PROMISING PRACTICES

Water harvesting technologies in the context of climate change
Lessons from Malawi and Rwanda

Acknowledgements

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We are also thankful to SCIAF staff for their trust, time, energy, wisdom and contributions.

SCIAF

The Scottish Catholic International Aid Fund (SCIAF) is the official overseas aid and development charity of the Catholic Church in Scotland. SCIAF supports people in 27 countries in Africa, Asia, Latin America and the Middle East, helping hundreds of thousands of people of all faiths and none to overcome hunger, poverty, war and natural disasters every year.

Inspired by the Gospel, our mission is to help the poorest free themselves from poverty by equipping them with the tools they need to survive and thrive. Working with the Scottish public, we put pressure on governments and big business to change the political and social systems that keep people in poverty.

Trócaire

Trócaire is the official overseas development agency of the Catholic Church in Ireland. Trócaire was established by the Catholic Church in 1973 as a way for Irish people to donate to development and emergency relief overseas. Their dual mandate is to support the most vulnerable people in the developing world, while also raising awareness of injustice and global poverty in Ireland.

The Scottish Government

The Scottish Government launched the Climate Justice Fund (CJF) in 2012 to help tackle the effects of climate change in the poorest, most vulnerable countries.

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Cover image Davie Ngozo, supported by CADECOM Mangochi, Malawi

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"Climate change continues to affect both countries, with rainy seasons regularly becoming shorter than the 'norm'."

Implementing partners

Rwanda

COCOF
COCOF Conseil Consultatif des Femmes (Advisory Council for Women) operate in the southern province of Rwanda, working to ensure the social, economic and political development of women through food security activities, climate change adaptation and women in leadership.

IPFG
IPFG Initiative pour le Promotion de la Famille et du Genre (Initiative for the Promotion of Family and Gender) operate in the southern province of Rwanda, aiming to develop and promote the socio-economic development of women, through food security projects, agricultural value addition, climate change and civic participation.

UNICOOPAGI
Union des cooperatives agricoles Integrees (Integrated Agricultural Cooperative) is a local cooperatives union, grouping together 22 farmer's cooperatives in three districts in the southern province of Rwanda. Its interventions are focused of food security, access to market for farmers, climate change adaptation and advocacy.

MMM Kirambi
MMM (Medical Missionaries of Mary) Kirambi is based in Gikongoro Diocese and operates in the southern province of Rwanda. MMM focuses its interventions on food security, nutrition improvement, climate change adaptation and behavior change.

Malawi

CADECOM Chikwawa
CADECOM (Catholic Development Commission in Malawi) Chikwawa operate in Southern Malawi, implementing projects focused on livelihood improvement and empowerment, climate change mitigation and adaptation, and emergency and relief.

CADECOM Dedza
CADECOM (Catholic Development Commission in Malawi) Dedza operate in Central Malawi, implementing projects focused on livelihood improvement and empowerment, disaster risk reduction, and climate change mitigation and adaptation.

CADECOM Mangochi
CADECOM (Catholic Development Commission in Malawi) Mangochi implement projects in the Mangochi, Balaka and Machinga districts of Malawi, focusing on livelihood improvement and empowerment, disaster risk reduction, climate change mitigation and adaptation, and gender equality.

Acronyms

CA	Conservation Agriculture
CADECOM	Catholic Development Commission in Malawi
COCOF	Conseil Consultatif des Femmes (Women's Consultative Council)
DRR	Disaster Risk Reduction
FGD	Focus Group Discussion
FHH	Female Headed Households
HDDS	Household Dietary Diversity Score
HH	Household
HIV	Human Immunodeficiency Virus
HVCA	Hazards, Vulnerability and Capacity Assessment
IPFG	Initiative pour la Promotion de la Famille et du Genre (Initiative for the promotion of family and gender)
IWRM	Integrated Water Resources Management
KII	Key Informant Interview
MHH	Male Headed Households
MMM	Medical Missionaries of Mary
NGO	Non-Governmental Organisation
SCIAF	Scottish Catholic International Aid Fund
SUT	Semi Underground Tank
UNICEF	The United Nations Children's Fund
UNICOOPAGI	Union des Coopératives Agricoles Intégrées (Integrated Farmers' Cooperative Union)

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Anesi Madzedze, supported by CADECOM Dedza, Malawi

FOREWORD

Climate change is an issue of justice for people in developing countries. Often those most affected have done the least to cause it. In his ecological encyclical, Laudato Si, Pope Francis urges all humanity to undergo an 'ecological conversion' and not leave this matter for future generations to deal with. The Holy Father is clear that climate change, poverty and caring for our environment can't be separated.

Inspired by Pope Francis and the Church's long tradition of teaching to care for God's creation, SCIAF is working to promote sustainable, natural resource management and affordable modern technologies in many countries around the world.

Working together with our Irish sister-agency Trócaire, and our local in-country partners, we are enabling communities in Malawi and Rwanda to adapt to their changing climates and help them cope with the damage caused by extreme weather and unpredictable seasons. Through two different projects funded by the Scottish Government's Climate Justice Fund, running in total from 2012-2017, we helped local communities improve their agricultural production and enjoy more reliable food and income, through improving water and crop management systems.

This publication reflects five years of practice and outlines the theory and design of the project, its results, key challenges and lessons, and the promising practices that emerged as a result. SCIAF thanks everyone who has made this work possible, particularly the Scottish Government and the communities in Malawi and Rwanda whose dedication and hard work achieved so much.

A C Dutton

Alistair Dutton
Director
SCIAF

INTRODUCTION

The Scottish Government established a Climate Justice Fund in 2012 to demonstrate Scotland's role in championing climate justice and supporting the development of climate adaptation solutions.

In earlier years the Fund had a particular focus on supporting solutions to manage water resources in vulnerable communities experiencing poverty, while addressing wider environmental issues. At the core of the Fund is the food/energy/water nexus, giving all three pillars particular focus. SCIAF won two funding awards from the Scottish Government Climate Justice Fund in 2012 for Malawi and 2014 for Rwanda.

Trócaire, a sister-agency of SCIAF, was established by Bishops in Ireland to respond to poverty and injustice in the developing world. SCIAF supported Trócaire and its in-country partners to implement two projects, funded through the Scottish Government's Climate Justice Fund. These projects focused on exploring and promoting water resource management and water harvesting systems, to support agricultural production in communities experiencing poverty and food insecurity in Malawi and Rwanda, within the context of climate change.

The publication is useful for individuals, organisations and donors working on the issue of climate change and supporting communities to implement their own solutions for adapting to, and building mechanisms to mitigate, the worst impact of climate change.

Local agricultural production in Rwanda, with support from UNICOOPAGI

OVERVIEW:

Setting the scene in Malawi and Rwanda

Malawi and Rwanda are vulnerable to climate change and extreme weather conditions. Both countries experience various climate hazards and their frequency and impact will only increase over time. This is a major concern to both governments due to the far-reaching impact of climate on water, food, energy and health. To address these issues a project was initiated in 2012 in Malawi and 2014 in Rwanda, with funding from the Scottish Government's Climate Justice Fund.

There are both similarities and differences in context between the two countries where the projects were implemented. The table on page 11 provides a high level snapshot of both countries.

Both countries have high population densities, with large proportions of people relying on agriculture as their main source of income. Climate change continues to affect both countries, with rainy seasons regularly becoming shorter than the 'norm.' The overall volume of precipitation has remained relatively stable over the years, but the intensity has changed significantly, with shorter, higher intensity rain-storms and dry spells within the rainy seasons becoming more frequent. Combine this with the high population density and the subsequent increased pressure on land use (deforestation, continuous mono-cropping and poor soil management), and the result is that farmers have become much less resilient to climate fluctuations in both countries.

The local contexts in which the projects have been implemented vary greatly. This variation is evident in the topography and ecology across all three sites in Malawi and between Malawi and Rwanda. All target communities in Rwanda are located in similar areas, characterised by steep hills and narrow valleys. In Malawi, the three sites are quite different. The Mangochi site is relatively flat and is located on the central plateau. The Dedza site is located on the central plateau, but is characterised by undulating broad valleys and rocky peaks. The third site in Chikwawa is located in the Lower Shire Valley, which includes a flood plain and cultivated areas around the edges of the flood plain.

The economic, political and social contexts in both countries are also quite different and the projects began and finished at different times. These differences make it extremely difficult to draw comparisons between each technology and across locations. A key finding is that while all the technologies work well, one cannot be recommended above all others. Instead, some technologies are more suitable in certain contexts than others, and there are many other lessons to be learned from these projects.

Malawi and Rwanda are vulnerable to climate change and extreme weather conditions.

Criteria[1]	Malawi	Rwanda
Human Development Index (out of 188, 2015)	170	159
Population density	Around 157 people per km2	Around 493 people per km^2
GDP per capita (US$ - 2016)	$1,100	$1,900
Topography	Narrow elongated plateau with rolling plains, rounded hills, and some mountains. Flood plains in the south	Mostly grassy uplands and hills; relief is mountainous with altitude declining from west to east
Climate	Sub-tropical; rainy season (November to March); dry season (March to November)	Temperate; two rainy seasons (February to April, November to January); mild in mountains with frost and snow possible
Average annual rainfall (mm)	725mm – 2,500mm (lowest in the southern plains)	780mm in the north east – 1,600mm in the west
Population below poverty line (%)	50.7% (2010 est.)	39.1% (2015 est.)
Agricultural land (%)	59.2%	74.5%
Area of Irrigated iand (km2)	740	96
Proportion of population involved in agriculture (%)	64.1%	75.3%

Source: UN HDI and CIA World Fact-book

1. Statistics are taken from a combination of sources including the UNDP's Human Development Index and the CIA World Fact-book.

THEORY OF CHANGE

Malawi and Rwanda's agricultural based economies are experiencing negative consequences of climate change, exacerbated by issues such as deforestation and population growth.

Rainfall is more erratic and concentrated, resulting in flash floods and periods of reduced rainfall. Most farmers rely on rain to water their crops, with little capacity to invest in other types of irrigation. Climate variability ranges from heavy rainfall to periodic drought and results in crop stress, soil erosion and poorer yields, while floods and landslides hamper agricultural production and food and nutrition security.

Both countries depend on monsoon rains for agriculture, though these are increasingly unreliable. Irrigation is therefore necessary for more effective farming. Crop production year round is necessary for food and nutrition security and economic growth. Thus both projects focused on creating irrigation systems in targeted communities.

There is variation in topography, ecology, soil condition and socioeconomic context so it is not advisable to have a particular water harvesting/irrigation technology across the different areas. It is important to identify appropriate water technologies which are more suitable to the local context and acceptable to communities.

It is essential to understand advantages and disadvantages of each promoted water technologies in context of climate change, need of communities, effectiveness and sustainability.

Disasters affect growth, especially amongst the most vulnerable, and destroy social and economic capital in affected areas. Steps can be taken to address underlying risk drivers to reduce disaster risk and the impact of climate change - and consequently, support sustainable development (UNISDR 2015). Communities must be involved in Disaster Risk Reduction (DRR) and developing community disaster risk reduction plans helps reduce the impact of future hazards. It is critical that communities are trained on this with involvement of local government and community leaders.

PROJECT DESIGN

Both projects were implemented as part of larger programmes to mitigate climate change impact through water management within communities.

Leniya Benson, supported by CADECOM Mangochi, Malawi

The projects aimed to enhance community resilience and improve agricultural production through water harvesting technologies. Brief project summaries are outlined below:

Malawi

Best practices and innovation in sustainable water resource management for enhancing climate change resilience in southern Malawi (November 2012 – June 2015)

This project was implemented in collaboration with Trócaire and its three in-country partners across Chikwawa, Dedza and Mangochi districts in southern Malawi. The project focused on improving agricultural production and food security through water harvesting and management technologies, and providing empirical evidence on the impact of these technologies. Various water systems for domestic and agricultural use were constructed, including in-field soil moisture improvement practices, community water reservoirs, household rainwater tanks, solar pumps, and a small dam. Water management committees were established and community members were provided with training on agroforestry and soil and water conservation techniques. Over 850 households were supported through the project.

Failos Kuchipoka, supported by CADECOM Mangochi, Malawi

Rwanda

Water for agricultural production (October 2014 – September 2017)

This project was implemented through Trócaire and its four in-country partners across nine villages of three districts in the Southern Province of Rwanda: Nyagisozi, Cyanika, Tare and Musambira. The project's key aim was to improve food and income security amongst the target population through improved agricultural production, supported by water resource management and harvesting technologies. Around 1330 households were supported and five types of water technologies were constructed: semi-underground tanks (SUTs); ferro-cement bamboo-lined tanks; polyethylene tanks; runoff ponds; and household wastewater recycling systems. Runoff ponds were built in fields for irrigation while water harvested through household systems was primarily used to irrigate vegetable gardens, in addition to meeting domestic needs. Training on climate change and adaptation also took place and Water and Climate Change Committees were formed, alongside supplementary activities adapted to each community such as tree planting.

Strategies and approach

Both projects were developed, managed and monitored by a consortium led by SCIAF with Trocaire as the lead partner. The additional partners represent national civil society with which both SCIAF and Trocaire have longstanding relationships. SCIAF is working through a partnership approach which involves the joint management and delivery of the project activities through local civil society organisations. SCIAF provided overall project management, strategic support, monitoring, reporting and liaison with the Scottish Government. Trócaire provided technical support and oversight to local partner organisations in each country. The technical expert in each country helped build the capacity of implementing partners and provided technical support in design and monitoring. In Rwanda, each partner also recruited a dedicated water technician to ensure direct oversight and strong project management at local level. In Malawi, existing local partner staff were used. Both approaches worked well. Both projects mainstreamed DRR and aimed to increase household and community resilience through improved agricultural yield and harvest predictability.

PROJECT RESULTS

All water technologies had a positive impact on household resilience in terms of income and food production. The extent of this impact varied greatly between households and communities.

The water harvesting technologies provided enough water for crop production throughout the year. This resulted in high agricultural yields for most households. A number of households sold surplus crops, generating additional income for individuals and groups.

Water availability was a major issue for households, with most of the responsibility of water collection falling on women and children who spend hours each day to find and transport water.

The project constructed most water systems in people's compounds, providing better access to water. Now, instead of collecting water, children are going to school regularly and on time, reducing their absenteeism. Women are able to spend more time working in their fields, running small businesses, participating in savings and credit groups and evening community meetings and socialising with family, friends and neighbours.

Though harvested water is planned exclusively for agricultural use, a number of project participants are using water for domestic activities such as bathing, washing clothes, cooking, utensil cleaning, cleanliness at home, washing food before cooking and drinking water after boiling.

Training in climate change adaptation and other related support provided by the project has enabled the project participants to adopt climate resilient approaches such as making and using compost to improve the soil fertility, mulching to maintain soil moisture and efficient water management.

Some of the irrigation systems were piloted in Malawi first and perfected in Rwanda. Thus the project results are better in terms of quality and quantity in Rwanda than Malawi. The learnings of the Malawi project were important for the success of the Rwanda project. Both projects are inseparable and need to be viewed together for better learning.


Philomene Mukamana, supported by UNICOOPAGI, Rwanda

MALAWI

The installation of rainwater harvesting systems, irrigation systems, solar kits, night-storage reservoirs, and a small dam and training on infield soil and water conservation and agroforestry practices led to healthier yields, soils and ecosystems.

The adoption of these water technologies and techniques resulted in 625 of households (508 FHHs and 117 MHHs) harvesting twice a year and diversifying their crops as they were harvesting once a year before the project intervention. Some other key achievements are listed below:

- 471 HHs (323 FHHs and 148 MHHs) accessed water for domestic purposes
- 432 HHs (261 FHHs and 171 MHHs) used water from the reservoirs for agricultural purposes
- 653 HHs (287 FHHs and 366 MHHs) applied soil and water conservation and management practices, substantially more than the original 425 target
- Water infrastructure, management and maintenance committees were established in all targeted villages with 50% female representation. All committee members were trained on the management and maintenance of the water infrastructure.

The project made deliberate efforts to empower women smallholder farmers and reduce gender inequality among participating households. This is reflected in the high number of female leaders in community based organisations and female participation in activities, as well as improvement in productivity of working practices.

The solar irrigation group in Chikwawa district, Malawi, saved enough money to purchase the 3.5 hectares of agricultural land they were irrigating, for around £370. They also bought new solar panels and had savings of £100 in their account.

Those benefitting from the night storage reservoir in Dedza, Malawi, reported a reduction in conflict between their community and downstream neighbours because of the project.

The project made deliberate efforts to empower women smallholder farmers and reduce gender inequality among participating households.

RWANDA

The installation of numerous types of water systems led to an increase in crop production of between two to ten times as much compared to those without these systems – indicating the powerful impact of the project in improving agricultural yield.

Several of the project's key achievements are outlined below:

- 1,330 HHs (797 FHHs and 533 MHHs) have the capacity to harvest twice a year by using rainwater harvesting and wastewater recycling technologies as previously they all were harvesting only once a year
- 951 HHs (567 FHHs and 384 MHHs) were supported to install the rainwater harvesting infrastructure and captured total 7,000,000 liters of water for vegetable production. The project installed three types of water tanks: polyethylene (plastic), bamboo and semi-underground
- 12 run-off water ponds with the total capacity of 3,230,000 liters of water were established and used by 389 HHs (232 FHHs and 157 MHHs) to irrigate their wheat – production of irrigated wheat increased from 3.2T/ha to 5.7T/ha
- 135 HHs (73 FHHs and 62 MHHs) were supported to recycle wastewater for vegetable production
- 1,330 HHs (797 FHHs and 533 MHHs) were trained on climate change adaptation and nine villages developed climate change adaptation plans
- Nurseries were established from June 2016 and a total of 108,500 trees were planted in the project target villages. An additional 11,000 trees were planted in Cyanika sector with Rwandan government financial support
- Water harvesting technologies were used for vegetable production. The main vegetables produced are: amaranth, beets, onion, green pepper, cabbage and eggplant. The most popular vegetables are carrots, beets, cabbage, onion and amaranth, and are produced by 82% to 91% of households. 64.9% households are producing vegetables between 2 to 4 cycles per year. Farmers changed production patterns by diversifying crops, bringing more land under vegetable production and by increasing productivity. All households are using vegetables for consumption and marketing surplus products.

In Rwanda many of the projects outputs were included in the local government's Annual Performance Plan and rainwater harvesting technology was included as key priority in the District Development Plan. They were consequently eager to support the project and contribute to its success.

+ 7,000,000 litres of water for vegetable production

The community based Integrated Water Resource Management (IWRM) planning aspect of the projects worked well in Rwanda with multiple hazards identified in each community. These were prioritised and included in community action plans. Some examples of the impact of this approach include:

- The adverse environmental effect of unregulated mining was identified as a key source of water contamination and soil erosion in one community. The community successfully lobbied for mining activities to cease until further investigations could be made and a solution agreed
- Trenches were dug along roadways and trees planted to prevent heavy rain eroding soil and to rebuild soil that was washed away
- The lack of potable water emerged as a key issue in most communities and the Water Resource Committees are in the early stages of developing advocacy campaigns to address this
- Free office space was provided by the local authority in Cyanika and Nyagisozi sectors to allow the two communities to store village maps and plans safely.

> **"When I have important national and international guests and have to show them innovative achievements in my district, I am always proud to take them to this Water Project and show them the rainwater harvesting technology and the vegetable gardens."**
>
> *Mayor Nyamagabe District, Rwanda*

Marie Rose Mukanyarwaya

My name is Marie Rose Mukanyarwaya and I live in Rwanda. A few years ago, I was among the poorest in my village; my husband was in prison and I lived in a small house with a straw roof with my three malnourished children. I weighed 35kg and used to beg for food from Kirambi Sisters (a local organisation).

Two years ago, when I saw friends in the neighbouring village using a semi-underground water tank to produce vegetables in their vegetable garden. I said, 'This could be the solution to my poverty'. I asked the Water Project to support me to build this water infrastructure, but they told me 'We can't, you are not in our area of intervention'.

With the help of my friends who are supported by the Water Project, I started to install my own vegetable garden but I wasn't sure how to get water. Thankfully my husband was released from prison and we began to fetch water for the vegetable production. Each of my three children had to bring three cans of water before going to school. It was really hard for all of us, so I decided that we had to build a semi-underground water tank - but we weren't sure how to do it and we didn't have any money.

We decided to sell our cow, which was given to us by a neighbour. With the money from the cow we went to our neighbours to learn how to install the water infrastructure and then started building the small house for the water tank. Once we built the house, we had no money left for the tin roof. I asked the Water Project to come and see what we had achieved so far, and they decided to give me the tin for the roof and a water pump manual.

For one and a half years now I have had my 10 metre semi-underground water tank. It is a miracle! All year round, I produce a number of vegetables – carrots, amaranth, cabbage, onion, beets, green pepper and eggplant.

Now I have very good income from vegetable sales and a reputation in my village as I share my vegetable production with my neighbours. With the income generated, I improved the nutrition of my family, bought a small field in the marshland where I also produce vegetables, and I have enlarged my house with a corrugated metal roof. I have also been able to buy good clothes for my family and can pay for their school fees and materials. It has changed our lives!

"It is a miracle! For 1.5 years I have had my 10 meter semi underground water tank. All year round, I am producing a number of vegetables..."

PROMISING PRACTICES

These projects demonstrated a number of promising practices that should be used to implement similar work and/or scale up new and existing projects. The promising practices are collated from across all of the project sites and discussions with project participants, staff and key local stakeholders in both countries. The promising practices are broken down into three phases:

1. Planning

2. Implementation

3. Follow-Up

1. Planning

Community selection and HH identification

Selection of communities in both countries was facilitated with the participation of local government officials, which is excellent practice. The criteria for selection focused primarily on poverty levels, government planning priorities and the experience and knowledge of local implementing partners with the involvement of communities.

Both countries utilised wealth rankings and the national poverty classification system in order to target the most vulnerable. The project participants were identified by communities through public meetings based on the above criteria, to ensure that the most vulnerable groups received proper support. Community leaders played a key role by providing additional information and by facilitating the process to produce a final project participant list. In Rwanda the wealth ranking process is known as 'Ubudehe[2]' and is implemented by the government every two years. In Malawi, a community wealth ranking exercise was conducted with each community defining their own wealth criteria. The communities consequently identified and selected households based on their wealth ranking at the beginning of the project.

Vulnerable household identification criteria:

- Households headed by children
- Households headed by women
- Households headed by elderly people
- Households headed or hosted by disabled people
- Households hosted by people living with HIV and AIDS
- Households headed by historically marginalised people

Community based disaster risk reduction management

There are long-term negative social and economic consequences beyond the immediate physical devastation of disasters, especially for vulnerable communities that are severely affected. Disasters are unresolved development challenges, which occur when risks go unmanaged. Communities were involved in risk identification, hazard assessment, vulnerability studies and risk analysis. The project in Rwanda included a component on the development of a community based climate change adaptation plan. A manual was developed to document this process. It aims to ensure that project interventions are based on local priorities and grounded in the community. Community-managed disaster risk reduction management, should be part of any development project. There is a clear mind-set change both at community and local government level. They realised that they have the capacity to manage the water resources and improve well-being of their community.

Selection of appropriate water technology

No water technology can be recommended above another; each context requires its own solution. The inclusion of multiple potential solutions for IWRM in the projects is recommended as a promising practice in itself. There are many factors to consider including value for money, the target group and project objectives. Annex 1 contains a simple matrix that can be used to guide technology selection. Annex 2 summarises the advantages and disadvantages of each technology.

IWRM planning and soil and water conservation measures should always be promoted, either in conjunction with water harvesting/irrigation infrastructure or as standalone technologies. This is by far the best value for money in terms of increasing resilience and water use efficiency.

2. **This is a national poverty screening process used in Rwanda to identify the most vulnerable HHs and to assist in the targeting of interventions to this group. There are six categories with 1 being the most vulnerable.**

2. Implementation

Infrastructure management and maintenance

The project supported communities to develop water infrastructure management and maintenance committees. All committees are collecting money towards the maintenance and management of the infrastructure. One committee in Msiyamphanje, Malawi, raised enough money in three years to buy the 3.5 hectare agricultural land (around £370) where the irrigation system was installed and also had substantial savings of around £100 in their bank account. They planned to use this to buy seeds and fertiliser for the next planting season. Another committee in Rwanda had 1.35 million Rwandan Francs (around £1,240) in their bank account. This was raised through regular contributions and group activities including day labouring. Some savings were loaned to individual members for minor repairs to their water tanks.

"I used to get just 50kg of maize from my plot but since applying compost I now get 300kg (a 550% increase!). Now I have enough to sell and eat."

Florence Mukanzaramba

Comprehensive package on infield soil and water conservation technologies

Infield soil and water conservation technologies promoted by the projects included mulching, rotation with legumes, diversifying crops, improved seeds, minimum tillage, pit planting, contour ridging, swales, composting and agroforestry. These measures are undoubtedly the most cost effective climate change adaptation methods for most smallholders. Florence Mukanzaramba is a member of a group of seven people who learned how to make compost through the project in Rwanda. She enthusiastically related, *"I used to get just 50kg of maize from my plot but since applying compost I now get 300kg (a 550% increase!). Now I have enough to sell and eat."* Infield methods for soil and water conservation need to be tailored to each context; what works in one area may not work in another.

Regular field visits

A hugely positive characteristic of both projects was the availability of dedicated field staff in each target area that regularly visited the field and provided ongoing mentoring and monitoring support. Dedicated staff were recruited by each partner to ensure smooth project implementation. These staff were supported by a network of field staff across the implementing partners as well as devoted technical staff at Trócaire's national office. Each community was visited more than once a week.

3. Follow-up

Sustainable access to inputs

The project in Rwanda trained construction workers who will be available for hire to build SUTs and bamboo tanks into the future. Both projects also stopped providing plastic water tanks early on because they were unaffordable and locally unavailable. The development of a simple pump system for the SUTs in Rwanda and the adoption of cheaper water filtration systems used locally available materials. In one community, attempts were made to work with a local microfinance institution to develop loans to support the construction of SUTs and/or bamboo tanks. This was a good practice and should be followed up closely to assess viability. In Malawi, training of local water maintenance technicians was included as a condition of tender for suppliers in the procurement process. This approach builds sustainability by removing dependence on the implementing partner as a middleman if something goes wrong.

Susan Simon, supported by CADECOM Chikwawa, Malawi

CHALLENGES

Rainwater harvesting was one of the central approaches within both projects. The single biggest challenge was how to target the most vulnerable individuals for this technology.

Rainwater harvesting systems work best with tin or tiled roofs yet, in Malawi, few of the most vulnerable HHs had such roofs. In order to demonstrate this technology, slightly better off HHs were targeted. The project made improvements to a few Rwandan houses to enable them to adopt the rainwater harvesting technology. Due to Rwandan Government policy, more Rwandan houses had metal roofs than in Malawi. A further key lesson was that plastic tanks and drip irrigation systems are not sustainable for most vulnerable HHs as they are unaffordable.

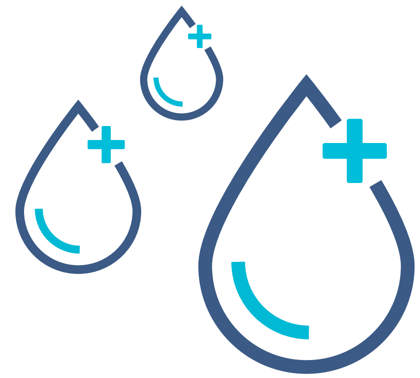
The project included the most vulnerable HHs due to different types of interventions being promoted. Where poorer HHs did not fulfil the physical criteria for rainwater harvesting, every effort was made to include them in soil and water conservation measures or as members of irrigation groups. For example, a HH that did not have a tin roof and could not afford to pay the monthly subscription fees to the irrigation group participated in training on low cost infield soil and water management methods.

Both projects targeted the most vulnerable people, including people living with HIV and AIDS, the chronically ill, people with disabilities, and the elderly.

Data was collected on these HHs but it was unclear which activities they participated in or how appropriate these were for their specific vulnerabilities. Data was only disaggregated to the level of male and female. It is important that data on these subgroups is collected and analysed to ensure the project is responding to the needs of the most vulnerable.

Watersheds were not considered when selecting communities for the project. Micro watersheds were assessed during community planning processes after the communities were identified. Selecting multiple communities in the same watershed would likely result in much greater cohesion in the planning process as well as greater impact of project interventions. This approach is less important in large relatively flat areas like Chikwawa in Malawi.

The households are not measuring their water usage. It is important to put in place a simple system of recording the water harvested and usage of water so that the households decide their priorities and manage available water.



Community based IWRM planning process

The community based IWRM planning process was very robust in Rwanda, but it took too long. Few plans were implemented by the final year of the project. This meant that the project interventions took place in parallel with the planning process, rather than as a result of it. Many communities had access to potable water as their number one priority, but as the planning process took long to complete, implementing partners had limited time to support communities in advocacy efforts on this issue.

In Rwanda the committees responsible for the planning process were the Water Resource and Climate Change Committees. These committees are part of local government structures, but prior to the project, they existed only on paper. Formalising these and building their capacity enabled project activities to be integrated into local government planning processes, which are quite strong in Rwanda. Both countries had executive committees at village level. These government structures should be used as the entry point for village level planning.

Village level planning should encompass all hazards, vulnerabilities and capacities at village level and not just climate change and water resource issues. This is important because climate change issues are usually interlinked with other problems and the community may have multiple priorities, not all of which are in line with this project. It is important that these community needs are addressed.

Vision mapping/exit planning

Neither project had a clear exit strategy. In Rwanda the plan was to facilitate the development of 'Vision Maps' after completing the village mapping and action planning process. The vision map could be a useful tool in the development of an exit strategy for the community. It is important that both communities and implementing agencies are clear on their responsibilities and that exit points are agreed at the outset.

Wealth rankings were used for targeting purposes in both projects, but these were not used as a means to monitor project impact. Re-wealth rankings could be conducted at midterm and end of project to assess changes in individual HH status and why these changes have taken place.

This participatory process could be used to establish a benchmark for exit.

During one of the debriefing sessions a Trócaire staff member highlighted the need to build a cadre of resource persons at community level who could sustain/rollout project interventions after exit. This could add greatly to sustainability and scale up. The project in Rwanda already trained skilled labourers on how to construct bamboo tanks and SUTs. Lead farmers were also trained in both countries, as were committee members. Formalising the capacity building required with communities could help define the community exit strategy.

Training in lifecycle costing and maintenance plans

None of the committees or individual HHs received training on budgeting and lifecycle costing of the infrastructure or their action plans. Monthly collections were based on what people agreed they could afford, rather than realistic expectations of what might be required to ensure sustainability. Loans were given at low interest rates, but repayments were not generally on time. This poses a significant risk to sustainability. Annex 4 contains a list of questions that should be included in the development of more realistic lifecycle costing and maintenance plans for committees, and HH infrastructure where applicable.

Cross visits for staff and project participants

The infield soil and water conservation techniques were found to be the most cost effective interventions, but there was scope to improve these considerably. It is expected that compost making, minimum tillage, crop rotations with legumes and mulching are near universally good practices, but as one female participant told us: *"mulching the garden means I use only half as much water for irrigation, but if the mulch layer is too thick the water doesn't reach the soil."* One size does not fit all and there is huge scope to learn from other organisations and share learning with them.

Demonstration plots worked well in some places, but the technologies demonstrated were generally dictated by the project staff. A 'Farmer Field School' approach might work better after an initial season of demonstrations. This process empowers farmers to design experiments to see what works well and what does not. Gross margins should always be used to assess effectiveness of any particular technology or combination of technologies. This is especially the case for irrigation schemes targeted at cooperatives or groups aiming to sell the bulk of their produce.

Each experiment/practice should be documented in detail so that promising practices can be replicated.

It is also important that the overall aim of soil and water conservation efforts is to develop sustainable practices that are adopted in every field in the target community/watershed. The project is successful if farmers outside the project adopt the technologies.

Integration of gender in project design and planning

Both projects have a key focus on women's empowerment and ensuring interventions do not increase the demand on women's labour. There is ample evidence of reduced labour in collecting water in relation to the rainwater harvesting systems, but there was no systematic monitoring of the impact of the project interventions on HH labour. The collection and analysis of this data will give excellent insights into the impact of the projects on demand for labour and enable management to make decisions based on this evidence.

Monitoring and evaluation

Due to the huge number of variables across the different project locations (soil type, topography, rainfall patterns, water use patterns, labour availability, crops selected, and others), it is difficult to establish recommendations on the volume of water required to irrigate a specific area of land over a growing season. Several participants in Rwanda related that during the first dry season (just two months) they maintained larger gardens than in the long dry season, when they decreased the size of their gardens considerably. The size of garden was considerably extended if the HH had access to a water recycling system, but it was difficult to determine how much bigger this should be.

During discussions on this issue the idea of requesting each irrigation group and a proportion of target HHs to keep diaries came up. This information could be used to inform the design of subsequent infrastructure and determine the messages that need to be relayed to project participants.

Sustainable access to inputs

Whichever technology is promoted, it is vital that the local market can provide sustainable access to the materials and/or services required to maintain and/or scale up the technology in the long term. Locally available materials and technology should always be the main focus. The ability of a vulnerable HH to access the technology (in terms of financial and human resource capacity) is equally important to physical access in the market. In Malawi, training of local water maintenance technicians was included as a condition of tender for suppliers in the procurement process. This approach can help build sustainability by removing dependence on the implementing partner as a middleman if something goes wrong.

RECOMMENDATIONS

Recommendation 1:

Participatory and holistic Hazards, Vulnerability and Capacity Assessments (HVCA) should be conducted in each community to identify the community's priorities (both in relation to natural resource management and other issues) at the start of the project.

- The entry point for planning should be the village level committee that represents the official decentralised system of government (e.g. Executive Committee in Rwanda and Village Development Committee in Malawi). Every effort should be made to avoid establishing new committees
- The HVCA should be completed within the first few months of the project to allow time for plans to be implemented.

Recommendation 2:

Exit Strategies should be agreed at the end of the HVCA and community planning process with the aim of moving towards a sustainable legacy in the project. A three-pronged exit strategy is recommended.

1. The community plan and vision map should be used to monitor progress towards an agreed 'end point'. The community's ability to plan and manage their own development should be included as key criteria at the end point
2. Participatory re-wealth rankings should be used to set benchmarks for exit and also help communities to see the changes that have been made as well as to analyse why these changes have come about
3. The project should agree with the community which resources will be left behind by the project. These can include infrastructure, but also the resource persons that were trained and how these will function after the project. The proportions of male and female resource persons should also be agreed.

Recommendation 3:

A checklist should be developed to facilitate group and individual training on lifecycle costs of infrastructure and budget planning.

This process should take place after group formation, but before any infrastructure is built. The inability to maintain infrastructure is the number one cause of poor sustainability and poor planning is a major factor in this. The budget should not be regarded as rigid and can be amended as necessary over time

Recommendation 4:

Cross visits should be conducted, first for field staff and then for project participants to learn which techniques have worked elsewhere and might be appropriate.

Recommendation 5:

Demonstration plots should be used in year one, but these should evolve into Farmer Field Schools in the following seasons where the farmers select the experiments they want to conduct.

- Experiments should be evaluated based on their relative gross margins
- Targets for roll out/adoption of promising practices should be included in the community IWRM plan.

Recommendation 6:

Male and female participants should be facilitated to document 'Daily Activity Logs' at regular intervals throughout the year (both rainy and dry seasons) to help households to understand the different work carried out by each, and together support and appreciate each other work/roles, and improve family life.

- A comparison should be made between HHs who have access to the new techniques/technologies and those who do not.

Recommendation 7:

All groups and a sample of target HHs should keep diaries detailing key information relevant to the project.

- Diaries should be checked regularly to ensure they are maintained
- Records should be maintained on the type of system they are using, the date they started using water from the system, what crops they planted, the area planted, if/when water ran out, date of harvest, volume of harvest, consumed crop verses sold and income generated, etc.

Recommendation 8:

Relationships should be built with service providers and local dealers to ensure sustainable access to the materials/services necessary to maintain/scale up infrastructure.

- This includes contact numbers for solar irrigation companies and installation contractors who may be better placed to provide services rather than local trade people
- Including service contracts and/or requirements to train local technicians as conditions in tendering documents is highly recommended.

ANNEX 1:
Example of a water technology selection matrix

This matrix is subjective and is based on observations from the communities visited. The list of criteria on the left is indicative only. Organisations planning similar interventions should adapt this matrix to their own needs and obtain broad stakeholder engagement before finalising their own.

Technology													
	Criteria	**Plastic water tank**	**Drip irrigation set**	**Bamboo water tank**	**Semi underground tank**	**Runoff water pond**	**Water recycling system**	**Submersible solar pump irrigation kit**	**Solar pump irrigation kit**	**Small solar kits**	**Night storage reservoir**	**Small earth dams**	**Infield soil & water cons. measures**
Project objectives	Increase ag production	Low	Medium	Low	Low	High	Low	High	High	Low	High	High	High
	Reduce poverty/ increase resilience	Medium	Medium	Medium	Medium	High	Low	High	High	Medium	High	High	High
	Empower women	High	Medium	High	High	Low	Medium	Low	Low	Medium	Low	Low	High
Value for money	Low	Medium	Medium	High	High	High	Medium	High	High	High	Medium	High	
Suitable location		All	Kitchen gardens	All	All	Depends on topography and rainfall	All	Must have access to groundwater <30m	Must have access to surface water	Must be a shallow water table	Limited suitable sites	Limited suitable sites	All (need to be tailored)
Target group	Labour constrained HHs	Y	Y	Y	Y	N	Y	N	N	N	N	N	Y
	Non labour constrained HHs	N	Y	Y	Y	Y	Y	N	N	N	N	N	Y
	Cooperatives/ group schemes	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y
Roof type	Metal/tile	NA	Metal/tile	Metal/tile	NA	NA	NA	NA	NA	NA	NA	NA	
Sustainability	Medium	Low (unless commercial enterprise)	High	High	Medium	High	Medium	Medium	Medium	Medium	Medium	High	
Potential for self-adoption	None	Low	Medium	Medium	Low	Medium	None	None	Low	None	None	High	

ANNEX 2:

Comparison of advantages and disadvantages of each technology

The following is the pros and cons of each of the individual water technologies promoted. This table illustrates the relative advantages and disadvantages of each of the water technologies.

Technology	Cost	Cost per HH (£)	Uses	Advantages	Disadvantages	Comments
Plastic water tank ($5m^3$) – Rwanda	750,000RWF	• £482	• Irrigation • Domestic use • Livestock	• Easy to install • Easy to move • No evaporation • No pump required	• High cost • Difficult to repair • Relatively short lifespan of ten years • Cannot be modified once installed	• Though the installed tanks are still working, this technology was deselected after the first year due to its high cost and the fact that it was not replicable by target groups
Plastic water tank ($1m^3$ – $10m^3$) with Drip Irrigation Kit ($100m^2$ – $200m^2$) – Malawi	MK140,000 – MK710,000	• £203 for $1m^3$ - £1,030 for $10m^3$	• Predominantly irrigation	• Easy to install • Easy to move • No evaporation • No pump required • Drip irrigation has 80% water use efficiency compared to 35% with a watering can	• High cost • Difficult to repair • Relatively short lifespan of ten years • Drip system requires constant maintenance and has a short lifespan • Sustainability of access to replacement parts for drip system • Cannot be modified once installed	• Tanks are used all year round. When rainwater has been used they are topped up with water from other sources to keep the drip system working • These have been distributed both to groups and individuals
Bamboo water tank ($5m^3$ – $8m^3$) – Rwanda	475,000RWF for $5m^3$ and 750,000RWF for $8m^3$	• £325 for 5m3 tank constructed by a non-participant • £450 for 5m3 and £710 for 8m3 constructed by the project	• Irrigation • Domestic use • Livestock	• Made from locally available materials • Easily repaired • 30 year lifespan • Low evaporation • No pump required	• Cannot be modified once installed • Requires skilled labour to construct (trained technician) • Takes a minimum of three weeks to construct • Limited maximum capacity	• Only feasible where bamboo is easily and cheaply available • Cost per HH has been calculated according to the local costs for own construction as this is likely more accurate than the cost to NGOs • The 5m3 capacity was considered too small so all subsequent tanks were $8m^3$

3 Ideally it would be better to compare cost per HH/m2 irrigated. It is impossible to make accurate comparisons here, as water is used for different purposes by different HHs. The infield soil and water conservation techniques used also have a huge impact on water use as does the choice of crops and other agronomic factors such as planting date.

4 Domestic use includes any combination of activities including bathing, cleaning household, washing dishes, water for livestock etc. In no instance did households mention that they used water collected from rainwater harvesting for drinking or cooking, though further study on this is recommended.

5 A local man building his own tank after seeing the ones made by the programme estimated his costs at 350,000 RWF, excl. transport, though his tank was not completely finished.

Technology	Cost	Cost per HH (£)	Uses	Advantages	Disadvantages	Comments
Semi underground tank (SUT) ($6m^3$ – $10m^3$) – Rwanda	250,000 RWF $6m^3$ and 350,000 RWF for $10m^3$	• £237 for 6m3 and £332 for 10m3	• Irrigation • Domestic use • Livestock	• Low cost • Locally available materials • Does not require skilled labour • Volume can be increased after installation • Easy to repair (replace plastic liner or re-plaster) • Low evaporation	• Requires a pump to lift water (labour requirement) • Higher level of water impurities/ germs than other solutions • Short lifespan of just ten years • Sourcing the correct specification of plastic for the 10m3 tanks is a challenge • Cannot be modified once installed	• This technology was by far the most popular in Rwanda due to its ease of replication and low cost. The addition of a simple pump was unique to the project. Other organisations had used a window with a bucket and a rope
Run-off water pond ($250m^3$ and $480m^3$) – Rwanda	3,400,000 RWF for $250m^3$ and 4,300,000 RWF for $480m^3$	• £122 (for a $250m^3$ pond)	• Irrigation only	• Large capacity • Easy to construct • Locally available labour and materials	• Requires pump to lift water (treadle pump currently used) • Too expensive for individual HHs • Requires a strong group/ committee to maintain/manage • Requires a large piece of land • High levels of evaporation	• Multiple ponds are required to irrigate a significant area of land • Calculations per HH are based on 110 members sharing four ponds of 250m3 each
Water recycling system – Rwanda	175,000 RWF	• £63 for the revised technology. The original cost was about £120	• Irrigation	• Low cost • Minimum space requirement • Made from locally available materials • Simple installation • Maximises use of already collected water – minimises labour	• Requires regular maintenance – the more it is used the more it needs to be cleaned • Short lifespan (depending on quality of plastic container)	• The unit cost has come down due to simplification of the design
Submersible solar pump (2 pumps with max flow rate of 113l/min) – Malawi	MK24 Million	• £815	• Irrigation	• Can irrigate a large area of land for a long period • Minimum labour requirement once operational	• High cost • Land availability and tenure issues need to be resolved • Only suitable where groundwater can be accessed • Sustainability - require a motivated committee to manage the system • High potential for theft of solar panels • Low output on cloudy days • Not replicable without external support	• These systems are high cost but also high impact if established effectively. This system is currently set up to irrigate 3.5ha even though it was designed for just 2ha

Technology	Cost	Cost per HH (£)	Uses	Advantages	Disadvantages	Comments
Superficial solar pump (max flow rate of 21m^3/hr) – Malawi	MK8,000,000 (€15,769)	£166	• Irrigation	• Can irrigate a large area of land for a long period • Minimum labour requirement once operational • Easier to maintain than submersible pumps	• Only suitable for surface water bodies • Removing water from these bodies may have negative consequences downstream • Sustainability - require a motivated committee to manage the system • High potential for theft of solar panels • Low output on cloudy days	
Small solar kits (4m^3 per day) – Malawi	MK1,055,000 (€2,080)	£20	• Irrigation • Domestic use • Drinking Water • Livestock	• Relatively low cost • Minimum labour required in collecting water	• Low capacity • Require a committee to manage/maintain • Ease of theft • Can overflow as pump runs whenever it is sunny • Regular water testing is required if being used for drinking water	• This solution has not been designed for irrigation purposes. However, HHs does take water from the pump to top up their plastic tanks and use in drip irrigation systems
Night storage reservoir (NSR) (700m^3) – Malawi	MK5,000,000 (€9,855.51)	£81		• Filling at night reduces conflict with downstream communities • High capacity • Easy to construct using local skills	• Requires regular maintenance to remove sediment • Limited applicability – must have perennial water source • Requires a committee to manage/maintain	
Small earth dams (21,746m^3) – Malawi	MK33 million (€65, 046)	£420	• Irrigation • Livestock	• Potentially very high volume • Construction costs can be kept down using local labour	• Evaporation losses • Requires an expert to conduct feasibility study and oversee construction • Siltation – catchment area may need to be rehabilitated as well • Only applicable in specific sites • Requires a large piece of land	• This dam experienced major problems due to 'once in a lifetime' flood damage • The calculation of evaporation was not accurate limiting the expected irrigation capacity
Infield soil & water conservation – Malawi & Rwanda	NA	Not available	• Increased quantity and predictability of yields	• Extremely low cost – only training required • Complement other technologies and increase water use efficiency • Long term sustainability of soil resource • Increase water infiltration and reduces runoff	• Do not extend the growing season into the dry season • Takes time to adapt approaches to local conditions • Require a very high level understanding of the technologies and their potential application • Some technologies can take multiple years for benefits to become evident	• There are a huge variety of technologies being tried in both countries. These include, mulching, crop rotation, minimum till, pit planting, contour ridges, swales, terracing, compost making, improved seeds and agroforestry

ANNEX 3:
Checklist of recommendations for water project implementation (recommendations)

Planning phase

1. Community selection

a. Should be done in participation with implementing partners and local government

b. Have a predefined set of criteria based on your organisation's strategic objectives

c. Target multiple communities in the same watershed where possible

d. Take a landscape approach so that integrated water resources management can be planned and implemented

e. Learn the water resources laws and related laws and regulations for the country and share them with communities and all partners

2. Complete holistic water resources identification and assessment, hazards, vulnerability opportunities and capacities planning with each community

a. This process should be completed for all communities within the first few months of the project

b. Action points that the project will address should be agreed with communities

c. Gender analysis of the possible impacts of the project. Facilitation of discussions between female and male participants about roles and tasks and sharing of them together with reconfiguration of domestic tasks

3. Develop an exit strategy in consultation with communities. Ideally this should include benchmarks for:

a. Changes in community wealth ranking

b. Community resource persons trained

c. Capacity of community to implement strategic plan

d. Condition of the water resources

4. Select appropriate technologies

a. Develop a selection matrix to select appropriate water technologies

b. Expose participants to a wide suit of technologies on and off site and support their selection

5. Targeting

a. A 'nothing for nothing' approach should be adopted where those who are most vulnerable receive the most support and where everyone is expected to contribute something. This can be in the form of labour, materials, expansion, pass-on or ongoing monitoring (keeping diaries, etc.)

Implementation phase

1. Training to committees/groups

a. A standardised approach to building the capacity of committees/groups should be adopted. This should include group formation and dynamics as well as specific technical trainings

b. Every committee/group should have a constitution

c. Capacity should be reassessed regularly

2. Budgeting

a. Both groups and individuals should be facilitated to draw up budgets before deciding how much each person needs to contribute/save

b. Budgets should be reviewed annually and revised accordingly

c. This process should happen before construction is underway

3. Comprehensive package on infield soil and water conservation technologies

a. These technologies are the most cost effective and should always be included either as the main activity or to complement irrigation interventions

b. The project should start off with demonstration plots in the first season, but these should evolve into Farmer Field Schools in subsequent seasons

c. Cross visits, both internal and external, for staff and participants should be included

4. Diaries should be kept by groups and individuals to record details of implementation as well as to collect monitoring data on impact on nutrition and men and women's workload

5. Staff: community ratio

a. The project should have dedicated staff to ensure smooth implementation

b. The optimum number of communities per staff member should be calculated based on the fact that each community should be visited for at least on full day each week

c. Office time also needs to be factored in

Follow-up phase

1. Sustainable access to inputs

a. Whatever technologies services are promoted the project must ensure that these can be accessed by the project participants after the project has finished

2. M&E

a. Participatory Annual Reviews should be the cornerstone of the M&E system

b. Progress against the community action plan and vision map should be discussed

c. An exit strategy should have been developed during planning and progress against this should also be jointly monitored

d. Meaningful indicators of women's empowerment should be developed and monitored.

ANNEX 4:
Sample questions for lifecycle planning on infrastructure costs

Some of the below questions are relevant for both groups and individuals and some are only relevant for groups.

01. What activities need to be budgeted for?
- Security, repairs, implementing action plans, social fund, expansion, etc...?

02. How much are repairs expected to cost per year?

03. How much will repairs cost over a 5-10 year period?

04. Is a rainy day fund required and if so, for what (e.g. theft of solar panels)?
- How often is this likely to happen?

05. How do we ensure everyone pays their share on time?

06. What happens if someone does not pay their share or repay a loan on time?

07. Will loans be given?
- What will loans be for?
- How much interest will be charged?

08. Who looks after the money collected and where will it be stored?

09. Are there likely to be losses due to inflation?

10. Should the group consider investing in productive assets rather than savings?

11. Is there a plan to save money to expand the system/construct more infrastructures?
- How much will this cost?

12. Is there potential for saving enough money to 'pass-on' the infrastructure either to new communities or more HHs within this community?

13. How much is required to be saved on an annual basis?
- How will this be collected/saved?
- Will regular contributions be enough?
- Will some group level activities or fundraising be required?

A water harvesting tank implemented with support from IPFG in Rwanda

Project participants celebrating at a borehole in Malawi, implemented with support from CADECOM Dedza

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