line for others to first access the source. Physical effort is a function of distance and elevation difference, mode of transportation and the quantity of water routinely used. Time and energy NOT applied to securing water can be devoted to more productive tasks. Consumers know this but may lack knowledge of and/or access to alternatives. This is why it is common to see households using low cost DRWH and storage methods (curved banana stem or piece of GI directing rainwater flow into a small plastic container). Access to a convenient source of water to meet a portion of their daily water needs is a valued 'water supply' improvement. The quality of rainwater collected is, in their eyes, of acceptable, equivalent or superior quality to public alternatives (even from a public standpipe). Even if considered inferior in quality and safety, convenience carries a higher weighting.
Quantity over	After 'access convenience', consumers additionally highly value having convenient access to

[17] No attempt is made to identify potential gender-based differences in perspectives or the potential influences of any such differences on the rate of adoption of WRSPs or to distinguish any differences in consumers preferences that may be attributable to income levels in relation to the costs of various rainwater storage product options.

Quality and Safety	LARGE QUANTITIES of water. Consumers would like to entirely eliminate any need to use time, physical effort and the physical risks of obtaining water from a public source, especially an unreliable one. Increased availability of water is also valued for commercial and social reasons; water surplus to personal needs can be used for livestock, small scale horticulture, nonfarm micro-enterprise, be sold, barter-traded or be used for reciprocity in the course of maintaining social relationships. Again, quantity carries a higher weighting than quality and safety.
Price versus Storage Capacity	Low income rural consumers are highly price-sensitive. Retailers of plastic tanks interviewed suggested that their customers tend to disregard quality in favour of paying cash on the spot for a lower-priced product rather than to wait and save the money needed to purchase an alternative product of superior quality at a higher price later. A recurring theme mentioned by a variety of key informants (consumers, retailers and micro-credit service providers) was that it is difficult for lower income consumers to hold and save money to buy higher prices items later due to other pressing household expenditure needs. In some rural locations, consumers purchase water from vendors, the price ranging from UGX 50 to 300 per 20-litre plastic jerry can (UGX 2,500 to 15,000 per m^3 compared to current national urban tariff rates of UGX 784 and 1,213 per m^3, respectively for water from a public standpipe and a private connection[18]). The larger the storage capacity of a rainwater storage product at any given 'low end' price point, the more attractive it is for low income consumers with little savings capacity. In the case of costly rainwater storage product: budget-minded consumers with higher incomes will still tend to prefer to maximize storage capacity (e.g. $10m^3$ rather than $6m^3$) if they're going to make a large investment and can afford to pay the incremental costs involved.
Product Durability	Consumers interviewed expressed some concern about durability when discussing a 'bag type' storage product. Concerns are resistance to puncturing and leakage and lifespan. Clearly, the lower the price of such a product, the less risk for the consumer and the less s/he will weight these concerns relative to the opportunity to capture be benefits of convenient access to a large quantity of good quality water and relative to the costs and benefits of any alternative products that might be available for purchase. The larger the investment (e.g. built-in-place options), the higher consumers weight durability. In both cases, a potential buyer's concerns about product durability can be addressed through trusted 3rd party testimonials, seeing first hand another's installed unit or by a partial guarantee provided by the vendor.

[18] NWSC – National Water & Sewerage Cooperation tariff rates in 07/08. During the same period, NWSC's average cost of water production was UGX 1,360/m^3 and that for privately operated small scale piped systems in rural towns was UGX 845/m^3.

6.4 Potential rural market share for rainwater storage product

Government defines access to safe water in rural areas as being water from an improved source[19] within 1.5 kilometres. Using this definition, government estimated in 07/08 that 37% of the rural population lacked access. This figure substantially underestimates 'satisfactory access' from the rural consumer's perspective based on their preferences profiled in Table 6.1. Thus, an unknown but probably substantial proportion of the other 63% of the rural population deemed by government to have access nevertheless remain inadequately supplied. By combining this statistic with population and household distribution data, a rough estimate of the potential total market for rainwater storage products may be estimated. Based on 2005/2006 population data and assuming an average of 6 persons per household, Table 6.2 conservatively indicates a total potential national rural market for rainwater storage product of approximately 1,600,000 households and a total market of almost 1,800,000 households.

Table 6.2 Potential market for rainwater storage product

Population Distribution, Uganda, 2005-06				
Population		Households		
		Total	With Hard Roofs[1]	Potential Market[2]
National	27,200,000	4,533,333	2,929,440	**1,767,864**
Rural	**23,011,200**	**3,835,200**	**2,301,120**	**1,610,784**
Urban	4,188,800	698,133	628,320	157,080
by Region				
Central	7,942,400	1,323,733	794,240	516,256
Eastern	6,854,400	1,142,400	685,440	445,536
Northern	5,358,400	893,067	535,840	348,296
Western	7,044,800	1,174,133	704,480	457,912
Notes:				
[1] 90% hard roofs urban 60% rural				
[2] 70% rural 25% urban				

Based on government's definitions and data, 37% of the rural population or roughly 1,500,000 rural households across Uganda now lack access to water. One might conservatively estimate that half of the 63% of the rural population deemed by government to currently have water access (within 1.5 kilometres of an improved water source), consider themselves to still lack adequate access (e.g.: distance, quantity shortfalls), suggesting that at least a further 1,250,000 rural households might welcome the opportunity to invest in some form of rainwater storage product. Clearly, these are substantial numbers.

Generally speaking, from a business perspective these conditions indicate there is widespread unsatisfied pent-up rural consumer demand for convenient access to large water storage containers.

[19] Improved rural water sources are protected springs, hand-pumps (hand dug well or borehole), gravity-fed systems and pumped-piped systems and rainwater harvesting facilities.

Alternative points of common water supply are variously too far, too labour intensive (Figure 6.2), do not offer 'large volume supply potential' and too unreliable to compete well with a rainwater storage product on-site at the point of consumption. On-site hand dug protected wells; another form of 'self-supply' may become an option but are not now promoted by government. Other rural water supply options such as gravity-fed systems and pumped-piped systems with a borehole source are too capital intensive for the government to use as a main solution for dispersed rural consumers. Thus, the rural market share that might potentially be captured by affordably-priced large capacity rainwater storage products is very substantial and likely to prove to be a majority of all rural households. Opportunities to affordably capture and store large volumes of water at the point of use are highly valued. That being said, it is still important to match rainwater storage products of differing capacities and pricing with various rural DRWH market segments.

Figure 6.2 Women collect water from Lake Bunyonyi, Kabale to and take it back up the steep hills

7 Potential DRWH Supply Chains in the Country

There are two categories of rainwater storage product supply chains evident in the locations visited, i.e. manufactured and portable, or built-in-place. The supply chain for built-in-place consists of building the capacity of the local artisan/masons plus supply of the needed construction materials. The supply chain for manufactured and portable rainwater storage products is closely correlated with that for building materials used for built-in-place. The following sections note any significant differences between the supply chain patterns where relevant.

7.1 Current distribution channels

The dominant distribution channel for manufactured water storage products is the Building Materials and Products distribution channel. This includes a sub-channel in some locations specializing in plumbing fixtures, products and parts. These channels also typically stock guttering, downpipes and associated parts (GI and PVC). Households, artisans and masons involved in constructing built-in-place rainwater storage products obtain supplies from these sources. Small volume manufactured water storage products may occasionally be stocked by retailers specializing in Fast Moving Household Goods. In these cases, no other building material products are stocked.

7.2 Supply competition, margins/mark-ups and retail pricing

Supply chains in the locations visited are characterized by intense, price-based competition amongst competing re-sellers at each point in the chain. Re-sellers have little scope for raising their mark-ups beyond the minimum levels that they and their direct competitors need to survive in business. Even in the smallest rural 'last point of supply' trading centres, which are little more than a crossroads, at least several resellers selling much the same range of products is typical. This is very good for consumers who benefit from the opportunity to purchase goods at the lowest possible prices that these items can be profitably supplied.

This general competitive pattern seems to be explained by the following conditions:

- The products concerned are largely commodities that do not require or involve differentiating 'value addition' by re-sellers i.e. no service, no guarantees, little credit, cash sales, and no delivery services.
- Highly price sensitive consumers and a mass market to serve (rather than consumer segments with highly differentiated preferences). With many vendors selling essentially the same commodities and price-sensitive consumers, there is limited opportunity to unduly increase prices: consumers shop around for the best price.
- The business strategies of manufacturers and national distributors focus on maximizing sales volume by selling to any re-seller prepared to pay cash (buyers arrange their own shipment).
- Low barriers to entry into the re-selling business for anyone with sufficient working capital.
- Ease of access to cheap and competitively-priced regional transportation services for re-sellers.

Reflecting strong price-competition and cost-efficient transportation services, retail pricing for various building products and water storage products is remarkably uniform across the trading points visited in Kabale, Mbarara, Masaka, Mbali and Kapchorwa (Table 7.1).

Table 7.1 Selected building product prices

Item	Kabale	Mbarara	Masaka	Mbale	Kapchorwa
100 litre Victoria Nile plastic blow-moulded tank	22,000 (120 litres)		17,000		18,000
220 litre Victoria Nile plastic blow-moulded tank	45,000	42,000	45,000		
10 foot GI gutter (plain)	12,000		10,000	12,000 - 13,000	10,000
10 foot GI down pipe	12,000			15,000	15,000
5 foot GI ridge cap			4,500	5,000	
4 by 8 foot mesh wire		15,500	15000	15,000	13,000
50kg cement	26,000	25,000	25000		30,000

The distinction between 'wholesale' and 'retail' is subtle. Nearly all re-sellers are serving the immediate retail consumer market. Many, if not most, also engage in wholesaling, that is, they are prepared to discount their retail pricing to make a sale to another re-seller or to a builder. The difference between the retail and the discounted 'wholesale' price depends on negotiation, the purchase quantity, whether short-term sale-on-credit is involved and prospects for repeat sales to the same 'wholesale' customer. That said, since resellers are operating on narrow mark-ups, the differences between the retail and wholesale prices appear modest.

For the reasons noted above, price mark-ups on existing water storage products, related rainwater harvesting products and other building materials in the Building Materials and Products distribution channel are considered modest.[20] While resellers will opportunistically try to maximize pricing, the following mark-up pattern seems to prevail:

- National distributor/wholesaler: 10% (high volume, high value) - 15% (low volume, low value);
- Re-sellers situated at trading centres (such as district capitals) and on a major arterial road: 10% (wholesale) - 15% (retail);

[20] Understandably, resellers are reluctant to divulge their pricing practices. In some cases, key informants were candid. Alternatively, mark-ups can be estimated by following the distribution path of products in the chain and noting their pricing at each stage.

- 'Last mile' retailers situated in remote rural trading points: 7% - 15% (depending on volume, value and assessment of what local consumers – most known – can afford).[21]

These trading conditions auger well for introducing and ensuring competitively priced and affordable low-cost rainwater storage products.[22]

7.3 Procurement practices and transportation economics

Uganda is blessed with a well developed bulk goods transportation sector. Although the surface condition of the roads network is wanting, the agricultural cash crop economy is supported by an abundance of private truckers operating in strong competition. Agricultural output is transported from rural areas to supply consumer demand in major regional trading centres and in Kampala. Emptied of their loads at these destinations, truckers look for 'backhaul loads' to earn additional revenues. It is common to see empty trucks parked in designated areas waiting for a backhaul customer. Retailers and wholesalers routinely make use of these truckers to ship goods from Kampala to their shops.[23] Transportation costs (for a 7 to 12 metric ton truckload) from Kampala are very economical relative to the potential value of goods shipped:

- Kampala to Masaka: UGX 100,000 – 150,000
- Kampala to Mbarara: UGX 180,000 – 200,000
- Kampala to Kabale: UGX 400,000 – 500,000

Notably, resellers situated on arterial roads almost to a person indicate that they prefer to and typically do procure their inventories directly from wholesalers in Kampala. Low transport costs make it in their interests to do so, if they have sufficient working capital to purchase truckloads of inventory. In turn, this opportunity to bypass intermediary re-sellers also contributes to constraining the mark-ups that an intermediary can charge. In contrast, 'last mile' retailers situated in more distant locations on rural feeder roads tend to procure from intermediary re-sellers situated along arterial roads. This is because their sales volumes are relatively modest and so procurement from Kampala is not economically advantageous.

7.4 'Last mile' access issues

Despite the availability in major trading centres (e.g. district capitals and some secondary towns – 10,000 to 25,000 population) of a relatively wide range of water storage products, product choice in more rural and 'off the beaten track' locations is 'partial' at best. 'Last mile' retailers rarely stock water tanks exceeding 250 litres capacity and often stock only smaller sizes. Access to transport is frequently a problem, because few households own a scooter and rentable transportation is costly.

[21] 'Last mile' retailers still operate in competition with nearby vendors and vendors in major towns. The size of their local market is also small. Thus, these retailers are sensitive to the need to apply fair pricing practices that ensure loyalty of their highly price-sensitive customer base. It is easy for customers to switch to another vendor.

[22] Assuming project design leverages supply competition to restrain pricing (if not regulated by other means).

[23] The shop-owner first arranges for truck hire on a desired date, then personally visits and pays for goods at Kampala wholesalers, after which s/he accompanies the hired trucker to the wholesalers' premises and collects the goods purchased. The trucker then delivers its load to the shop-owner's premises.

Equally important, the absence of product choice at the 'last mile' retail level combined with limited access to information (print, radio) conveying knowledge about the range of water storage product choices elsewhere, further removes rural consumers from an opportunity to purchase a rainwater storage product suited to their particular needs. Strategies to address these issues will be central to enabling rural consumers to have the opportunity to invest in a low-cost rainwater storage product (or built-in-place tank for that matter).

7.5 Micro-credit and inventory financing

Africa Microfinance Analysis and Benchmarking Report, 2008, issued by Mix and CGAP[24] ranks Uganda 10th amongst countries across Sub-Saharan Africa by penetration rates of borrowers and savers. Uganda's borrower penetration rate is just 0.7% (216,000 borrowers across a population of 29,000,000). That said, micro-financial services appeared to be available in the locations visited. Branch offices of MFIs and banks are present in small towns (population 10,000 – 25,000) situated in outlying areas visited such as Kapchorwa. Micro-credit services are supplied by micro-finance banks (e.g. FINCA), micro-finance NGOs, local savings and credit cooperative organizations (SACCOs) and informally through small-group rotating savings and credit traditions involving individuals who trust each other. Although the performance of SACCOs is allegedly widely variable across the country, key informants generally felt that access to credit is not a problem. Moreover, the capacity of rural households to save and/or repay monies needed to invest in larger capacity rainwater storage products should not be underestimated; the desire for convenient access to large quantities of water is compelling for many households.

Two cases of direct financing of DRWH products were found during field work:

- FINCA offers credit to support the purchase of the Aquatank brand of DRWH storage, manufactured by Kampala-based Crestank. It discounts the list price of tanks sold by FINCA by 15% serving as a partial contribution towards credit costs and pays FINCA's credit officers a sales commission. FINCA purchases the Aquatank 'sold' to its loan clients from the nearest Aquatank vendor. The loan client then makes delivery arrangements with the vendor. Crestank leverages FINCA's linkages with its loan client base and, in exchange, FINCA generates additional repeat loan business from trusted clients. The main risk to FINCA is brand reputation risks; its reputation is tarnished if quality and durability problems arise with the Aquatanks purchased on credit.
- The UK charity ACORD initiated linkages to credit in locations where its broader water and sanitation projects are situated in Isingiro District. In this case, credit is offered by a local SACCO to finance construction of aboveground ferrocement tanks.

Similar arrangements could be organized by EWV if warranted with FINCA or other MFIs. Discussions with FINCA indicate that its minimum loan size is UGX 50,000 and interest rates to consumers are 3.5% monthly.[25] The main issue may be one of scale. MFIs' active client numbers are quite modest

[24] Micro Information Exchange (www.themix.org). Consultative Group to Assist the Poor (www.cgap.org).

[25] FINCA expressed substantial interest in participating in a future EWV rainwater storage product initiative, both to assist EWV promote rainwater storage products to FINCA's 47,000 active client base and to provide supporting credit services to

and so if it proves necessary to use credit to support sales, a relatively large number of MFIs would be needed to achieve any large sales volume target set by EWV.

For more capital intensive storage (e.g. larger than $4m^3$ ferrocement tanks), group-based rotating savings and credit (ROSC) is a popular way to raise the cash needed. FINCA also extends credit (2.0% - 2.5% monthly) to individuals (e.g. farmers and proprietors of small enterprises). Enterprises may also access bank financing (currently available at rates starting at 20% annually to the most creditworthy prospects). Lastly, some resellers indicated that they extend very short term credit (in the form of goods supplied on credit terms for up to 10 days) to trusted customers (who, by definition, are repeat buyers).

In summary, access to consumer credit or trade credit to support an EWV initiative, if needed, should not prove difficult to arrange.

8 Recommended Path forward for DRWH in Uganda

8.1 Overall Conclusions and Recommendations

In conclusion there is no doubt that there is enormous potential for promoting domestic rainwater harvesting (DRWH) production and distribution chains on a commercial basis in rural Uganda. DRWH is a highly suitable technology for increasing access to safe water in Uganda. In most of the country, rainfall is adequate, about two thirds of the population have hard roofs which seem to be on the whole of adequate size to obtain at least 5 litres of clean water per person per day for drinking purposes. Households themselves recognise this reality, and 18% of rural households use rainwater for drinking in the wet season. Sample surveys suggest that the figure is higher in certain parts of the country.

Government policy favours DRWH and its merits are being praised from Ministerial level right down to the political leadership at local Governments as well as within the civil service. Government has put its resources into funding of DRWH facilities. There is a growing consensus that DRWH is an ideal technology for Government investment in areas where more conventional technologies are not suitable, although there are concerns about the high per capita investment cost in comparison with other, more conventional, community managed technologies. Numerous NGOs in Uganda have joined the early innovators with respect to DRWH and are sourcing funding for promotion and construction of facilities. One key obstacle to DRWH is a focus on sole source technologies and government policy of providing 20 litres/person/day of clean water rather than 5 litres/person/day of drinking water coupled with lower quality from other sources. This means that there is a tendency for Government to focus on promoting larger storage volumes of $4m^3$ and above, rather than on smaller storage, which can be increased on an incremental basis.

In Uganda, both Government and NGOs have a history of highly subsidising service delivery of rural water supplies. In most cases, this norm is also being adhered to with respect to the promotion of DRWH although subsidies are not supposed to be above 40% of the capital cost. Cries of "*the people*

prospective buyers of rainwater storage products generally. FINCA is one of the largest and longest standing MFIs in the country.

are too poor to pay the full cost" are common from politicians as well as the administrative staff. Although there are clearly limits with respect to affordability, this attitude is not helpful in forging a way forward for self help initiatives with DRWH. This pro-subsidy attitude discourages investments in DRWH by people themselves, and stifles thinking with respect to fully commercial initiatives. However, the recognition by some stakeholders in Government and certain NGOs that self-supply is a valuable way forward is starting to fly in the face of such attitudes. Proving the commercial viability of DRWH would add considerable credit to the proponents of self-supply. This could significantly open up new ways of solving the problems of the un-served, as well as those technically covered, but still walking long distances to fetch their water supplies.

Although there have been efforts to encourage commercial uptake of DRWH, they are still fairly small in relation to the country as a whole. With the exception of the training centre in Kabale, such initiatives have tended to focus on only one or two technology types. Thus most rural people are simply not aware of the wide range of options available in the country as a whole. Even efforts to improve knowledge and skills of what already exists in Uganda could significantly increase the adoption of DRWH.

To date, systematic efforts to support local enterprises in promoting the technology, with a strong business development and marketing component have been feeble. Thus despite all the potential of the technology to take off widely in Uganda, some key ingredients appear to be missing.

Clearly, the availability of much cheaper DRWH storage could make a significant impact on the uptake of the technology. The private uptake of the partially below ground tanks in Isingiro and of small cement mortar jars in Kabale are cases in point in this regard. In both cases the facilities are affordable, the skills are locally available and people are investing their own resources.

There are a many stakeholders involved in rural water supply in Uganda. The sector wide approach and coordination bodies that have been established (WESWG, UWASNET, URWA, MWE Technical Support Units) render it fairly easy to inform and engage in dialogue with key decision-makers in a coordinated manner. If EWV were to undertake a pilot project in Uganda, it would be advisable to bring these stakeholders on board from the outset. This would set a good foundation for policy dialogue. Establishing a small project advisory group or information-sharing team would be the most obvious mechanism for doing this. Building up trust over time is an essential ingredient for influencing policy (such as changing from the standard of 20 litres of clean water to 5 litres of drinking water) in the long run in Uganda. A major policy change could provide a better market for DRWH products, and support some form of voucher scheme for example.

Given the numerous NGOs involved in DRWH promotion and their reach throughout the country it may be possible to leverage their support in promotion. It would also be advisable to bring them on board to a more commercial approach to DRWH than they have been following in the past.

It is important to note that good sanitation and hygiene practices would still be required in conjunction with DRWH to have a significant impact on reducing the incidence of diarrhoea.

8.2 Low-Cost Rain Water Storage Product

An affordably priced rainwater storage product with a minimum capacity in the range of 750 - 1,250 litres would fill a gap in current product offerings and has a strong chance of commercial success on a large scale in Uganda.

Although it may not be necessary to have public sector or NGO sector support for a new low-cost storage tank introduced commercially, this appears desirable. Clearly, it is more beneficial to have such public endorsement than not. As explained previously, such endorsement is likely to depend on whether the tank satisfies the current public policy position limiting endorsement to water storage devices that supply water deemed to be 'safe for human consumption' (a product design question). There seems to be some chance that the current policy position may be 'softened' to recognize the legitimacy of water storage devices whose designs do not satisfy the 'safe for human consumption' test but are adequate as solutions for consumers' other water (non-consumptive) water needs. A tank designed to satisfy the more stringent standard at any given target retail price is clearly preferable.

This low-cost tank would at least need to be technically sound enough to satisfy consumers' expectations pertaining to product performance in relation to the price paid to purchase the product. As noted previously, retail (installed) pricing in the range of UGX 80,000 would appear to be highly attractive to consumers relative to the costs of current product substitutes.

8.3 Built-in-Place Rainwater Storage Product

As discussed in this report, several built-in-place rainwater storage product solutions are already commercially available in Uganda. Capacities range from 420 litres to over 10 cubic metres. Above-ground built-in-place rainwater storage tanks have been designed to satisfy public 'safe for human consumption' policy standards. Though not complying with this standard but costing roughly half as much, below-ground built-in-place rainwater cisterns are proving very popular with consumers. Consumers value the quantity over the quality of stored water. Field observations noted that consumers who adopt built-in-place rainwater storage product tend to opt to invest in as large a capacity as they can afford because the incremental cost of 'going larger' falls as capacity increases.

The primary intervention opportunity is to foster and support more rapid diffusion of above-ground and below-ground already accepted built-in-place rainwater storage products in the country. Each built-in-place product is now marketed in very small and isolated local markets. There are two key explanations for this:

- The agencies that initially introduced and may still be promoting the products have not set out to establish expanding diffusion based on commercial grounds (e.g. their non-profit perspectives and funding base limit the scope of their efforts to serving localized target constituencies, built-in-place storage products often being only one aspect of a wider development program); and,
- Production of these built-in-place tanks is 'artisan-based' so technology diffusion is heavily dependent on (a) the artisans' mobility, and (b) the number of trained artisans who promote the technology in new locations.

A modest level of investment aimed at facilitating skills transfer into new locations can reasonably be expected to 'seed' new consumer demand for built-in-place rainwater storage products in 'green field' locations. That said, the number of new rainwater storage units and the pace of diffusion are likely to prove relatively modest compared to the potential of low-cost tank. This comparatively 'lower near term scaling' potential is explained by: (a) the significant lead time needed by consumers to save the funds required to invest in built-in-place tanks and (b) the time needed for an artisan to acquire fabrication skills and to market new built-in-place storage products. There is some scope to develop loan products that could be offered by micro-finance institutions for the purchase of tanks.

8.4 Rainwater Storage Product Choice for Consumers

The DRWH development vision is to ensure that consumers are able to store some quantity of water as a partial or total solution to their short-term and annual water needs. Consumers actually have differing degrees of DRWH need and differing rainwater storage preferences, based on their income levels and their understanding of the potential costs and benefits associated with various storage products accessible for purchase. From a development perspective, the ideal 'accessibility' scenario in any given localized market would be for consumers to have a choice of rainwater storage products to choose from. This would maximize the percentage of all potential consumers in a given location who actually choose to buy a storage product. It would also facilitate 'upgrading' of storage capacities at each household over time. From a commercial perspective, clearly the central interest is to sell the specific storage product offered. But, equally, the more aware, informed and 'active' consumers are in DRWH generally, the more likely it is that sales of a specific product will occur: the 'halo' or 'spill-over' effect.

At the same time, the potential sale of a particular rainwater storage product in a given localized market (e.g. a cluster of villages within walking distance) is relatively small. So, a vendor selling a variety of rainwater storage products can expect to do better (sales volumes, profits) than a vendor selling just one product.

Thus, it may make sense to consider a commercial rainwater storage product promotion strategy that supports product choice rather than just one product. This would aim to ensure that resellers are able to sustain sales and after-sales service over the longer term (the alternative being that resellers might otherwise cease to operate once they've saturated the local market with a specific storage product).

8.5 General consumer education about rainwater storage product

There is a general need to accompany specific product promotions with general consumer education and building their awareness of what DRWH/S is and its benefits in terms of improved access to safe water, reduced time and physical effort, convenience, income generating potential (increased availability of water), more time available to be more productive (earn money, go to school, keep husband happy, etc), increased privacy (bathe and wash clothes in privacy of own home). This is as important a task as making rainwater storage products available to the consumer. Village-based installers and 'last mile' vendors are well-placed to play this general consumer DRWH/S education role. This is ideally structured (e.g. at zero cost) as an embedded information service as part of their normal course of selling storage products. A modest one time investment to pay for design and reproduction of appropriate communications materials (posters, flyers, and comics) available at the point of sale for rainwater storage products would be well worth the cost.

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EnterpriseWorks/VITA

nauglej@enterpriseworks.org