Chapter 11

Rainwater harvesting for improved food security and environmental conservation; Experiences from Malawi

Macpherson Nthara

Rainwater Harvesting Association of Malawi
macphersonnthara@yahoo.co.uk

Keywords: conservation, food, environmental, Malawi, rainwater harvesting, security, water

11.1 INTRODUCTION

The scarcity of water in different parts of the world has over the years forced people to find alternative sources of water. Rainwater harvesting (RWH) is one such technology that has proven to be more viable to complement conventional methods of water supply. Agriculture remains the main source of livelihood in semi-arid areas of Africa and will continue to dominate for the foreseeable future. However, land degradation and climate change have negatively impacted water resources and this is has led to reduced agricultural productivity leading to food insecurity in a number countries including Malawi. Rainwater harvesting technologies are required in these areas to impart stability in crop production during sub-normal years. The techniques help to maximize soil-water availability to crops and hence optimize crop yield per unit of available soil water.

11.2 CONTEXT

11.2.1 Geographical location

Malawi is a landlocked country located in Southern Africa between latitudes 9°22′S and 17°03′S and longitudes 33°40′E and 35°55′E (Figure 11.1). The main rain

Editor(s): José Arturo Gleason Espíndola, César Augusto Casiano Flores, Raul Pacheco-Vega and Margarita Rosa Pacheco Montes
doi: 10.2166/9781789060584_0141

bearing systems are the Inter-Tropical Convergence Zone (ITCZ) and the Congo Air Boundary. Annual rainfall ranges from 700 to 2400 mm with mean annual rainfall being 1180 mm. The country's population of 4.4 million in 1966, has quadrupled to 17.2 million as of 2017 and is still largely dependent on natural resources. By 2022, the population is projected to grow to 19.4million and may continue to exert adverse pressure on access to services and overall socio-economic development of the country (GOM, 2017).

Malawi is relatively well endowed with water resources with 20 per cent of its total area covered by surface water bodies. While there seem to be abundant water resources in the country, the distribution across the country is irregular and varies by season and year. Ninety percent of the runoff in rivers and streams occurs between December and June, and only 0.1% of this is estimated to be captured for later use (GOM, 2017). Malawi is categorized among water stressed countries with less than 1700 cubic meters of freshwater per capita. The country's economy is largely dependent on agriculture and water resources are therefore central to socio-economic development. Water consumption in the country has undergone considerable increase for both rural and urban areas due to demand for domestic (3%), industrial (10%) and agricultural use (85%) (Mloza-Banda *et al*., 2006). The stressed water resources are further challenged by high population growth, climate change and variability, increased sedimentation in rivers, lakes and reservoirs due to catchment degradation.

The Malawi Government estimates that 65% of the population has access to potable water. However, due to poor maintenance of supply systems only 40% of the population is actually served with potable water. The most common type of water facility used in Malawi is an unprotected well or spring while the most popular safe sources of water is a borehole. It has been observed that in rural areas, families tend to rely on unprotected traditional water sources which often get polluted in the rainy season. On the other hand, Malawi has ample water resources which translated into 18 billion cubic meters per annum as surface runoff. As of the year 2010, the estimated domestic demand was 95 million cubic meters or about 0.5% of total surface runoff.

11.2.2 The Rainwater Harvesting Association of Malawi

Rainwater harvesting initiatives received a major boost in the country with the formation of the Rainwater Harvesting Association of Malawi (RHAM). The association was launched in 2005 in Lilongwe, as a development partner toward integrated water resources management initiative of the Government of Malawi (GoM) and other stakeholders. It comprises of a number of individuals and institutions that are involved and take interest in rainwater harvesting activities throughout the country. The Association is also an integral network member of the Southern and Eastern Africa Rainwater Harvesting Network (SearNet) and the Flood Based Livelihood Network (FBLN). The association has a constitution and

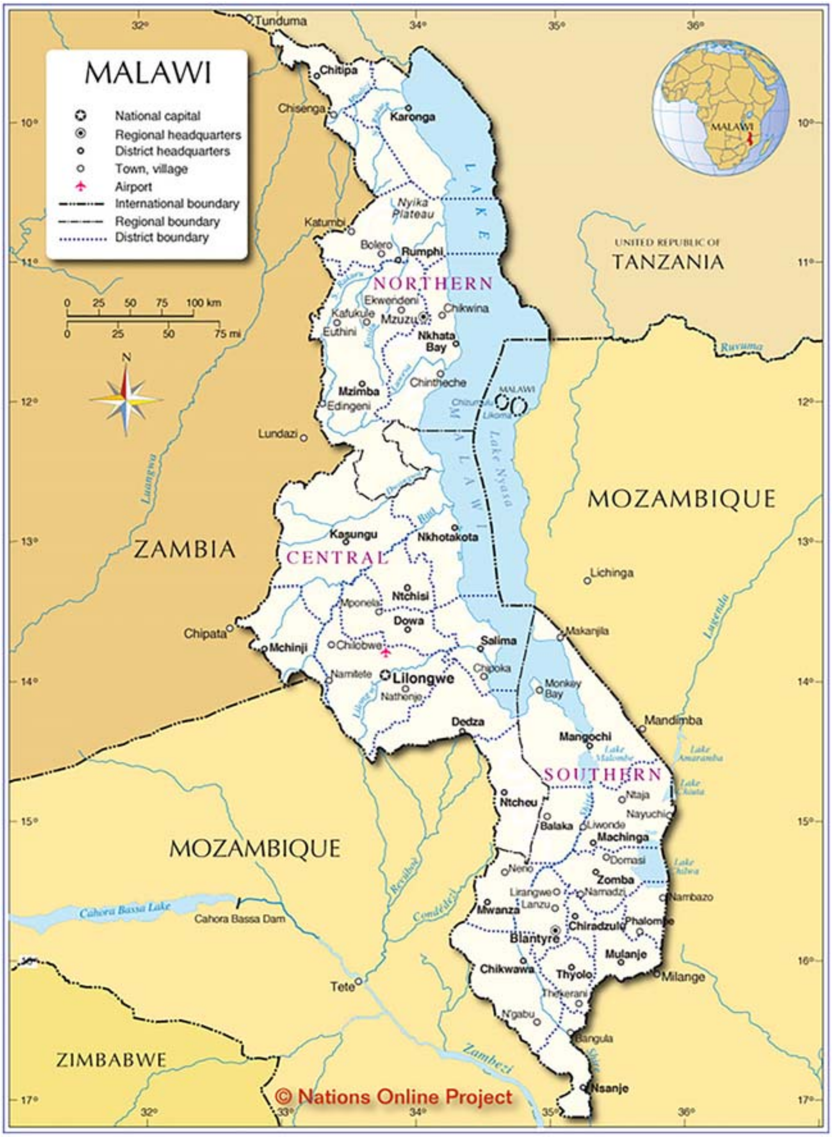

Figure 11.1 State of water resources in Malawi. (*Source*: Nations Online Project, Sajidu *et al.* (2013)).

is run by the executive committee through its secretariat. Since 2005, the association has collaborated with government and non-governmental agencies in organizing trainings, demonstrations, field days and a number of advocacy activities on rainwater harvesting across the country.

11.2.3 Policy direction on rainwater harvesting in Malawi

Promotion of rainwater harvesting is in line with the government developmental agenda as outlined in the Malawi Growth and Development Strategy III under the Agriculture and Climate Change Management key priority area. The MGDS calls for RWH as a way of mitigating water shortages and augmenting current supplies. Other national policies include the Irrigation Policy (GOM, 2017) which supports the development and testing of irrigation technologies including simple water harvesting techniques, hand dug wells, dams, weirs, and water control structures. Malawi is also committed to international frameworks including the Sustainable Development Goals (SDGs). For Malawi, provision of water to communities through rainwater harvesting will contribute to the attainment of two SDG targets, namely: Target No 2 – '*End hunger, achieve food security, improved nutrition and promote sustainable agriculture*'; and Target No 6 – '*Ensure availability and sustainable management of water and sanitation for all*'.

11.3 RAINWATER HARVESTING PRACTICES IN MALAWI

A number of projects and NGOs have been promoting rainwater harvesting in Malawi including:

- Irrigation Rural Livelihood and Agriculture Development Programme (IRLADP).
- Farm Income Diversification Programme (FIDP)
- Emergency Drought Recovery Programme (EDRP)
- Malawi Drought Recovery and Resilience Programme (MDRRP)
- Department of Irrigation Services
- Land Resources Conservation Department
- World Vision Malawi
- World Vision of Malawi
- Alliance One Tobacco
- Canadian Physicians for Aid Programme (CPAR-Malawi)
- Project Concern International (PCI-USAID)

Some of the RWH storage structures have been described below.

11.3.1 Above ground tanks

Above ground tanks for domestic application have been the most popular technique for rainwater harvesting in Malawi. The reasons for their popularity include: ease of colleting water from them; the water is usually of good quality; and the impacts they have on reducing drudgery of water collection over long distances. The first tanks were normally constructed using bricks and mortar (Figure 11.2). However, the last three years has seen the proliferation of ferrocement tanks and the use of

Figure 11.2 Above ground brick tank, Karonga District. (*Source*: Author's own).

Figure 11.3 Plastic tanks for rainwater harvesting, Balaka District. (*Source*: Author's own).

plastic tanks (Figures 11.3–11.5). To date over 500 above ground tanks have been constructed for roof-top water harvesting across the country.

The high cost of constructing these tanks remains a challenge to their wider adoption. On average, a 30,000 liter ferro-cement tank costs about 4000–5000 USD. As a result, most of these tanks are constructed with donor support. To upscale rooftop harvesting, low cost methods for water harvesting using the Calabash Cistern which cost about 300USD for a 5000 liter tank are being explored.

11.3.2 Lined underground tanks

Concrete lined underground tanks have mostly been built to collect runoff from ground surfaces e.g., school grounds, hill sides and road runoff (Figures 11.6 and Figures 11.7). The water from underground tanks is mostly used for cleaning, watering livestock and tree nurseries for afforestation. The Irrigation Rural Livelihood and Agriculture Development Programme facilitated the construction

Figure 11.4 30,000 L ferrocement tank Kasungu District. (*Source*: Author's own).

Figure 11.5 Ferrocement tank under construction. (*Source*: Author's own).

Figure 11.6 Underground tank, Karonga District. (*Source*: Author's own).

Figure 11.7 Underground tank (150,000 liters). (*Source*: Author's own).

of over 50 Underground tanks in the early 2000 which were used for agriculture production using Drip Irrigation. However, poor maintenance has rendered most of these underground tanks unusable. There has been lack of ownership of these tanks with communities expecting the donor to maintain the tanks for them.

Underground tanks have been popular in Malawi since they are able to collect huge volumes of water compared with the above ground tanks. The water is cooler making it suitable for irrigation. Their disadvantages include the large amount of sediment that is collected in the tank, and since the water is stored under the ground, withdrawing water cannot be done using gravity.

11.3.3 Dams

The history of dam construction for rainwater harvesting dates back to the mid-1940s when the colonial government formulated an irrigation policy with the primary objective of reinforcing water and soil conservation (Nthara *et al*., 2008).

Figure 11.8 Water harvesting small dam, Senzani, Ntcheu. (*Source*: Author's own).

Figure 11.9 Mr. Mataka, a renowned water harvester in Ntcheu. (*Source*: Author's own).

Figure 11.10 Communally owned earth dam, Chitsime EPA, Lilongwe district. (*Source*: AMEI (2014)).

The colonial government constructed small dams as a conservation strategy and also as a source of water for the urban populace as well as for livestock Njoloma (2011) (Figure 11.10). Irrigation around small dams was an 'informal trend' that progressively developed either downstream or upstream of the dams. Between 1950 and 1980, the government of Malawi facilitated the construction of over 600 dams across the country (Figure 11.10). The dams were used for irrigation farming but some also supported livestock production and other activities. Due to land degradation, most of these dams are no longer functional as a result of siltation and lack of maintenance. Of late, there have been a number of projects that have constructed run off detention weirs for retaining surface run off (Figures 11.8 and 11.9). However siltation remains a major challenge for these structures requiring farmers to routinely de-silt them.

11.3.4 In-situ or soil storage rainwater harvesting

Farmers in Malawi are fully aware of the changes in climatic conditions evidenced by erratic rainfall and frequent dry spells. To address the situation, farmers practice rainwater harvesting in their fields in order so that they can harness any water that is available. Farmers have implemented a number of low cost in-situ water harvesting measures including swales, infiltration pits, percolation pond (Figures 11.11 and 11.12), conservation agriculture, box ridges, marker ridges, mulching and crop residue management, compost manure making and application, and the planting of grass strips/hedge-grows along the contours (Figures 11.13 and 11.14).

Figure 11.11 Infiltration pit, Neno District. (*Source*: Author's own).

Figure 11.12 Percolation pond, Neno District. (*Source*: Author's own).

In Liwonde Village, Neno District, rainwater stored in the ponds and hand dug wells is used productively in watering vegetables and fruit trees. Farmers are growing different vegetables (Chinese lettuce, mustard and tomatoes) in their fields that are recharged using in-situ techniques. The vegetables are growing well and are able to be used as a source income for the households. The success of in-situ techniques is attributed to the fact that they are cheap and easy to implement. Due to the huge potential of scaling up these in-situ techniques, more efforts have been devoted to capacity building of communities to enable effective implementation. The structures are continually monitored so that some minor maintenance is done by individual land owners. Implementation of in-situ techniques is achieved in clusters formed by the farmers. Choice of sites for

Figure 11.13 Check-dams, Karonga District. (*Source*: Author's own).

Figure 11.14 Infiltration pits, Karonga District. (*Source*: Author's own).

in-situ technologies is based on sites that have serious land degradation and can show the best results within a short time.

11.3.5 Flood-based farming systems

Flood-based farming (FBF) constitutes a highly productive, yet undervalued option for communities in flood plains to better manage flood water for crop and livestock production. Use of floodwater for productive uses is common in Chikwawa, Nsanje, Zomba, Nkhatabay, Salima and Karonga Districts. The following categories of flood-based farming are being practiced in Malawi:

(1) Flood-plain agriculture: cultivation of flood plains, using either receding or rising flood water. Farmers divert water into earth canals or concrete canals. Sometimes flooding rivers inundate adjacent field when they over topple their banks.
(2) Spate irrigation: diversion of short-term flood flows from seasonal rivers to field by means of small earth canals (Figure 11.16).
(3) Use of residual moisture: this the most widespread FBFS in Malawi especially in wetlands or Dambos (Figure 11.15). These areas are typically fertile, enabling farm households to intensively manage small plots of land with high returns for their labour and investment. As the moisture dries up, farmers will use water from shallow wells, using watering cans or treadle pumps to irrigate crops.
(4) Inundation canals: where cultivated fields are fed through a networks or canals by temporarily high water levels in perennial rivers.

These FBFS serve crop production, fishery, livestock, and are the sustenance of local ecological systems. Dependent on flood events, they are prone to climate change, yet they have considerable unused economic potential, as can be seen

Figure 11.15 Maize under residual moisture. (*Source*: Author's own).

Figure 11.16 Previously flooded fields planted with Maize. (*Source*: Author's own).

from the different experiences in countries in Africa and Asia. FBFS is, in essence, a resilience building block to smallholder climate change adaptation.

11.4 BENEFITS AND IMPACTS OF RAINWATER HARVESTING

Rainwater harvesting has been shown not only to improve the immediate water situation but also leads to a whole range of other benefits to the individual and communities that include: increased food and water security at household and community levels; provision of an appropriate water source at the point of use at low cost; provision of an independent back up water supply system supply for emergencies; development of employment opportunity and experience sharing skills for builders and artisans.

11.4.1 Lessons learned

Implementation of rainwater harvesting has demonstrated that there are opportunities to slow down land degradation and mitigate the impacts of climate change. Through integrated land and water management, both off and on-site ecosystem services can be derived that would lead to sustainable livelihoods. Rainwater harvesting can assist smallholder farmers to sustainably utilize low quality water to reduce pressure on high quality waters and preserve land. The following key lessons have been learnt from selected water harvesting projects.

Choice of farmers: In choosing farmers and sites for rainwater harvesting, future projects ought to focus on clusters of farmers who live and work in areas where there are serious water shortages and land degradation problems and which have a high potential to show positive results, rather than working with farmers regardless of their location in a watershed. It is important to target areas where there is greatest risk of land degradation from uncontrolled runoff.

Promoting few self-perpetuating practices: It will be important for rainwater harvesting projects to promote practices that will continue to spread among the farmers beyond the project period. While provision of inputs will be important, emphasis should be on practices that are of such benefit to a farmer that she or she will continue them independently and neighbors will emulate and continue to change the landscape. An example of such practice includes the excavation of swales and percolation ponds. Farmers use the residual moisture and stored water to grow vegetables, improving their income level and household food security (Figure 11.17).

Issues of incentives and subsidies: There is a general belief among extension staff that without incentives it would be impossible for rainwater harvesting practices to be taken up by a significant number of farmers. During sensitization meetings, it would be important for communities to realize the type of problems they are experiencing in their fields. Once the root problem is understood by the

Figure 11.17 A woman managing her vegetable garden, Balaka District. (*Source*: Nthara (2015)).

communities, no incentives or subsidies will be required for them to take remedial measures.

11.5 WAY FORWARD

There is need for a sustained campaign aimed at creating a mass movement on rainwater harvesting in the country. This will involve both the public and private sectors, NGOs, the media and the corporate world. At the heart of such a campaign will be school students who will be expected to carry the messages to their communities.

Due to high cost of some rainwater harvesting structures, there is a need to promote technologies that can be adopted at the small scale level. Much attention has so far been devoted to the promotion of in-situ techniques like conservation agriculture, manure making and application and Vetiver planting.

Capacity building in rainwater harvesting has to be intensified at all levels. This will include farmers, extension staff, and artisans.

There is need to lobby for investment in rainwater harvesting structures. While a number of NGOs have taken up the practice by constructing tanks, much remains to be done to upscale the practice in urban areas.

REFERENCES

AMEI (2014). Catchment Management Strategies for Linthipe catchment, Report No NWDP/IPC/021/09/010. Lilongwe: Ministry of Agriculture, Irrigation and Water Development).

Government of Malawi. (2017). Malawi Growth and development Strategy (2017–2022) – from Poverty to Prosperity. Government of Malawi, Lilongwe, Malawi.

Mloza-Banda H. R., Chikuni A. and Singa D. D. (2006). Small Scale Rainwater Harvesting for Combating Water Deprivation at Orphan Care Centres in Peri-Urban Areas of Lilongwe, Malawi. ATPS Working Paper Series No. 46, African Technology Policy Studies Network, P.O. Box 10081, 00100 General Post Office, Nairobi, Kenya.

Njoloma H. M. (2011). An Assessment and Inventory of Investments in Rainwater Harvesting and Small-scale Water Resources Development in Malawi: A Final Report. Rainwater Harvesting Association of Malawi (RHAM), Lilongwe, Malawi.

Nthara M. T., Manda M. J. and Mkwinda S. (2008). Technical Field Manual on Rainwater Harvesting, Land Resources Conservation Department, Ministry of Agriculture and Food Security, Lilongwe, Malawi.

Nthara M. T. (2015). Best Practices scaling up sites (SUPs) on Rainwater Harvesting and conservation agriculture, Rainwater Harvesting Association of Malawi, Lilongwe.

Sajidu S., Monjerezi D., Ngongoro C. and Namangale J. (2013). Malawi Country Water Resources Profile, University of Malawi.