

MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

## The rainwater harvesting strategy for Uganda

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*This paper is a review of the study carried out to develop a national strategy for rainwater harvesting (RWH) in Uganda. RWH has been practiced over years although it had been treated as a 'third-class' water source in government policies and investment plans. The study assessed hindrances to utilisation of rainwater as one of the major sources, and the strengths that could be taken advantage of to promote its use. Seven districts in different climatic zones and regions were used for this study. RWH is possible throughout Uganda. However, the availability of suitable roofs varies between 28% and 95% for different areas. Affordable storage was modelled in different areas for household and communal facilities. RWH was recommended to increase safe water coverage where this is deemed low. The study recommends government participation in piloting investment in RWH, and provision of training support and subsidies.*

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### Background

"It falls pure, you hide from it and after it has stopped, you run to collect it polluted". Water harvesting is the collection of runoff and its use for agricultural and domestic use (Finkel and Finkel, 1986). There are many regions in the world where rainfall is heavy for some months of the year and negligible for the rest; rainwater and storm runoff, harvested in season and then stored, would help in alleviating the problem of water shortage during the dry season. In the last 20 years, RWH for domestic use has undergone major renaissance in many countries. Africa and South-Asia have been at the heart of this revival during which tens of millions of roof catchment systems have been constructed. Some countries like Kenya and Thailand have been focal points of technological innovation, while others have followed in their lead (Gould, et al., 1999). In other places systems and technologies have evolved to suit local conditions. RWH projects are generally local and of a small scale that do not include the treatment of water or its conveyance over long distances (Rubarenzya, 2003).

Water is essential for all life and is used in many different ways – for food production, drinking and domestic uses, and industrial use. It is also part of the larger ecosystem on which biodiversity depends. Precipitation, converted to soil and ground water and thus accessible to vegetation and people, is the dominant precondition for biomass production and social development in dry lands. The amount of available water is equivalent to the water moving through the landscape. It also fluctuates between the wet and dry periods. However, water is becoming scarce not only in arid and drought prone areas but also in regions where rainfall is abundant: water scarcity concerns the quantity of resource available and the quality of the water because degraded

water resources become unavailable for more stringent requirements (Pereira, et al., 2002). Most natural hydrologic phenomena like RWH are so complex that they are beyond comprehension, or exact laws governing such phenomena have not been fully discovered. Before such laws can ever be found, complicated hydrologic phenomena (the prototype) can only be approximated by modelling.

RWH is simple and appropriate method of water supply is growing importance due to increased potential catchment surfaces and failure of the conventional methods to meet the challenges of providing "clean water for all". Saline groundwater has made the population yearn for much easier option with good quality water. However up to recent years, the Government of Uganda (GOU) had not recognised the option of RWH and most of the designs and implementation mechanisms are based on the conventional methods of use of groundwater, natural spring water and surface water.

Rain and storm water harvesting techniques are not entirely new and were extensively practiced throughout a vast region of North America, through the mountains and basins of the Mexican northwest, and through the civilizations that flourished in the south central highlands of Mexico. These techniques were also practiced throughout the Middle East, North Africa, China, and ancient India (Rubarenzya, 2003). However, the focus of this paper is on the development of a domestic RWH strategy for Uganda.

### Introduction

The GOU has been undertaking water and sanitation sector reforms to enhance efficiency and effectiveness in the implementation of water and sanitation programmes. The main targets have been set out in the fifteen-year Rural Water and Sanitation Investment Plan (MWLE, 2000), the Poverty

Eradication Action Plan (MFPED, 1999), the five-year Operation Plan (OP5) (MWLE, 2002), and the Rural Growth Centre Investment Plan and Strategy (MWLE, 2003). In all these documents, and in the National Water Policy (GOU, 1995), the main water sources considered include groundwater, sub-surface water and surface water sources. While government institutions and non-governmental organisations (NGOs) have been installing RWH facilities under various programmes, there has been no deliberate effort at the policy and planning levels to promote RWH as a major source of safe water supply.

RWH is particularly important for sustainable development in that, unlike other sources, which may be subject to depletion or possible pollution, RWH is based on the use of a renewable resource and is not known to have any adverse environmental impacts. The facilities for harvesting rain can be developed in basic forms to suit even the poorest of beneficiaries. With the convenience it provides in terms of decreased distance to the source and less time spent, the labour freed from water collection drudgery can be engaged in other activities, including income generation. This gives RWH technology an edge over other technologies as a tool for poverty eradication, particularly for the improvement of women's livelihoods. Whereas some areas may not be endowed with other water sources, virtually all parts of Uganda receive sufficient rainfall (over 600mm on average a year) that can be harnessed to cater for the basic domestic water supply needs (Figure 1).

In a study commissioned by the Ministry of Water, Lands and Environment (MWLE) (MWLE, 2004), the country was classified into five RWH zones based on the mean annual rainfall. Zone A receives between 400mm and 800mm; Zone B between 800mm and 1000mm; Zone C between 1000mm and 1200mm; Zone D between 1200mm and 1400mm; while Zone E experiences over 1400mm. A behavioural analysis model was used for storage analysis with a constant demand approach to assess the efficiency of RWH systems for each zone, operating strategies, and interventions at household and communal levels. The choice of technology options was guided by the material requirements, skills for operation and maintenance (O&M), cost considerations, social and cultural acceptability, environmental concerns, durability and replicability. Ferrocement storage facilities were found to be the most appropriate, and for large volumes exceeding 50m<sup>3</sup>, masonry tanks were recommended.

### Description of the Study Areas

The selection of case study areas aimed at covering different topographic and geographic spreads, representing different regions of the country and covering lowlands, rangelands and highlands. The selected areas include Nakasongora, a semi-arid lowland in the central region; Kamuli, a lowland, Mbale and Tororo, highlands to rangelands in the East; Kaberamaido, a rangeland in the north-east; Rakai a semi-arid rangeland in the south; Mbarara a rangeland; Kabale a highland in the southwest; and Arua, a highland in the north.

### Methodology

A desk study was done to review existing literature on the advances and experiences in RWH practice locally, regionally and globally as a guide to ascertain existing designs and technologies that are appropriate and can be adopted for Uganda. This review also tackled the current policies to determine how RWH can be encompassed as a major source in GOU programs to attract sufficient public funding.

Field assessments were done to cover socio-economic aspects, existing RWH practices and financing arrangements for social infrastructure. The assessments were carried out through physical observation and interaction with people using a checklist and a thematic questionnaire.

Further discussions and consultations were made with district officials, NGOs involved in water and sanitation activities, officials from MWLE, donor agencies, and with related government ministries. These were in form of individual approach, group presentations, and workshops.

To describe the relationship between seasonal patterns and availability, a hydrological analysis was carried out to establish the relationship between climate and rainfall variability, and hence reliability of rainwater. This analysis was also intended to assess the effect, on RWH, of rainfall extremes in regions of vulnerability.

### Results and Discussion

The households with roofs suitable for RWH vary from area to area, and range between 28% and 95%. Districts in the same region had closely similar characteristics of economic well-being and human development, both of which factors relate to the nature of housing structures. The majority of the people were willing to pay for their household RWH facilities. In approximately 68% of the households sampled, the modal annual average income per household in rural areas was found to be about US\$200. The socio-economic assessment showed that only 15% of this income could be dedicated to investment in a household RWH facility. However, this would only be equivalent to approximately 11% of the RWH facility needed for an average household of 5 people or a communal facility for 60 such households. There was a section constituting 32% of the households whose average annual income was over US\$800. The assessment of this category indicated that they would meet up to 72% of the capital cost for a 5m<sup>3</sup> ferrocement tank, which was found sufficient to meet the basic domestic demand (7L/c/d) throughout the year for the average household (MWLE, 1994; MWLE, 2000; MWLE, 2004). This analysis indicates that for the successful promotion of RWH in Uganda, the GOU has to consider investing up to 90% in communal facilities with beneficiaries contributing only 10%, and 30% towards household facilities where users can afford up to 70% of the initial investment cost.

It was further noted that there is a distinct disparity in current safe water coverage for different districts. RWH would come in handy to supplement efforts to increase the safe water supply coverage in districts where this is low, and

where other suitable sources would also be hard to come by. RWH would suffice for critical domestic demands of 7L/c/d (for drinking and cooking) throughout the year.

The study found that the promotion of RWH has been hindered by lack of clear policy and legal framework, which has led to lack of substantial GOU support in terms of training and support. Other factors were found to include lack of awareness and misconception about safety of rainwater, inappropriate designs and technologies that make RWH technically unappealing to promoters and beneficiaries, drastic seasonal variability that affect its reliability, and high investment costs especially for household facilities with no GOU support.

The study envisaged designs that consider rainfall (amounts and variability), population (density and distribution), household size, and application (total, partial or specific). Partial demand targeted a unit rate of 10L/c/d while specific demand (drinking and cooking) a unit rate of 7L/c/d was adopted. The total demand was taken as 20L/c/d. A design horizon of 10 years was adopted in line with the sector targets. Communal facilities were sized for a maximum of 300 people (about 60 households), while households were designed for an average of five people per household (MFPED 2000). The management of both quality and quantity of harvested rainwater is critical in operation to ensure the RWH facilities satisfy the purpose for which they are designed and provisions were incorporated in the designs for that purpose. The recommended facilities aimed at meeting up to 100% of the specific demand throughout the year, and the other demands (partial and total) with a confidence level of at least 70%.

Table 1 summarises the recommended storage facilities and their reliability in different zones, together with the estimated initial investment costs. Areas with low roof coverage were considered for communal facilities where they are feasible in respect of population density. Otherwise, improvisation in form of dummy roofs for households would be necessary.

## Conclusions and Recommendations

RWH is a feasible option of water supply in the whole country but the storage capacities vary from region to region dependent on the rainfall amounts, distribution and pattern. For effective promotion of RWH, both a holistic approach to the utilisation of rainwater, and group training in construction and management skills were considered as being of paramount importance.

The study concluded that GOU does not have a deliberate effort to promote RWH as option of Water supply. The existing legal and planning framework do not emphasize RWH as a priority. Currently only NGOs and Community Based Organisations (CBOs) are involved in promotion of RWH. Legal and planning frameworks are required for the promotion of RWH as water supply technology that can be effective in alleviation of poverty. These should be included in the policy, investment strategies, and other planning documents for the water sector.

A combined implementation approach was recommended, to be coordinated by GOU through the Directorate of Water

Development (DWD). Implementing stakeholders would include the private sector, NGOs, CBOs, and communities. These stakeholders would operate within the confines of relevant government laws, policies, guidelines and strategies.

It is recommended that District administrations be involved in implementation carried out through the private sector for communal facilities, and through UWASNET (an umbrella for water and sanitation NGOs). Implementation of household facilities would best be done through NGOs and CBOs. The study recommended the involvement of women at each stage of the RWH programs because of their vital role in water and sanitation provision in households. Figure 2 shows the proposed implementation structure. In the figure, WUG stands for Water User Group.

The study concluded that while the beneficiaries are willing to pay for the RWH facilities, the capital investment is high for most of the poor in the villages. Thus, the study recommended that government subsidies be allocated. Furthermore, the existing system of a revolving fund as used in CBOs was found to be efficient, especially where CBO membership is composed predominantly of women. Initial capital to the funds would come from the GOU subsidy. The funds operate best when there are other benefits to the scheme.

The RWH facilities have no major O&M problems and thus, the responsibility for O&M of RWH facilities was apportioned solely to the beneficiaries. This was recommended to take advantage of existing institutional arrangements and policy provisions.

Piloting for RWH was recommended for the success of the strategy. This would demystify the technology and develop confidence among potential stakeholders, resulting in wider scale investment in RWH. The study recommended that the GOU encourage greater involvement of NGOs, the private sector, and CBOs in promotion of RWH technology. Along with piloting would be broad awareness and sensitization campaigns targeting beneficiaries, planners and promoters.

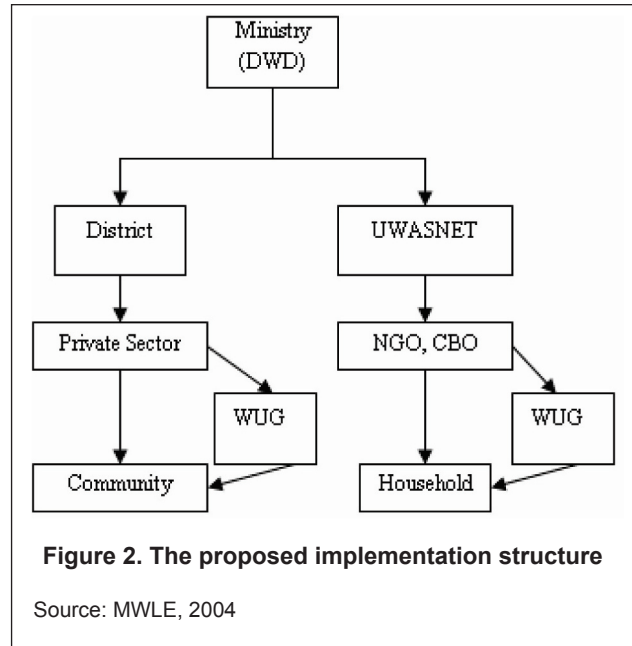
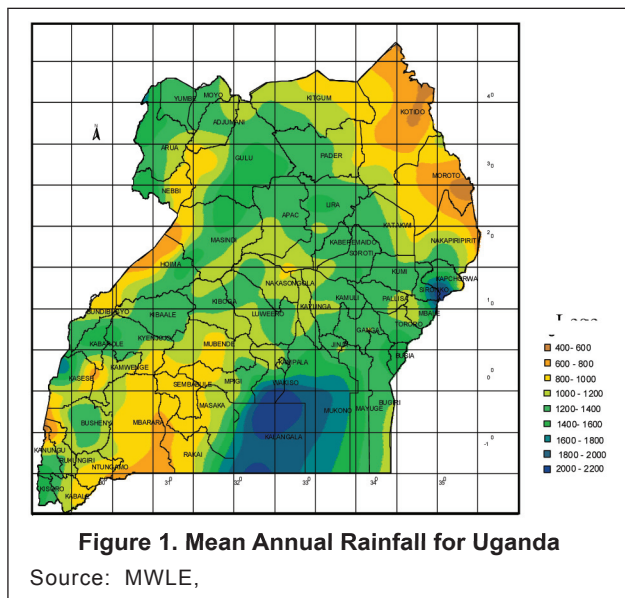
It was generally acknowledged that as in other technologies being promoted by GOU, and since GOU is charged with the responsibility of social service delivery to all people, it is prudent that financial support be provided for RWH programs. The GOU contribution was estimated at 90% for the majority of communal facilities, and 30% for the majority of household facilities. Expenses partially covered by this subsidy would include capital costs, mobilization, training, monitoring and evaluation. This proposed investment aims at addressing the imbalance in safe water coverage with consideration to the socio-economic factors. Table 2 summarises the projected 10-year investment by GOU and contribution of beneficiaries towards RWH facilities.

The training is essential for the communities, planners and promoters of the technology. A deliberate effort was recommended to impact the construction skills to the communities, which skills are useful even in other areas of life. The study recommended training, to be facilitated by GOU and targeting all stakeholders including planners, implementers,

extension staff, and beneficiaries. It was established among stakeholders that irrespective of their formal education attained, skills of RWH are easily grasped. It was recommended that beneficiaries be involved in all activities as a way of determining their desire for the technology and their sense of ownership. Since the beneficiaries are expected to meet part of the costs, especially for household facilities, it was considered necessary to also highlight the possible collateral benefits such as commercial applications in agricultural production, in addition to the health and hygienic benefits of using safe water.

**Table 1. Designed storage for different zones**

Zone		Communal	Household
A	Capacity (L)	100,000	7,000
	Reliability (%)	80	73 – 100
	Cost (US\$)	8,750	280
B	Capacity (L)	100,000	7,000
	Reliability (%)	84	78 – 100
	Cost (US\$)	8,750	280
C	Capacity (L)	100,000	7,000
	Reliability (%)	86	85 – 100
	Cost (US\$)	8,750	280
D	Capacity (L)	50,000	5,000
	Reliability (%)	80	86 – 100
	Cost (US\$)	6,250	200
E	Capacity (L)	50,000	5,000
	Reliability (%)	92	97 – 100
	Cost (US\$)	6,250	200



**Reference**

Finkel H.J., Finkel M, “Engineering measures: Water harvesting”. *Semi-arid Soil and Water Conservation*, 1986.

Gould, J., Niessen-Petersen, E., “Rainwater catchment systems for domestic water supply”. *Immediate Technology Publications*, 1999.

Ministry of Water, Lands, and Environment (MWLE), UGANDA, “The Water Action Plan”. GOU study report, 1994.

Ministry of Finance, Planning, and Economic Development (MFPED), UGANDA, “The national household survey 1999-2000”. GOU study report, 2000.

Ministry of Water, Lands, and Environment (MWLE), UGANDA, “The Rural Water and Sanitation Strategic Investment Plans (SIP15)”. GOU study report, 2000.

Ministry of Water, Lands, and Environment (MWLE), UGANDA, “The National Strategy for development of rainwater harvesting facilities for household, communal and institutional water supply”. GOU study report, 2004.

**Table 2. Ten-year investment in rainwater harvesting**

Year	Current	1	2	3	4	5	6	7	8	9	10	Total
GOU ('000US\$)	372	10,626	10,997	10,997	10,997	10,997	372	10,626	10,997	10,997	10,997	<b>109,973</b>
Beneficiaries ('000US\$)	173	4,890	5,063	5,063	5,063	5,063	173	4,890	5,063	5,063	5,063	<b>50,628</b>

Pereira, L.S., Oweis. T., Zairi. A., "Irrigation management under water scarcity". Agricultural Water Management 57, pp. 175-206, 2002.

Rubarenzya, M.H., "Analysis of rainwater harvesting by PARCHED-THIRST model". MSc Dissertation. Katholieke Universiteit Leuven/ Vrije Universiteit Brussels, 2003.

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