

# Climate and institutional water resilience for ‘the left behind’

*Thomas Shavu, Marietha Thomas, Akila Marton, Anglican Dioceses of Kagera & Biharamulo, & Christian Engineers in Development*

## Introduction

Rainwater harvesting is a well-accepted ‘solution to water scarcity and climate extremes due to climate change’ (Heijnen, H, IRHA, International Maji Scientific Conference, Dar es Salaam, 2024)

*In mid-2022 a programme was started to train tank builders and to build tanks for marginalised people in western Tanzania **through local church partnerships.***

*To date, 9 RWH workshops have been held in six Dioceses, training some 160 people who have now built over 360 tanks of various sizes.*

## The Scheme

Aiming to ensure sustainability in on-going water delivery as well as in the safe use of RWH, the international sponsor, Christian Engineers in Development, is embedding the process within the most effective local community organisation, in this context, the local church.

The diocese, in collaboration with local pastors and evangelists, ascertains the most-needy households at grass-roots level, then supports trained masons to deliver tanks in the right way, motivating local support, sharing any problems/ improvement ideas. Diocese involvement assures that tanks are built for the most vulnerable. Water testing is carried out and repairs are made if required.

In a way the relationship is like that in a franchise, but with a reverse funds flow. Funds move from the global church to the national church through CED’s tap twinning programme. This programme invites donors in the UK to support tank building in Tanzania on the basis that access to water is a human right (UN General Assembly A/RES/64/292). In the West people have taps. In Tanzanian villages people have a right to one!

Responsible for overall ‘quality assurance’, CED continues to help through training and ongoing development of construction techniques, funding water quality testing and post construction evaluation, as well as marketing, both nationally to extend the programme to adjoining church districts & internationally to neighbouring countries.

## Description of tank building and experiences in construction

The Kagera Diocese has gained strong experience in constructing rainwater harvesting tanks since starting in 2021. The process begins with preparing a firm foundation, followed by assembling the wire mesh and formwork that shapes the tank. Layers of mortar are then applied and plastered inside and outside to ensure durability and prevent leakage. Finally, the inlet, outlet, tap, and cover are installed to complete the structure. Smaller tanks are cast against a sawdust-filled sacking mould.

## *Building for the Rain: Practical Challenges in Rainwater Harvesting*

Constructing rainwater harvesting (RWH) tanks is about far more than just mixing cement. It is a complex task that requires navigating challenging logistics, mastering specialized formwork, and ensuring precise curing. Drawing from recent workshops and field visits in Shinyanga, Kagera, and Biharamulo, the primary practical challenges faced by artisans in the field have been found to be:

### *The Logistical Puzzle*

**Logistics** often represent the first and most persistent hurdle. Transporting materials to remote villages is expensive, as delivery lorries often charge for full loads even for single small tanks. Once materials arrive at a central village dump, they must often be moved to individual sites by motorcycle, adding significant cost and effort. Furthermore, church procurement systems can be rigid, with challenges in handling petty cash for small, urgent items, which can stall a project mid-build. Even tool management is a practical concern; workshops have occasionally been disrupted by missing tools, requiring strict oversight to keep the work moving.

### *Mastering the Formwork*

The construction of the popular "pumpkin" tanks (ranging from 5,000 to 10,000 litres) relies on a **steel skeleton frame**. These frames are specialized and can wear out over time, necessitating a repair fund for long-term sustainability.

A critical step involves **sewing sacks (gunny bags)** onto these frames to create the mould.

### *The Sand and Cement Balance*

The quality of **sand** is perhaps the most critical factor in tank longevity; poor-quality sand containing clay or dust is cited as the primary cause of tank failure. Ideally, builders use **clean river sand** sieved to a maximum size of 5mm. If only poor sand is available, it must be meticulously washed in buckets until the water runs clear.

**Cement** usage must also be precise:

- **10,000-litre tanks** typically require between **18 and 20 bags** of cement, covering the plinth and multiple structural coats.
- **1,000-litre tanks** (often called Thai jars) generally use about **3 to 4 bags**.
- **Layering:** Masons apply mortar in several layers—typically three structural coats on the outside and internal coats for waterproofing.

### *Curing: The Secret to Strength*

**Curing** is a non-negotiable stage where many failures occur if skipped. Cement reaches approximately 85% of its design strength within the first two weeks, but only if kept constantly moist. Practical challenges include:

- **Shading:** Tanks should be covered with **tarpaulins or old sacks** to protect the "green" cement from direct sunlight and shrinkage cracks.
- **Watering:** The structure must be watered at least **3 to 4 times daily** for the first two weeks, and twice daily for another two weeks thereafter.

- **Controlled Filling:** To prevent a young tank from bursting under pressure, water should be added slowly—approximately **300mm per day** starting from the seventh day. Premature filling has led to catastrophic collapses.

### *Gutter Fixing and Leveling*

The final link in the system—**gutters**—is often the most difficult for masons to master. Achieving the correct **level and fall** (ideally around 1:60) is essential to ensure water reaches the tank without stagnating or overflowing. **Support spacing** is also vital; brackets should be placed approximately every 800mm to prevent the weight of the water from causing the gutters to sag or twist. While PVC gutters are common for large tanks, many smaller 1,000-litre projects use more economical **galvanized iron (mabati)** sheets cut into lengths to keep costs accessible for the poorest households.

When the work first began, a 10,000 litre tank typically took 9–10 days to finish. Today, thanks to the skills and efficiency gained through experience, the same tank can be built in just 7–8 days. This progress demonstrates the Diocese’s growing capacity to deliver reliable, durable tanks that provide safe water for vulnerable households.

## Quality Assurance Survey

A user survey was undertaken in May 2024, based on **WHO Sanitary Inspection Packages (2024)**, within the context of WHO ‘Minimum Evaluation Procedures’.

For the n=24 sample of the 51 domestic water tanks then constructed in Biharamulo / Kagera, an average of 6.6 people depended upon the 1,000 litre water tanks (avg. 40m<sup>2</sup> roof catchment) with two of the tanks empty at the time of the survey which was about one month into the two to three months dry season.

It was found that 42% of households had a first flush diverter (now discontinued due to complexity and cost), and 63% had a functioning ‘stones and charcoal filter’ at the entry to the tank. Some 29% of households had a dirty or ‘in poor condition’ tap, 2 of these on tanks that ‘require some repairs’.

## Water Quality testing

In the 2024 water quality testing (through a government laboratory), 71% were found to have zero E.coli, 21% having an average of 4.2 mg/l E.coli and one tank on 14 mg/l. It transpired that some tanks had been used to store water from other sources so may have become infected that way rather than through RWH.

Of the six houses with measurable levels of E.coli, four had a functioning entry filter. Seven other households reported zero E.coli even though they did not have functioning filters.

*Online search results indicate that ‘for rural, untreated water supplies in low-income countries, a range of 0 to 10 faecal coliforms (including E. coli) per 100 ml may be an acceptable minimum level, with up to 100 Total Coliforms/100 ml being potentially tolerable if necessary.’*

Initial results from a follow-on survey in February 2026 has found zero E.coli in the 30 household tank water samples but 70% having Total Coliform counts at a Mean level of 2.8. Notably the tanks which had maintained their charcoal treatment system reported zero total coliform.

Perhaps the testing at a different time of year has revealed different aspects about water quality issue.

## Usage

The 2024 survey found tanks reported to be used 4 times per day, an average of 4.6 buckets of (10l) being taken daily, with 92% of respondents reporting no further water treatment. Every household had access to another water source, whether it be a pond, a stream or the unreliable municipal supply.

Most respondents said the water tasted 'a little bitter' in the dry season. In the context of climate resilience, all respondents thought their climate had become a 'little wetter'.

## Conclusion

The 'hands-off' approach of an INGO delivering an ongoing 'tap-twinning' funding stream plus some level of quality assurance, demonstrates a model of Rain Water Harvesting that has an important part to play in 'ensuring no one is left behind' in the face of accelerating climate change.

Enabling a self-managed community group (religious in this case, overseen by the Diocesan Bishop) to train local masons, rather than an INGO inspired limited lifespan 'community water committee', or an overstretched local government, is providing a sustainable, cost-effective and reliable source of water (for most of the year) for those who need it most.

*One recipient told the interviewer "Before we had a tank my days were consumed fetching water. If I decided to go to get water, that was my day - nothing else got done.*

*The tank changed our lives. I can now focus on other things like taking care of my hearing and sight impaired husband and disabled daughter.*

*The tank didn't just provide convenience, it brought a profound sense of security and freedom". (source: householder survey, May 2024).*

When asked in the Dar Es Salaam International Water Conference, January 2025 "Who are the marginalized people, and how are they identified to ensure no one is left behind?" We were able answer confidently "The church has a strong system in place, from the diocesan level to the local level, with pastors, evangelists, and church leaders helping to identify marginalized people. We also collaborate with local government leaders to ensure no one is overlooked."