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Market Brief

Rooftop Rainwater Harvesting

Insights from Uganda

Preface

This market brief is an output of the Technology, Markets and Investment for Low-Carbon and Climate resilient Development (TEMARIN) project, that is carried out in two African countries, namely Kenya and Uganda. The project is funded by the Danish Ministry of Foreign Affairs and is implemented by the UNEP Copenhagen Climate Centre. It aims to support countries in accelerating the transfer, diffusion and uptake of specific climate technologies. The project focus is on strengthening domestic markets for climate technologies, removing bottlenecks for domestic firms operating in these markets and increasing cooperation among private, public and international actors to build global and national partnerships for upscaling implementation.

This market brief contributes to the project's overall aim by undertaking a detailed scoping and analysis of the contemporary state of rooftop rainwater harvesting (RRWH) in Uganda. It provides an analysis of the respective socio-economic conditions as well as the enabling environment, policies and support structures that are involved in the diffusion of the technology. Further, it investigates the key drivers and determining factors that determine the uptake of the technology. The brief provides empirical insights into the Ugandan RRWH market and the regime it operates in, as well as current barriers to the further uptake of the technology.

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1. Introduction

The Ugandan government has set out an ambitious plan to provide safe and reliable access to water resources to all by 2030 and has developed comprehensive policies and frameworks to support that plan. While this target is already within reach when it comes to urban areas (92% accessibility of water), rural settlements are struggling in achieving water security, as only 66% of Ugandan villages have access to clean water (MWE SSIP 2018). Reaching remote areas is particularly difficult, as the establishment of large-scale water infrastructure is financially constraining (MWE SPR 2020), making the exploration of alternative water sources ever more important. Here, climate technologies such as Rooftop Rainwater Harvesting (RRWH) can play a vital role in providing water access to rural Uganda, while simultaneously building climate resilience.

In Uganda, temperatures are predicted to rise in the coming decades, impacting rainfall seasonality and overall rainfall patterns in the country. As a result, the frequency and severity of extreme weather events such as droughts, floods, inundations, and landslides are predicted to increase. Given the vital role of water to socio-economic development, shifting availability of the resource will potentially have adverse impacts on Uganda's economy and society.

Mitigating climate related risks by diffusing technologies that enable adaptation to future climatic conditions is thus key to building resilient communities in Uganda. Deploying climate resilient technologies that provide water access to all Ugandans and thus ensure water security in the country is particularly important, as the impacts of climate change can already be experienced today.

In order to enable and support Uganda in developing increased climate resilience, the country has recently completed working on its Technology Needs Assessment (TNA)[1] and a supporting action plan, respectively.

1 For further information on the TNA process: https://bit.ly/tech-action
Further information on the TEMARIN project: https://bit.ly/temarin
Further information on UNEP-CCC: https://unepccc.org/

The TNA is a country-driven systematic process for identifying, selecting, and implementing climate technologies for mitigating or adapting to climate change to support implementation of Uganda's nationally determined contributions (NDCs) and related technology-dependent climate actions at national level. It is a participatory process involving all relevant stakeholders to ensure understanding, acceptability, support, and implementation. The TNA plays a key role in promoting and facilitating technology development and transfer, supporting developing countries to identify appropriate technology options and implement them for their climate response.

The TNA in Uganda, as in other countries, seeks to assist in identifying and implementing potential technologies that build on existing national policies and investment plans, ultimately promoting climate adaptation and mitigation. The national stakeholders have prioritized water, agriculture, and forestry sectors within climate adaptation. Within the water sector, the TNA prioritised amongst others, RRWH as one of the technologies that can play a crucial role in climate change adaptation for the water sector in Uganda.

As part of the TNA process, a Barrier and Enabling Framework analysis was conducted, followed by a Technology Action Plan, proposing a range of different activities and measures to be taken to ensure the promotion and diffusion of the RRWH technology. Simultaneously, Uganda has developed its Nationally Determined Contributions (NDC) to reduce greenhouse gas emissions, supporting the Paris Agreement. Building upon the work of the TNA and NDCs the Technology, Markets and Investment for Low Carbon and Climate Resilient Development Project (TEMARIN) was developed. The TEMARIN project is a three-year, Danish-funded funded project covering Kenya and Uganda with the overall aim to support countries in accelerating the transfer, diffusion, and uptake of specific climate technologies. The project focuses on strengthening domestic markets for climate technologies, removing bottlenecks for domestic firms operating in these markets and increasing cooperation among private, public and international actors to build global and national partnerships for upscaling implementation. Within its water-sector component, TEMARIN seeks to deepen the understanding of the barriers to deployment of RRWH technology and analyse the market situation to further identify and implement actions with a potential to catalyse adoption.

The main objective of the TEMARIN water-sector component is to provide a focused push, through an analytical deep dive, to one specific technology prioritized in the water sector: rooftop rainwater harvesting.

The Technology Needs Assessment and TEMARIN

The Technology Needs Assessment process is organized around three main activities:

a) To identify and prioritize mitigation and adaptation technologies for selected sectors;

b) To identify, analyze and address barriers hindering the deployment and diffusion of the prioritized technologies, including the enabling framework for these technologies;

c) To conduct, based on the inputs obtained from the previous two steps, a Technology Action Plan (TAP), which is a medium/ long-term plan for increasing the implementation of the prioritized technologies. The Technology Action Plan outlines actions that are elaborated further as project concept notes.

The TEMARIN Project strives to support and promote the implementation of the initiatives developed in the TAP. Based on the outcomes of the TNA, the project seeks to strengthen domestic markets for climate technologies and to increasing cooperation among private actors, public actors, and international actors to build global and national partnerships for implementation.

The purpose of this is two-fold: 1. To improve the deployment and take-up of the technology in Uganda following the expressed priority of national stakeholders; and 2. to generate lessons on modalities and approaches for more effective implementation of technologies from TNA and NDC processes. In this regard, this market brief seeks to provide: i) comprehensive insight into the contemporary state of RRWH in Uganda; ii) barriers to the uptake and diffusion of the technology; as well as iii) potential opportunities that could arise from increased private and public sector engagement. The brief strives to set the scene for both public and private sector stakeholders, outlining market potentials and the measures that need to be taken to reach them.

Throughout the implementation of both the TNA and TEMARIN project, several reports and stakeholder consultation workshops have been conducted, providing valuable insight into the contemporary Ugandan water sector, with particular focus on the state of rooftop rainwater harvesting technologies in the country. This brief draws on the findings of these studies and workshops associated to the TNA for Uganda and the TEMARIN project, as well as existing reports and policies of the Ugandan water sector.

In a first step, the brief sheds light on the current and predicted future climatic/ geographical conditions that shape Ugandan water resources, as well as the policy context of the Ugandan water regime. Following this, the RRWH technology, its potential as well as the current state of the technology in Uganda is presented. In section 5, the brief considers the potential demand of RRWH, with a focus on households, public institutions and agricultural facilities that could benefit from an uptake of the technology. In chapter 6, the brief outlines the current RRWH market in Uganda, including the main suppliers and operators in the country. Finally, the brief discusses the challenges and opportunities for RRWH uptake in Uganda, considering the main barriers and proposed measures identified in the TNA and TEMARIN project.

2. Context

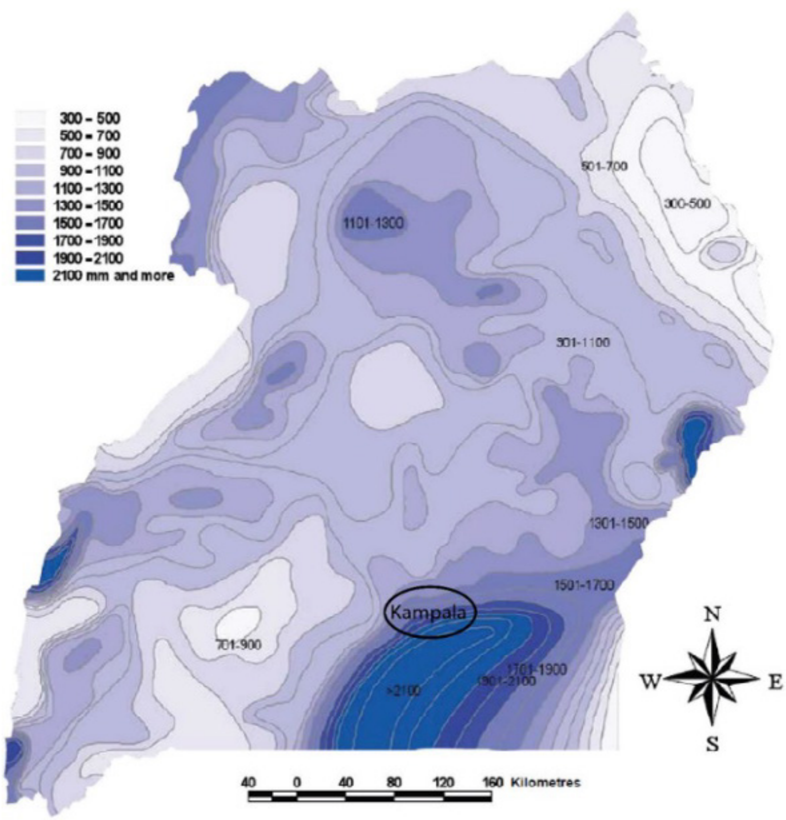
2.1. Ugandan Climate Context

Rainfall and water resources are unevenly spread as Uganda is experiencing high inter-annual variability of precipitation. Annual rainfall patterns range from 650mm in the North, to up to 2200mm in the Lake Victoria Basin (TNA).

Climate change is expected to have significant impacts on Uganda, leading to rising mean temperatures as well as alteration of rainfall seasonality and intensity. By 2050, an increase of 0.8-2.10C is predicted, likely accelerating evaporation of water and soil surfaces and evapotranspiration in vegetation. (SNC 2014). Rainfall may increase during seasons that are currently dry, possibly affecting perennial crops and post-harvest activities (USAID 2013). In Northern Uganda however, precipitation is predicted to decline by 50-150 mm per year. When rainfalls occur, they are likely to be intense, leading to an increase likelihood of floodings, landslides in mountainous areas, soil erosion and land degradation. (SNC 2014; CDC 2015; UBOS 2018) Further, the current wet season that ranges from March to May, might possibly shift forwards, while the September to November rainfalls may extend into other months. (NEMA 2010)

A combination of these challenges will affect the agricultural sector, as well as putting additional pressure on already scarce water resources in Uganda. At the same time, the Ugandan population is expected to grow, increasing water abstraction demand from 408 million cubic metres to up to 3.963 million cubic metres in 2050 (MWE 2015). As a result, growing water shortages coupled with increased water demand and abstraction may lead to increased effort for domestic water collection/supplies (e.g., walking long distances), the incremented consumption from unsafe water sources, migration, disruption of hydro-electricity generation, and even conflicts over resource scarcity amongst communities, putting livelihoods and human development at risk (NAPA 2007). In addition, incidents of prolonged drought also led to loss of live-

FIGURE 1. Average annual rainfall distribution in Uganda (Source: USAID 2013)



stock, crop failure and thus compromised food security. Some of the most vulnerable areas to those climate change induced shifts are the shores of Lake Kyoga, Lake Victoria, the Albert-Nile valley as well as the lowlands of southwestern and eastern Uganda (SNC 2014).

2.2. Uganda Policy Context

Uganda recognizes the importance of protecting its water resources and its crucial role in ensuring lasting socio-economic growth. To meet the nation's target of providing the population with safe and reliable water resources, the Ugandan authorities and water sector stakeholders developed a range of policies, legal frameworks and handbooks that govern the nation's regime towards improved sustainability within water resource management. When looking at the development of guidelines and policies that support the deployment and diffusion of RRWH solutions, the technology falls under the mandate of the Directorate of Water Development under the Ugandan Ministry of Water and Environment.

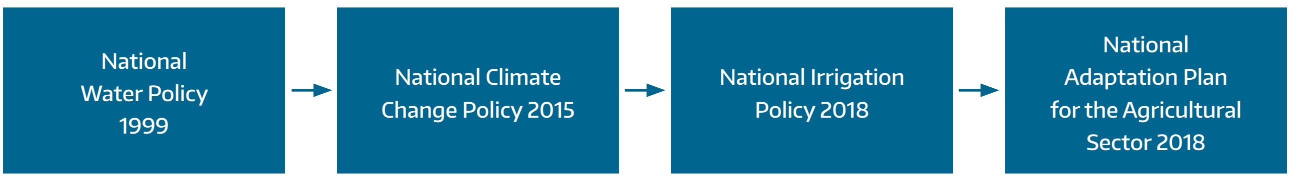
Uganda's first water policy was passed in 1999, with the government committing to clean and safe water for all (Baguma et al. 2012). The policy is the foundation for Uganda´s integrated and sustainable management, and further development of water resources. In 2003-2004 a rainwater strategy was prepared, focusing on improving overall awareness of rainwater harvesting practices, as well as the development of entrepreneurial capacities to provide the facilities (MWE 2017).

Like many developing countries, Ugandan water policy was initially, and still is, significantly shaped by the urgency to provide all citizens with safe and reliable access to water. Thus, the provision of large-scale bulk water capacities by the means of large infrastructure development such as dams was prioritized by the nation's authorities. Consequently, the country's main water policies (e.g., National Water Policy 1999; National irrigation Policy 2018) approach water as a commodity that enables socio-economic development.

Over the years, a manifold of policies have been developed that build on the National Water Policy from 1999, extending the focus to the promotion of the development of capacities that allow harvesting and utilization of rainwater for agricultural production. In this context, the policy promotes water harvesting technologies for irrigation and livestock development. In recent years, policies such as the National Climate Change Policy 2015, and the National Adaptation Plan for Agriculture 2018, put increased emphasis on the promotion of sustainable development and integrated water resource management. Here, rainwater harvesting, and respective water storage technologies are mentioned as pathways to build resilience in times of extended droughts and water scarcity (NAP 2018). Further, in the early 2000s, a rainwater strategy was developed, promoting the construction of rainwater harvesting facilities by NGOs and private sector actors.

Although the Ugandan government has been working on integrated water resource management in the past, and actively promotes the deployment of climate technologies in the water sector, existing legal and planning frameworks do not necessarily emphasize RRWH as a priority. Consequently, none of the policies and frameworks specifically address the issue of RRWH. Currently, RRWH technology is generally considered as a vital supplement to the National Water Policy 1999 and the policies that followed, where private households are strongly encouraged to access water on their own accord. This "self-supply" policy strives to motivate citizens to independently pursue minor improvements to their supply, using local and easy-to-replace solutions. (Staddon et al. 2018) The policies emphasize the deployment and installation of technologies and infrastructures; private sector back-up support, as well as the considerations of efficiency, sustainability and environmental awareness to improve the overall state of water accessibility in Uganda. (SDP 2018-2022)

FIGURE 2. Major milestones of Ugandan Water Policies and Frameworks



3. RRWH and its potential in Uganda

In Uganda, only 65 % of the population currently have safe and reliable access to water resources, meaning that they access water from an improved water source that is within 1 kilometre reach. (MWE 2015). In rural Uganda, approximately 7.4 million people are waiting for access to clean water. RRWH can play an important role to overcome those shortcomings by providing communities in remote areas with access to water. In most areas in rural Uganda, rainwater is still one of the safest and most economic sources of freshwater for domestic consumption. With an average rainfall of 500-1200 mm per year, RRWH has the capacity to provide clean water for a high number of households and can thus play a crucial role in achieving the country's national water access targets. The technology is considered as particularly promising in water-stressed and remote communities, as the high degree of flexibility offers small to large-scale solutions for both household and institutional facilities.

RRWH has a long tradition in Uganda, with first rudimentary facilities being developed centuries ago. The technology does not require a large set of different components to be operational. Rooftop rainwater harvesting collects water that runs off roof surfaces and directs it into a storage container where it can be utilised for many different purposes that can strengthen and improve local livelihoods (Danert and Motts 2009). The main components of RRWH units include a roof surface, gutters, pipes, a storage tank, filters, waterproofing agents and tap fittings. In addition, first-flush diverters, a pump, hard or concrete ground below the taps and channels to drain off excess water are required to minimize the creation of muddy conditions and soil erosion. As research shows, hard roof surfaces proved to be the most efficient in collecting rainwater. Such roofs can be found on 70% of the overall houses in Uganda, and in approximately 65% of buildings in rural areas (UBOS 2016). However, assessing the average roof-size is difficult in Uganda, as sizes vary significantly from less than 10 m^2 to more than 80 m^2 (Danert and Motts 2009). Apart from the roofing, the storage tank is one of the main key components of the technology. Often, they are ready-made or built on demand. The tanks can be stored on the surface, underground or partially buried. They are produced in different materials, e.g., plastic, mortar, polyfibre, tarpaulin and corrugated iron. In terms of sizing the storage tank, the ideal capacity for a rural household consisting of 6 people, is more than 10 m^3. This ensures all-year supply in areas with bimodal rainfall patterns[2] (Martinson and Thomas 2003).

If applied correctly, RRWH facilities not only provide water for domestic use and mini-irrigation systems, but also for watering of livestock. Consequently, RRWH enables households to access additional streams of income, as well as already established farmers to lower their water cost and to build resilience for times of drought. Further, the high degree of adaptability in storage and catchment facilities makes the technology equally attractive for domestic households, as well as for public institutions, schools, hospitals and local government offices. Furthermore, RRWH enables households and communities to take control over their water resources, without being constrained by the use of energy or chemicals.

RRWH units do not only allow for increased water security and independence from high water tariffs, they also have the potential to improve the overall resilience to the impacts of climate change. As parts of northern/ north-western Uganda are subject to biannual rainfall patterns, the region experiences extended periods of drought, followed by sudden and often severe rainfalls that cause floods and mudslides. This poses a threat to local households and communities, as runoff water from rooftops can quickly lead to soil erosion, putting the house structures at risk and therefore their residents' very livelihoods. Here, RRWH can be of great support, as a properly installed facility not only catches the water from the roof, but also channels excess water away, minimizing the creation of muddy conditions and potentially serious damage to building structures.

In addition, the technology offers a high degree of time saving, as water does not need to be fetched from other sources. This is a particularly important benefit to women and children, as this group usually carries the burden of collecting fresh water for the household.

2 Bimodal refers to a wet season with two rainfall peaks, separated by at least one dry month.

4. Current status of RRWH in Uganda

As mentioned above, RRWH in Uganda is promoted by the government through a wide range of policies, regulations, government strategic plans, investment initiatives and budgets. The government led initiatives involve a broad range of approaches and tools. Investment initiatives, e.g., focus on the development of facilities that demonstrate the technologies, striving to generate further demand amongst organisations, communities, and private sector. Policies, at the same time, emphasize the deployment and installation of technologies and infrastructures; private sector back-up support, as well as considerations of efficiency, sustainability, and environmental awareness to improve the overall state of water accessibility in Uganda.

However, translating policies into action remains challenging. As part of government and donor-funded initiatives, many schools, hospitals, and other public institutions were equipped with RRWH units to showcase the application of RRWH system. Yet, the spill over effects remained marginal, as financial constraints, and lack cultural awareness of the technology remained a significant barrier to the uptake of the systems.

Despite the encouragement of RWH technology uptake by public authorities, RRWH exploitation therefore remains far below its potential, contributing only 0.4% of the nation's water capacities in rural areas (SPR MWE 2018). This is a particularly disturbing shortfall, as there are currently over 7.4 million Ugandans that lack access to fresh water. The technology currently benefits a very limited number of households, with only 20,320 rainwater tanks serving approximately 122,000 people. Most of the systems can be found in western Uganda and in Rakai (MWE SPR 2020).

The reasons for the low exploitation rate of RRWH are manifold and vary between urban and rural areas. In urban areas the promotion of the technology is severely lacking and not integrated in water/ urban planning.[3] Further, ownership rights and lack of clarity on potential returns, as well as legal requirements make piped water a more favourable alternative to RRWH. In addition, many buildings lack gutters. For households in the rural areas, the biggest challenge to RRWH diffusion is the low access to affordable equipment, such as storage tanks (Blanchard 2012). Low awareness of alternative materials and the lack of capacity to maintain the RRWH units also constrain the technology uptake.

The Ugandan authorities have recently decided to improve RRWH deployment through several measures and initiatives, such as financing the installation of hundreds of demonstration units, actively promoting voluntary establishment of the technology throughout the country (MWE SSIP 2018). However, as Ugandan water policy is reliant on NGOs, donor-funded and private-sector engagement, the maintenance of installed RRWH units is often neglected, due to lacking skills and awareness of the technology, once funding is exhausted. As a result, such initiatives and government programs for individual households have had marginal impacts and are thus currently being phased out.

Furthermore, structures and capacities to promote RRWH were supposed to be developed, many key actors such as Assistant Water Officers, District water Offices and CDOs are not sufficiently enabled and capacitated to implement and monitor rainwater harvesting technologies (TNA BAEF Report Uganda 2020). As a result, many of the demonstration facilities on institutional buildings are deteriorated due to limited resources or skills (Staddon et al. 2018).

3 Stakeholder consultations conducted under the TEMARIN Project

5. Demand for RRWH

Given the current average annual rainfall of 500-1200 mm, harnessing the potential of rainwater by the means of RRWH technology deployment could bring water security as well as additional financial income to a broad range of actors. Three groups in society that could most benefit from RRWH can be identified: private households, public/ government institutions, and industries, particularity the agricultural sector.

5.1. Households

70% of all houses in Uganda, and approximately 65% of all houses in rural areas are equipped with hard roof surfaces, highlighting the potential demand for RRWH units. Although the potential demand for RRWH on a household level is high, installed RRWH units remain low. This is mainly attributed to the low number of rural households that possess the financial capital needed to access conventional loans or to cover the initial capital costs for the RRWH system. This has resulted in a low demand and thus low interest of private stakeholders to invest in the improvement of services (Tgayil-Blanchard& Mihelcic 2015).

Demand for RRWH units in the realm of individual households is driven by several factors, such as the affordability of the storage tank (the highest upfront cost of the entire system), biophysical conditions (rainfall, mountainous terrain, low ground water availability) or limited connection to or dissatisfaction with the main piped water systems (Martinson & Thomas 2003).

Once a decision on investing in RRWH has been made, households in rural communities often choose low-cost RRWH units. Here, storage options of 250 litre are preferred, as they tend to be the most affordable option. Although the tank size might not be the adequate solution for the respective household needs, this option often appears to be viable, as available surface area is limited (Blanchard 2012). Demand for high-cost options occurs only in few areas, such as in southern Uganda, where customers have the financial means to afford them. These more costly options provide the most reliable source of water in the given environment.

Many rural households are not aware of the different RRWH options, in terms of prices, parts and materials. For instance, above-ground water tanks are most used, as they are the most known of storage type. However, below-ground plastic tanks would be cheaper and more suitable for rural households (TNA BAEF Report Uganda 2020).).

Previously, there was almost no demand for RRWH systems in urban areas, as government support was non-existent, and ownership and legal concerns hindered the uptake of the technology. Although the adoption of RRWH units is much lower in urban settings than in rural ones, there are indications that this might soon change. Given the changes in storage sizes, increased availability of plastic storage tanks and improved aesthetics, the technology becomes more attractive for urban residents. Though plastic tanks are more expensive than metal alternatives, the demand for them currently exceeds the supply. Here, the preferred storage size for ready-made tanks is 500 litres.

5.2. Public Institutions

RRWH has proven to have great potential for institutional facilities, especially schools and hospitals. These facilities often consist of multiple buildings with large overall surface areas of hard rooftops, providing the ideal conditions for collecting large volumes of rainwater.

RRWH units have been installed on public buildings and institutions for several years, mainly for demonstration purposes. Currently, the Department of Physical Planning is working a holistic policy approach to include RRWH in the planning and approval of new building plans in Uganda.

The Ugandan authorities are already using RRWH units on public institutions to showcase the technology and to raise awareness and promote RRWH and its positive effects. Given the size of the respective buildings such as hospitals, schools, shopping centres, and public offices, they represent the main consumers for high-cost RRWH units. The storage capacity for such facilities is up to 500,000 litres. Here, the demand for especially plastic tanks is growing rapidly. Typically, masonry water harvesting tanks (e.g., Walugendo model tanks) of up to 500,000 litres capacity are constructed for such institutions.

5.3. Agriculture

Within the agricultural sector, rainwater harvesting allows farmers to ensure production, even during dry seasons. Combining it with other good farming practices, such as mulching and manuring, it can help increase production whilst reducing soil erosion (FAO 2018). Like other consumer groups of RRWH systems, unlocking the potential of small-scale rainfed agriculture requires comparably high investments.

RRWH units have proven to be of high potential for small-scale farmers, as they can help them to get over extended dry periods, when it would be otherwise impossible. The specific tank sizes depend on the needs, and investment capacities of the farmers, as well as on the size of the dwelling.

There have been initiatives to support Rainwater Harvesting (RWH) investments in valley tanks[4] and dams, to use the technologies for livestock watering. Demand for the technology remains high, as population growth and changing rainfall patterns put pressure on the sector. Although RRWH might not be the most efficient form of RWH in this particular sector (given the water intensity of some crops or cattle), the deployment of other RWH technologies such as run-off-based micro/macro-catchment systems is considered to be favourable (Kiggundu et al. 2018).

4 A valley tank is an excavated barrier that stops or restricts the flow of water or underground streams.

RRWH can help increasing production of agricultural goods, particularly for small-scale farmers.

6. Supply of RRWH

Private Sector Companies

Despite the comparably low application of RRWH technology, an extended network of private and public stakeholders has been established in the past decades. In 1997, the Ugandan Rainwater Harvesting Association was established to promote and create awareness of the diffusion of the technology.

Regarding the demand and supply of plastic and iron tanks (a key component of the RRWH system), as well as other equipment, most private companies such as Crestank, Polyfibre, Gentex, Skyplast, Afroplast, Acqua Tank, Victoria Nile, Generic chemical barrels, Roofings, Uganda Baati, Premier and Arsalan are based in or around Kampala and Jinja. This is mainly due to the client structure of these companies. Most of their customers are government entities and NGOs located in these cities. Hence, proximity to their offices becomes vital for their business. Moreover, business manufacturing grounds in close proximity to urban areas such as Kampala and Jinja allow private sector actors to easily access all relevant material required for local production.

This urban concentration of suppliers, however, makes it difficult for rural suppliers to access various tank options, ultimately lowering the options they can offer to clients, as well as increasing transportation costs for rural businesses. Retailers in remote areas, where tanks are most needed, are less motivated to stock large tanks because of the low ability of consumers to pay. The prices for the RRWH units range widely, depending on the respective dimensions of the roof and the required tank size. Tank prices span from UGX 17,000 for a 60-litre Afro-Plast tank to as high as UGX 4,645,200 for a 50,000- litre ferro-cement tank. The larger/ high-cost solutions are often demanded by public institutions and schools (MWE SPR 2020).

In many cases, these private-sector companies are catering not only to RRWH systems but are meeting the demand needs from the construction, plumbing, and allied sectors broadly. Hence the mainstay of these companies is diversified than just the RRWH business. In addition, several companies registered under the All Plumbers' Association have also been active in advising end-users on the suitable brands in the market (e.g. for tanks, pipes, gutters etc.) and in installing RRWH systems in Kampala. Overall, there is still limited data on the private companies and the market mechanisms around how RRWH uptake works.

From consultations, it can be gauged that tank manufacturers or suppliers play an important role in coordinating the supply chain for the RRWH systems, including mobilization of all equipment and specialists (e.g., design engineers and plumbers).

Imported ready-made tanks are often more expensive than locally manufactured ones. This is due to several factors that determine the price of the tank. However, some ready-made plastic tanks and accessories are manufactured locally using raw materials (virgin low linear density polyethylene) imported from Saudi Arabia, Egypt, China, South Africa, or India. Nevertheless, importing raw materials is costly, as the transport takes up to 45 days. In addition, Ugandan manufacturers pay multiple taxes including VAT (18% of the price), withholding tax (6%) and corporate tax (30% of profits). These all, combined with high water and electricity bills, contribute to the pricing.

In remote regions, local masons and small-sized private companies are hand-building the tanks needed for the units. They often construct the storage tanks out of bricks, corrugated metal, oil drums, mortar jars, tarpaulin, ferro-cement and interlocking stabilized soil bricks (Blanchard 2012, MWE SPR 2020). The installation of these built-in-place tanks is mainly carried out by youth and women groups that obtained training by NGOs. These artisanal service providers often receive fewer demands for their services once subsidies provided by the NGOs ended. This often leads to a disintegration of the group, which later becomes challenging for consumers in the event that demand resumes at a later stage.

There are several different tank options available, differing in storage size and cost.

Financiers and finance provision for RRWH systems

There are financial service providers including SACCOs, banks and microfinance institutions provide assistance to customers to obtain tanks and pay back the cost on favourable terms. One of these is the Katosi Women's Development Trust, which uses a revolving fund method. The Trust installs tanks for households on credit after they have been guaranteed by group members. Beneficiary households then pay back the cost of the tank over a period of three years at a 10% interest rate. Beneficiaries can choose which tank type and size they prefer.

Other credit institutions, including Opportunity Bank, Vision Fund, have a variety of packages to enable households to overcome the high upfront installation cost barriers, and other banks and micro-finance entities also offer support, for example, FINCA and Housing Finance Bank. Potential users are encouraged to approach them for assistance.

Companies can also partner with tank manufacturers to provide packages (such as grants, subsidized loans, revolving funds and zero interest loans) that help households overcome the upfront costs. The Alliance for Rooftop Rainwater Harvesting for Climate Change Adaptation is working on building such partnerships. If you are in an organized group or association, you can work with your leaders and artists to crowd-source through activities like the charity runs, walks, car washing etc.[5]

5 Stakeholder consultations conducted under the TEMARIN Project

7. Challenges and Opportunities

High upfront capital cost for end-users

A commonly mentioned barrier against the further development of RRWH capacities is the high upfront cost of the associated equipment such as pipes and other parts. On average, the installation of a 10,000-litre tank costs UGX 1.8 million per unit of a Gentex tank; 200,000 for the guttering; 450,000 for the pump and related equipment and 100,000 for pipeworks and fixtures. In total this amounts to UGX 3.2 million, requiring a payback period of approximately 6 years. Low-income households especially are struggling with these costs.

In order to investigate the main financial barriers for the uptake and diffusion of RRWH, activities of the TEMARIN project include approaching financing institutions to identify measures on how to overcome them. Though there are a number of actors that provide support the financing of RRWH facilities, private individuals are often unaware of them, and funding schemes thus remain underexploited. Consequently, one of main findings of TEMARIN is that financial institutions and the provision of loans cannot solely drive RRWH diffusion. Going forward, financial actors should engage with NGOs to create partnerships that combine awareness-raising initiatives with information on possible financing schemes of the technology.

Several financing schemes are in place, involving modest co-pay plus labour input into constructing the system, with a community or intermediary organization covering the rest of the bill (Staddton et al. 2018). However, these initiatives are rare and a further strengthening of local savings and credit schemes is necessary. Improvements in the financing modalities could have significant impacts on the demand of RRWH systems, as accessing the technology would become much more beneficial for individual households.

Logistical and supply-related challenges to service remote areas

Suppliers of RRWH technologies face significant barriers that limit their willingness to engage in the market and therefore prevent uptake of the technology. As the number of costumers that are able and willing to pay the considerably high prices for the storage tanks is quite limited, low demand puts many suppliers out of business or prevents them from starting one. In addition, RRWH can be supplementary to other climate technologies. Yet, monetizing those benefits remains challenging, further limiting the easy identification of revenue streams and business cases. (OECD 2022)

Accessing supply and materials in remote areas remains a challenge for many retailers. As road conditions are often poor and distances to economic hubs such as Kampala are long, warehouses with higher storage capacities for different tanks and other equipment would be needed. However, like private customers, many suppliers and local business do not have the financial capital to invest in a broad variety of different storage tanks, nor are they able to purchase several of them in advance. (From Stakeholder Consultations conducted under the TEMARIN Project)

Therefore, improving access to finance not only for individual households but also entrepreneurs is crucial. Unlocking access to capital creates the potential for several spill over effects, as local businesses would be able to operate more freely, providing offering different tank sizes to potential customers. Further, improved financial flexibility of the suppliers could potentially make the business more attractive, driving competition that eventually lowers cost for RRWH units. Several initiatives are currently in place where companies are establishing partnerships between manufacturers and financing institutions, aiming to offer packages to customers that reduce risks for both, suppliers and private costumers.

Throughout the TEMARIN Project, several stakeholder consultations have been conducted to engage with public and private sector actors

In order to facilitate a forum that voices the needs of the different stakeholders involved in the diffusion of RRWH, both from the public and private sector, striving to ultimately strengthen technology uptake, the TEMARIN project supported the formation of a "Alliance for RRWH Technology Deployment". The initiative aligned well with the envisioned one-program approach under the third National Development Plan (NDP III), which looks at joint initiatives by government, NGOs and private sector. So far, the alliance has been welcomed by strong buy-in of private sector companies and key government entities, such as KCCA, MWE and UNCST. The aim of the activity is to create an alliance that is self-sustaining, building a network of actors that work together to stimulate market deployment of RRWH for climate change adaptation, designing strategies and activities that are required to meet that goal. Through the alliance, stakeholders engaged in dialogue to discuss policy reforms and new regulation that are needed to further drive RRWH developments in the housing and urban development sectors.

Awareness and Stakeholder engagement

In addition to the financial challenges, one of the key constrains of RRWH uptake is the lack of public awareness of the technology and their beneficial impacts. Further, in those cases where households are aware of RRWH, social acceptance often remains low. Many households consider RRWH an accessory, rather than a necessity or technology that builds resilience. Many potential consumers are simply unaware of the technology, different systems, financing mechanisms and benefits of the technology. Moreover, residents often react n towards the deployment of RRWH facilities. This is due to concerns regarding the design of the tank structures, as well as the quality of the drinking water obtained by the technology. Different solutions exist in terms of tank placement as well as architectural integration of the tanks that can minimize the visual impacts of installing RRWH systems. Moreover, when treated correctly, water obtained by rooftop harvesting is as safe and clean as conventional piped water. Thus, raising awareness by actively promoting and demonstrating the socio-economic benefits of RRWH is of paramount importance.

Once a RRWH unit is established, it is rather difficult to alter it, and the opportunity to improve the chosen systems is limited (Blanchard 2012). This highlights the necessity to have a full overview of the available solutions. RRWH stakeholders therefore have to improve their overall awareness-raising measures, since many rural inhabitants are simply unaware of RRWH and the different technologies that exist.

In this regard, increasing community involvement in future RRWH projects to overcome these barriers is key for the further uptake of the technology. This is especially so, as government subsidies to the supporting RRWH deployment to individual households are expected to phase out in the coming years. By engaging with communities at an early stage, demonstrating the advantages of improved water resource management and climate resilience, social acceptance can be increased. Partnerships on RRWH deployment can connect with communities to reach a wider pool of households. By installing demonstration facilities in the community, residents can observe the technology and can gain first-hand experience on its benefits. Highlighting the additional benefits of RRWH to households, local businesses and farmers reveal the potential to shift pre-existing perceptions. Rising awareness that the technology can enable the improvement of both, individual and communal livelihoods.

The TEMARIN project pursued a number of activities that aimed to increase overall public awareness on RRWH. Amongst others, a catalogue of information on frequently asked questions around the technology was developed to provide Ugandan households with a brief, yet comprehensive overview of the technology. A documentary was made to motivate potential RRWH users to understand the urgent need to use the technology to harness and utilize the rainwater resources. In addition, the project engaged with different groups and organizations and facilitated a number of workshops and stakeholder consultations.

Inconsistent or inadequate information on policies and legal requirements

One of the major barriers for the uptake of RRWH is the lack of information, ranging from the different solutions to technical support and maintenance of the installed units. Consequently, having a better understanding of the overall RRWH market in Uganda, including insight into the different legal requirements, government policies, stakeholders and suppliers, as well as the wide range of different products and technologies that are available to Ugandan end-consumers is crucial. Gathering such information in one designated document would be beneficial for both, individuals that are interested in the technology, as well as retailers and suppliers that offer their services to the public. The opportunity to compare the range of different systems to make a more financially sound decision on future RRWH instalments could increase demand.

An elaborate list of stakeholders, future demands and potential project opportunities enables policy makers to streamline their efforts to make more sound decisions when creating a more enabling environment for the further uptake of the technology.

Thus, a joint approach from retailers, NGOs and government actors needs to be taken. Together, this partnership could reach out to local communities to raise awareness of the market deployment initiatives and promote the available services. Joining forces within communities can lead to lowering the cost for RRWH systems and thus create new business cases within industries that didn't even consider RRWH before.

In a similar approach, forming a platform that facilitates the constant exchange on ideas, perspectives and future initiatives, could further support the promotion of RRWH. Such coordination committee could gather relevant stakeholders from different sectors and departments to enable them to engage and take part in decision-making processes. Their input can also be valuable for harmonizing the planning of initiatives as well as the timely identification of synergies and business opportunities.

As outlined previously, actively engaging with government bodies and policymakers that influence frameworks and regulations is crucial for the effort to scale up RRWH in Uganda. Currently, a manifold of NGOs, international donors, as well as the private companies are engaged in similar activities, including proactively influencing water policies, advocating for lower tax on RRWH components. However, many of these initiatives take place independently from each other, often missing potential synergies. A coordinated overarching approach, combining cross-sectoral insights as well as bundling resources and expertise, could have a significant impact on successfully influencing policies. To realize the full potential of RRWH, all actors and entities that influence infrastructure, housing, and economic planning in Uganda, need to work closely and harmonize their planning and regulatory processes (Farahbakhsh et al. 2009; Baguma et al. 2012; Staddon et al. 2018). Including the technology into cross-sector policies and strategic planning creates demand and clearly points out business cases for the private sector. Several initiatives have been established that aim to mobilize the private sector to engage with public actors to ramp up investments in the deployment of RRWH for climate change adaptation.

A weak enabling environment for investments is one of the biggest obstacles that actors face when developing sustainable financing models (OECD 2022). Thus, actively working on improving water policies that prioritize RRWH is as crucial as advocating for tax reduction on parts and tanks. Currently, the Ugandan tax regime on RRWH equipment and associated raw materials is considered a mayor constraint for local suppliers and industries, as they often lead to decreased demand due to high prices for RRWH units. For instance, the 18% VAT rate contributes to the high price of the technology. Prices of RRWH equipment are likely to further increase, as are costs of production and the associated tax.

In addition, local manufacturers are unable to compete with systems that are produced and imported from outside the country, as lower tax requirements make them more financially viable for local households and industries. In order to increase affordability and demand, as well as to strengthen local production, tax legislation on RRWH equipment and the related raw materials is urgently needed.

These dynamics further highlight the need for a more inclusive and encompassing approach towards RRWH diffusion. Funnelling resources and insights to promote the uptake of RRWH reveals a great potential ranging from improving water accessibility, to creating business cases for private sector and industries, as well as overall enhancement of climate resilience and adaptation. In order to achieve this goal, Government, NGOs and the private sector working on the promotion of RRWH need to align their efforts to avoid excessive focus on one area, while neglecting others.

Under the TEMARIN project, strengthening of private-sector engagement was prioritized as a way of catalyzing RRWH technology deployment. Through three consultative meetings with stakeholders including market actors, government, NGO, research and academia, various actions for strengthening private sector engagement in RRWH technology deployment were considered and barriers to their implementation analyzed . The following were prioritized for implementation during the project period.

1. Formation of a market-led multi-actor Alliance for deployment of RRWH technology
2. Raising awareness on RRWH technology for climate change adaptation
3. Building on previous/ongoing initiatives on deployment of RRWH technology
4. Mobilizing private companies to co-invest in deployment of RRWH technology

In order to ensure successful implementation of these initiatives, the following activities where conducted:

1. Consultations with MLHUD, KCCA, parliamentary committee on climate change, MWE and CCD during monthly Alliance meetings.
2. Consultation with real estate developers in Kampala and Wakiso on the need for a regulation
3. Development of a catalogue of information on frequently asked questions around RRWH technology.
4. Holding of awareness creation meetings in Kampala and Mukono districts with messages tailored towards increasing demand for RRWH technology and related services.
5. Development of a documentary on RRWH to motivate potential technology users to understand the urgent need to use the technology to harness and utilize the rainfall resource.
6. One-on-one engagements with the following corporate companies using a checklist. FINCA, Housing Finance Bank, National Housing and National Water and Sewerage Corporation.

Overall, the TEMARIN project has enabled mobilization of a RRWH Alliance with strong market-actor leadership, which has great potential in taking ownership of and sustaining RRWH technology deployment actions beyond the project time line. Private companies were difficult to access, but the few that gave the Alliance members audience, especially housing estate developers and banks responded positively to co-investing in RRWH. If the Alliance continues to build these conversations into actual commitments, there is strong potential to mobilize additional financing options for enabling RRWH.

References

Baguma, D., Hashim, J. H., Aljunid, S. M., Hauser, M., Jung, H., & Loiskandl, W. (2012). Safe water, household income and health challenges in Ugandan homes that harvest rainwater. Water policy, 14(6), 977-990.

Blanchard, J. P. (2012). Rainwater Harvesting Storage Methods and Self Supply in Uganda. Graduate Theses and Dissertations. https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=5175&context=etd. Accessed on 02.03.2022

CDC (Centers for Disease Control and Prevention) (2015). Public Water Systems. https://www.cdc.gov/healthywater/drinking/public/water_treatment.html. Accessed on 15.05.2022

Danert, K., & Motts, N. (2009). Uganda water sector and domestic rainwater harvesting subsector analysis. Washington, DC.

FAO. (2018). Guidelines on irrigation investment projects. Rome. Retrieved from http://www.fao.org/3/CA2608EN/ca2608en.pdf. Accessed 12.05.2022

Farahbakhsh, K., Despins, C., & Leidl, C. (2009). Developing capacity for large-scale rainwater harvesting in Canada. Water Quality Research Journal, 44(1), 92-102.

Kiggundu, N., Wanyama, J., Mfitumukiz, D., Twinomuhangi, R., Barasa, B., Katimbo, A., & Kyazze, F. (2018). Rainwater harvesting knowledge and practice for agricultural production in a changing climate: A review from Uganda's perspective. Agricultural Engineering International: CIGR Journal, 20(2), 19-36.

Martinson, B., & Thomas, T. (2003). Economically viable domestic roof-water harvesting. In Sustainable environmental sanitation and water services (pp. 281-284). WEDC.

Martinson, B., & Thomas, T. (2003). Economically viable domestic roof-water harvesting. In Sustainable environmental sanitation and water services (pp. 281-284). WEDC.

MWE (2015). Ministry of Water and Environment. Uganda National Climate Change Policy. https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf. Accessed on 26.06.2022

MWE (2017). Ministry of Water and Environment Uganda National Report, Water Supply Atlas. https://www.mwe.go.ug/sites/default/files/library/Atlas%202017_1_Introduction.pdf. Accessed on 01.06.2022

MWE SPR (2020). Ministry of Water and Environment., Water and Environment Sector Performance Report 2020., https://mwe.go.ug/sites/default/files/library/Water%20and%20Environment%20Sector%20Performance%20Report%202020.pdf. Accessed 05.05.2022

MWE SSIP (2018). Ministry of Water and Environment., Water and Environment Sector Strategic Investment Plan 2018., https://www.mwe.go.ug/sites/default/files/library/Water%20and%20Environment%20Sector%20Investment%20Plan%20%202018.pdf. Accessed on 27.06.2022

NAP (National Adaptation Plan for Agriculture) MAAIF (2018). National Adaptation Plan for Agricultural Sector. November 2018. https://www.agriculture.go.ug/wp-content/uploads/2019/09/National-Adaptation-Plan-for-the-Agriculture-Sector-1.pdf. Accessed on 14.05.2022

NAPA (National Adaptation Program of Action) (2007). National Adaptation Program of Action on Climate Change in Uganda. http://www.preventionweb.net/english/policies/v.php?id=8578&cid=180. Accessed on 12.06.2022

National Environment Management Authority (NEMA), State of the Environment Report for Uganda 2010., https://wedocs.unep.org/20.500.11822/9085. Accessed on 27.06.2022

OECD. (2022), Financing a Water Secure Future., https://www.oecd-ilibrary.org/sites/a2ecb261-en/index.html?itemId=/content/publication/a2ecb261-en. Accessed on 27.06.2022

SNC (Second National Communication) (2014). Uganda Second National Communication to the United Nations Framework Convention for Climate Change. https://unfccc.int/resource/docs/natc/luganc2.pdf. Accessed on 12.06.2022

SPR MWE (2018). Water and Environment Sector Performance Report 2018. https://www.mwe.go.ug/sites/default/files/library/SPR%202018%20%20FINAL_0.pdf. Accessed 01.04.2022

Staddon, C., Rogers, J., Warriner, C., Ward, S., & Powell, W. (2018). Why doesn't every family practice rainwater harvesting: Factors that affect the decision to adopt rainwater harvesting as a household water security strategy in central Uganda. Water International, 43(8), 1114-1135.

TNA Barrier Analysis and Enabling Framework Report, (2020). Technology Needs Assessment Report for Climate Change Adaptation. TNA report for Climate Change Adaptation in the Agriculture, Forestry and Water Sectors of Uganda. The Republic of Uganda. https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2021/01/adaptation-report-baef-uganda.pdf. Accessed on 26.06.2022

UBOS (Uganda Bureau of Statistics), (2018). Uganda National Household Survey (UDHS) 2016/2017. Kampala, Uganda; UBOS https://www.ubos.org/wp-content/uploads/publications/03_20182016_UNHS_FINAL_REPORT.pdf. Accessed on 02.04.2022

UBOS, (Uganda Bureau of Statistics) (2016). National Population and Housing Census 2014. Main report. Kampala Uganda. https://www.ubos.org/wp-content/uploads/publications/03_20182014_National_Census_Main_Report.pdf .Accessed on 07.06.2022

USAID (2013). Uganda Climate Change Vulnerability Assessment Report. https://www.climatelinks.org/sites/default/files/asset/document/ARCC-Uganda%2520VAReport.pdf. Accessed on 07.06.2022

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