

Sustainable Livelihoods Program

**CONSTRUCTION,
MANAGEMENT AND
MAINTENANCE OF
BAMBOO WATER TANK**

Manual developed with a support from Scottish
Government through the partnership between
TRÓCAIRE and SCIAF

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Construction, management and maintenance of bamboo water tank

Training manual

Commissioned by Trócaire, the Irish Catholic Agency for Overseas Development.

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Water for
agricultural
production

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1. INTRODUCTION




Climate change is now a well-accepted reality and there is emerging evidence that climate change poses a threat for development in Rwanda. An understanding of the emerging trends of climate change and its effects in Rwanda is an important starting point in addressing the negative effects of climate change. The impact is significant and poses a threat to the country's economy varying across geographic areas, sectors, social and economic groups at the national level. In general, rural women, children and other disadvantaged segments of society will be the most affected socio-demographic groups.

Different organizations and ministries have already started to deal with possible adaptation measures focusing on the rural areas. It is in this line that Trócaire, an international development agency working in Rwanda since 1994, launched a pilot project named water for agricultural production with a support from the Scottish government through partnership with SCIAF. This project aims at integrating technologies and practices in rain water and waste water management for boosting agricultural production and increasing climate change resilience for small farmers.

Bamboo water tank is one of the technologies used by Trócaire's project to broaden the options available to poor rural communities and manage water more efficiently and sustainably, in the context of limited resources and climate threats. Bamboo water tank has been designed to harvest large amount of water for long period of time and it has an advantage of filtering harvested water before storage. Within water for agricultural production project, bamboo water tanks have been installed at household level in Kamonyi and Nyamagabe Districts through Trócaire partners (COCOF and IPFG respectively), in order to boost agricultural production with a focus on vegetables for poor communities in spite of the changing seasons.

This guidebook introduces "Bamboo water tank" as a rain water harvesting technology and gives guidance on the construction, management and maintenance of the tank. It can be used by the project beneficiaries for management and maintenance but also at all levels for the project duplication.

2. Types of technologies used to harvest rainwater through the project support.

Types of technology	Advantages (To be filled by the owners after 2 years of experience using them)	Disadvantages (To be filled by the owners after 2 years of experience using them)
 <p data-bbox="197 687 400 711">Bamboo water tank</p>		
 <p data-bbox="206 1062 392 1086">Plastic water tank</p>		
 <p data-bbox="165 1382 432 1430">Semi-Underground water tank</p>		



One of appropriate technologies based on its durability, low cost and built with local materials.

3. Bamboo water tanks advantages

1. The tanks are constructed with local materials
2. The price is less expensive comparatively to other types of water tanks
3. It has an advantage of a water filtering system
4. The cleaning and maintenance of the tank is easy.
5. The durability of bamboo water tank is very long compared to other tanks (>30 years)
6. It can be easily repaired by the owner when damaged

4. BACKGROUND OF BAMBOO

4.1. Bamboo and rainwater harvesting

Bamboo has historically been used as a building material due to its inherent properties, being regenerating, biodegradable with high tensile strength and light weight. Bamboo is the fastest growing woody plant on the planet belonging to the grass family. Most species produce mature fiber in about three years, much more rapidly than any tree species. Some species grow by up to one meter a day, and the majority of them reach a height of 30 meters or more.

4.2 Bamboo as a Building Component

In general, the techniques used in conventional reinforced concrete construction don't need to be changed when using bamboo for reinforcement. The same mix can be used as would normally be used for steel reinforced concrete. Concrete slump should be as low as workability will allow. High early-strength cement is preferred for minimizing cracks.

Bamboo reinforced concrete design is similar to steel reinforcing design. Bamboo reinforcement can be assumed to have the same mechanical properties. The following factors should be considered in the selection of bamboo culms (whole plants) for use as reinforcement in concrete structures: Use only bam-

boo showing a **pronounced brown color** (This will ensure that the plant is at least three years old)

4.3 History and experimentation of Bamboo water tanks:

Water tanks made from bamboo-cement has been reported in several Asian countries, Many researchers have investigated the use of bamboo for many structural elements but the analysis and design for water tank was not yet well established. At the Asian Institute of Technology, a 6 m³ capacity bamboo reinforced cement water tank was constructed in June 1983. The objectives was: to investigate long term behavior and to establish the advantage of using bamboo as reinforcement.

This tank has been observed for 5 years:

“The tank was kept alternately full and empty of water. The objective was to simulate the actual field condition. After five years, the tank has not shown any structural defects and bamboo reinforcement 0.3 m from the top was investigated and the tank was found in good condition. Observation of the tank continued”.

The same investigation have been conducted by ANA Rwanda in Kicukiro district, where the tank of 15 years old is still working and the tank was found in good condition

5. CONSTRUCTION PROCEDURE:

5.1 Selection of site

Prior to site selection consider the following:

1. The site should not be near with toilet, compost or any another hole
2. The site must be near the house to reduce spending on connecting materials from rooftop to the water tank

5.2. Materials

- | | |
|-------------------------------|---|
| 1. Stones | 7. Trees |
| 2. Big sand | 8. Water tanks annexes (tap, overflow, cleaning van...) |
| 3. Small sand (fine) | 9. Gutters, connection and filtering system |
| 4. Gravels | 10. Paints |
| 5. Cement | |
| 6. Bamboo in basket structure | |

5.3. Construction steps

Step1: Manufacturing of a suitable bamboo structure for:
- Good management of materials (cement & sands)
- Avoid the inclination of the water tank



Step2: Dig the foundation whose depth depends on soil resistance for avoid the collapse of the water tank



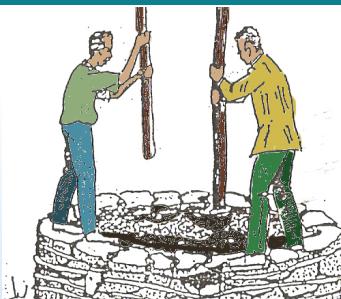
Step3: Introduce rubble and mix with the crushed concrete for solidifying the soil



Step4: Construction of foundation with stones



Step5: Solidify the foundation ground by hitting the ground repeatedly with wooden pestles for avoiding subsidence



Step6: Levelling whole the base of water tank for joining the foundation to the base



Step7: Putting the bamboo basket structure vertically on top of the foundation for

- Good management of materials(cement & sands)
- Avoid the inclination of the water tank

Fix wooden supports to prevent the tank structure falls down



Step9: Concreting and plastering the bamboo basket structure (external Vs internal)

Remove wooden sticks when cement is solidified and after applying two concrete layers



Step10: Fixing annexes and applying different concrete layers (inside and outside) for strengthening and levelling the water tank



Step11: Finishing works and painting(channeling water, painting the water tanks, connecting gutters to the tanks and installing plastic filtering system made with gravel and sand)



Construction period: the construction period depends normally on the bamboo tank capacity.

e.g.: the time required for the construction of a bamboo tank of 5m³ does not normally exceed six days.

Estimated cost: The cost depends normally on the bamboo tank capacity and project location.

Attention! Cracks are most often caused by :

1. Poorly proportioned plaster mixes (too much water, not enough cement, etc.)
2. Poor quality sand or water containing silt or organic matter
3. Improperly or unthoroughly mixed plaster
4. Thin or weak sections in the bamboo-cement wall
5. Failure to properly cure or shade the tank in the weeks following construction

MANAGEMENT AND MAINTENANCE OF BAMBOO WATER TANK

1. MANAGEMENT

In general, the owner must manage and maintain the water tank carefully. However the following instructions are recommended

1. Strictly forbid the making of changes

- we can neither increase or decrease the volume of the tank already built because the water tank should be damaged completely
- Any changes can weaken the water tank (changing the place where the tap, cleaning drain valve and overflow are located)



- If gutters are not well fixed a large amount of rainwater will be lost

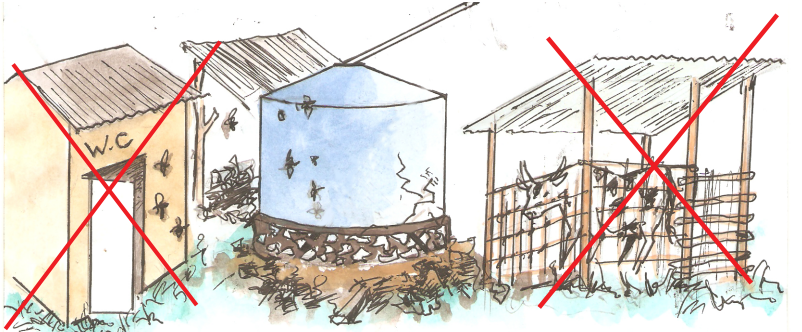
2. It is recommended to ensure that the tap and drain valve are closed when it's raining: Just to avoid water loss

3. The user must be a good manager, he must avoid to open and close the tap whenever it is not needed

- Taps and pipes are not for children entertainment, make sure that children do not misuse them and give some instruction to the whole family



- It is better to have a box attached to the tap with a locking system in order to manage water carefully
4. **The area around the water tank must be protected and kept clean (avoid some activities near the water tank like toilet construction, compost storage, barns)**
 - This can damage the water tank or cause some diseases linked to poor hygiene
 5. **Water from the rooftop can be clean but not safe for drinking, it must be boiled or treated with some water treatment products like Sur'Eau or "PURE"**



Water is normally treated with chlorine but it is expensive for the poor communities, that's why sur'eau is recommended.

Using **Sur'eau** product instruction:

- Do not put the product directly into the tank but treat water after fetching
 - One small cap of the solution treats about 20 liters of water
6. **Rooftops are not usually clean, it warns the user not to harvest directly the first rain drops for the rooftop to be cleaned first:**



Because this can contain large debris such as dead lizards, leaves of trees that can damage the filtering system or cause some diseases.

7. **The user must check regularly whether the gutters, connection and filtering system are well fixed:**
 - Because when gutters and pipes are separated they can cause erosion to the neighbors land and generate conflicts
 - Because rainwater from rooftop can run directly into the water tank without any control of waste
8. **If signs of cracking do appear, repair the cracked portion immediately:** as neglected cracks can grow and destroy the tank. Insects can also infest the tank through cracks, so be careful.
9. **The water tank must not be "empty" of water** to avoid cracks due to lack of moisture
10. Manage and control the use of the harvested water so that it fulfills its intended purpose

2. MAINTENANCE

1. Maintenance begins immediately after the tank has been built, be sure to keep the tank shaded for 10 - 15 days and splash the tank with water to help it dry slowly and evenly and cure without cracking.
2. **Never let the tank become completely dry** to avoid damage.
3. In daily use, keep the tank and the surrounding area clean and tidy, and do not allow any foreign matter to pollute the stored water
4. Repair shallow cracks on the tanks surface begin by roughing up the surface around the crack moistening the area with water, and then filling the crack with plaster. Smooth repaired portion
5. In case the tap or drain valve are clogged, the user removes, cleans and re-fix them using wrench and pliers. To fix the annexes you must use Teflon to prevent water drops
6. The owner must save some money to help for the eventual repairs and/ or replacing water tank annexes (tap, drain valve and plastic filter)



3. Cleaning

1. As we know the project objective is to harvest rainwater for agricultural activities, however we have to manage water very efficiently and objectively. The cleaning frequency should not be defined. it should be done“ WHEN NECESSARY “

The user must regularly check if there is no microbes or insects developping in the tank as these can contaminate the stored water. If any of these are noticed, the tank should be cleaned.

Let's remember that after cleaning, we must keep small quantity of water in the tank ($\pm 80L$) to avoid cracks normally due to the lack of moisture



2. The cleaner enters by the top hole of the water tank using wooden ladder and start to clean the inside of the tank with soap and water: The cleaner must be sure that all wastes are removed because some bacteria could develop in the pores of the interior layer.
3. The plastic filter should be removed and cleaned as much as possible. After cleaning, the user returns the plastic filter filled with sand and gravel also cleaned at the top hole of the tank.

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