Rainwater harvesting system (RWH system)

Parts and technical equipment of your rainwater harvesting facility

- House (or Greenhouse) with roof of corrugated iron or other impermeable material
- Gutters to conduct rainwater to a ground tank
- Pipe from ground tank to pump and further on to elevated tank
- Pipe from elevated tank to Garden and drip lines to the single rows
- Greenhouse (if part of the facility; including drip lines)

Rainwater harvesting tanks for households in Epyeshona

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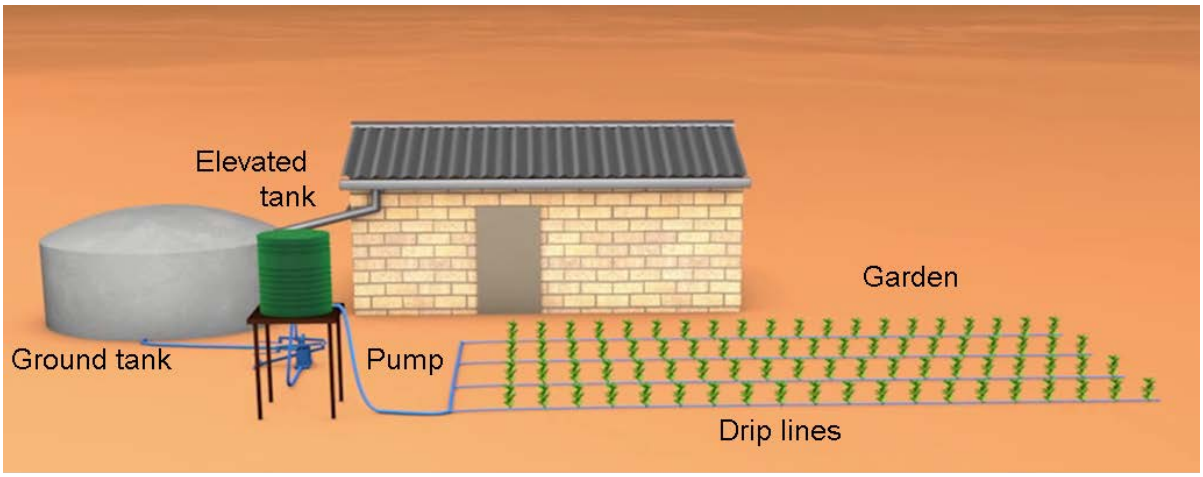
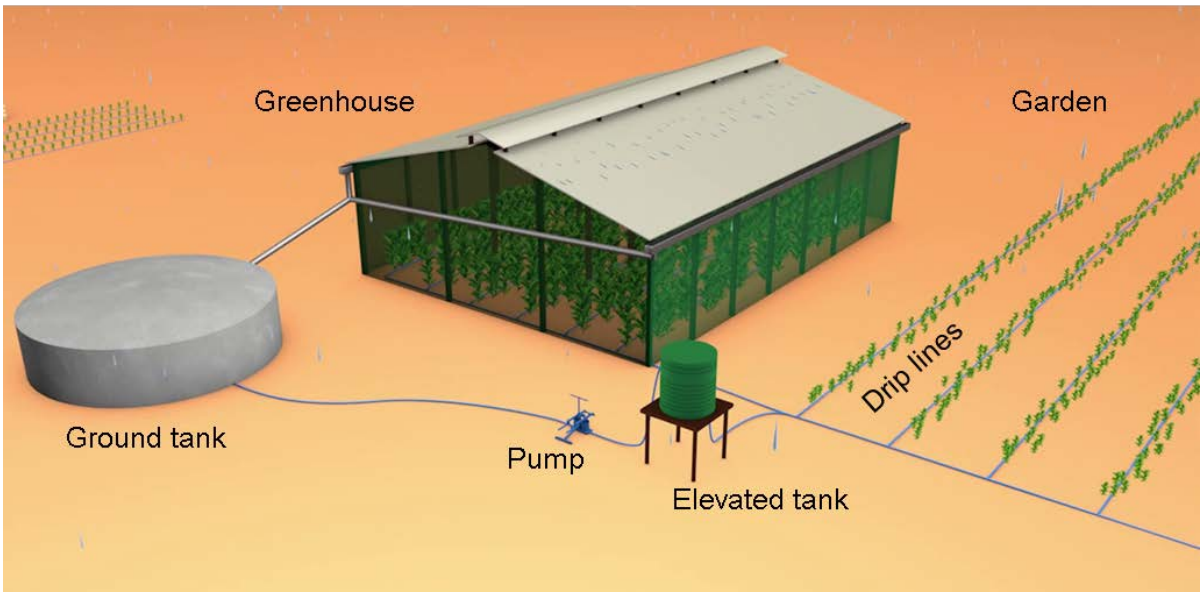




Rainwater harvesting facilities using rainwater collection from roof of a dwelling house (above) and from roof of a Greenhouse (below) for gardening

Factsheet

CUVEwaters integrated water resources management

Rainwater Harvesting in Central-Northern Namibia

Challenge

Namibia is the driest country in southern Africa. The Cuvelai-Etosha Basin in central-northern Namibia is particularly affected: With about 850,000 people, almost half the Namibian population is concentrated here. The region's climate is characterized by a rainy season lasting from October to March, with a mean annual rainfall of 470 mm and a dry season lasting from April to September. The technology of rainwater harvesting was introduced to make harvested rainwater available during the dry season too, thus making horticulture possible year round. The challenge of introducing rainwater harvesting in the region was to successfully guide local novice farmers through processes of group building and governance, as well as the development of technical and management skills. Finally, the benefits and feasibility of private gardening and horticulture had to be demonstrated within the local organisational and institutional structures and implemented with locally available construction materials.

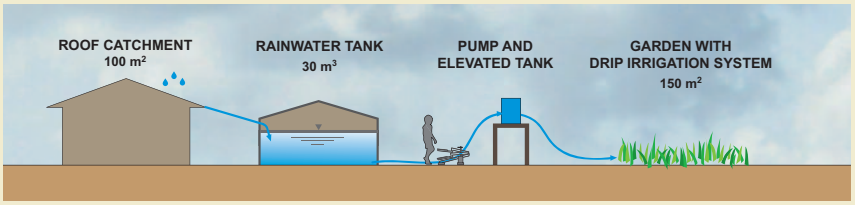
Approach

Facilities for rainwater harvesting have been piloted in the village of Epyeshona, near Oshakati, since 2009. During the short rainy season, rainwater is harvested on rooftops and concrete surfaces and stored in tanks and ponds. The harvested water is of fairly good quality and is mainly intended for gardening purposes, but can also be used for washing, cooking or watering livestock. Gardens were established next to the water storage facilities. Water-saving drip irrigation systems are driven by a pedal or hip pump, depending on the size of the irrigation area. As part of capacity development, the project provided training and enabled local people from the village to build, operate and maintain the facilities. Furthermore, people have learned to cultivate and manage gardens, and to make profits from the crops. CuveWaters has tested two technical and organisational options for rainwater harvesting: the household and the communal approach.

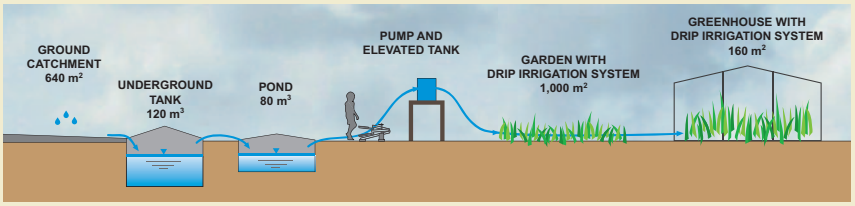
Rainwater harvesting facilities in the village of Epyeshona: household (top) and communal approach (bottom)

Household and Communal Approach

Up to 30 m³ of water are harvested from the roof of a single household and stored in above-surface tanks during a normal rainy season. The water is used to irrigate a small garden or a small greenhouse (upper figure).



The communal approach comprises five households that work together. It consists of an underground tank, a covered pond, a greenhouse and an open garden area. The greenhouse and parts of the outside garden are jointly operated, meaning that the farmers share their work and their gain in equal measure (lower figure).



Additionally, farmers have their own plot in the communal approach, which can be used for self-consumption or market production of fruits and vegetables. Advantages of greenhouses are the prevention of evaporation, temperature control and the protection of plants from wind and pests.

Findings

- The existing infrastructure in central-northern Namibia already offers good possibilities for harvesting rainwater, e.g. from the roofs of public and private buildings.
- Cost-benefit and sustainability analyses showed that on the household level, ferrocement tanks, and on the communal level, greenhouses with ponds are the most appropriate options.
- Nearly all materials for construction can be obtained from regional hardware shops.
- Tanks, greenhouses and irrigation systems can be constructed by local staff supervised by trained technicians.

Type of costs	Household approach		Communal approach	
	Material costs for pilot plant	Calculated costs for roll-out	Material costs for pilot plant	Calculated costs for roll-out
Investments for construction				
Infrastructure (tank 30 m³, gutters, downpipes)	N$ 12,000-18,000	N$ 9,000		
Infrastructure (ground catchment, underground tank 120 m³, shade net covered pond 80 m³, gutters, downpipes)			N$ 110,000	N$ 82,000
Garden (90 m²), drip irrigation system	N$ 2,700	N$ 2,000		
Garden (750 m²), greenhouse (160 m²), drip irrigation system			N$ 40,000	N$ 30,000
Operation and minor maintenance (per year)				
Infrastructure (e.g. tanks, fences)	N$ 100	N$ 75	N$ 1,000	N$ 750
Garden (drip irrigation system, seeds, fertilisers, pesticides)	N$ 500	N$ 375	N$ 2,000	N$ 1,500

Minor maintenance includes repairs of cracks, fences and of the drip irrigation system. Not included are costs for renovations of the structures, such as necessary regular replacement (roughly every 5 years) of greenhouse roofs or drip lines. Due to various reasons, costs during pilot plant implementation are much higher compared to calculated investment costs during roll-out. Calculated roll-out costs presume that materials for construction (initial investment and renovation) as well as for operation and maintenance are purchased in larger quantities and under optimal conditions. Calculations for roll-out show that costs can roughly be reduced by one quarter. The minor maintenance costs in both cases presume that good and regular maintenance work is carried out. N$ 1,000 ≈ € 77 (May 2015)

Benefits and Risks

Benefits

- Harvesting and storing water mitigates the risks of climate change, mainly dry spells during the rainy season, and allows almost continuous vegetable crop production during the dry season.
- The diet and health situations of families have improved.
- Knowledge about construction, agriculture and irrigation has been further developed.
- Jobs have been created as further plants have been built by people trained during the project.
- Possible income for a household by selling crops is up to N$ 12,000 per year.
- Maintenance, gardening equipment, seeds etc. can be financed by the household and the community, respectively.

Requirements and risks

- The costs listed are material costs only. Additional costs during implementation for: local workers, construction management, tools, training in horticulture and team management.
- Governmental financial support is needed for the initial construction and later renovations of structures.
- Future rainwater harvesting projects must be linked to upcoming Namibian policies.
- Risk of project failing due to problems within the group, mismanagement, restricted financial resources or minor technical problems.

Building an underground tank for rainwater harvesting

Harvest of green peppers at Epyeshona Green Village

Success Factors for Implementation

Starting point

- Demand for additional water for local small-scale irrigation farming
- Sustained interest within the community to build and run rainwater harvesting tanks as well as gardens/small-scale farms

Social and organisational

- Training in group management: binding rules for common tasks, working times, how to market the products, maintenance
- Combination of different age groups of women & men to ensure continuity
- Women taking the chance to earn their own money and expand their skills, being supported to take over full responsibility
- Communication with the local group members in their native language
- Short distances to homesteads and customers
- Long-term guidance of the group during all activities for five years

Technical

- Assistance in accounting/bookkeeping and marketing the products
- Step-by-step farming training during at least one growing period: Fertilisation, pest control, building fences and daily maintenance
- Training in long-term maintenance of tools and other facilities to avoid extensive repairs
- Outside technical support from agricultural and technical extension services to solve technical problems
- Additional water supply to ensure that gardens are maintained during very dry years
- Sufficient soil quality
- Strong fence to protect against animals (> 1.5 m)
- Access to materials and spare parts in the region

Rain- and Floodwater Harvesting Toolkit

For more detailed information, the project has developed the CuveWaters Rain- and Floodwater Harvesting Toolkit. It is intended for organisations and private persons interested in establishing rain- and floodwater harvesting projects and contains detailed information on their implementation as well as construction manuals for all kinds of storage tanks and irrigation infrastructure. The CuveWaters Rain- and Floodwater Harvesting Toolkit can be downloaded at: http://www.cuvewaters.net/Toolkits.112.0.html

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Floodwater harvesting system (FWH system)

Rain or floodwater harvesting?

The design of a floodwater harvesting system may be appropriate in locations in the vicinity of oshanas. In contrast to rainwater harvesting systems

- you do not depend on local rainfall.
- you depend on oshana water of sufficient quantity and quality.
- you do not need a roof or ground catchment to collect rainwater.

But of course you can combine both systems to use rain *and* floodwater for irrigated gardening.

Parts and technical equipment of your floodwater harvesting facility

- Motor pump and pipe for water from oshana
- Pipe from pump to tank (ground or underground) or to a pond
- Pipes from ground or underground tank or from pond to elevated tank
- Garden
- Greenhouse (if part of the facility)

Floodwater harvesting facility in Iipopo

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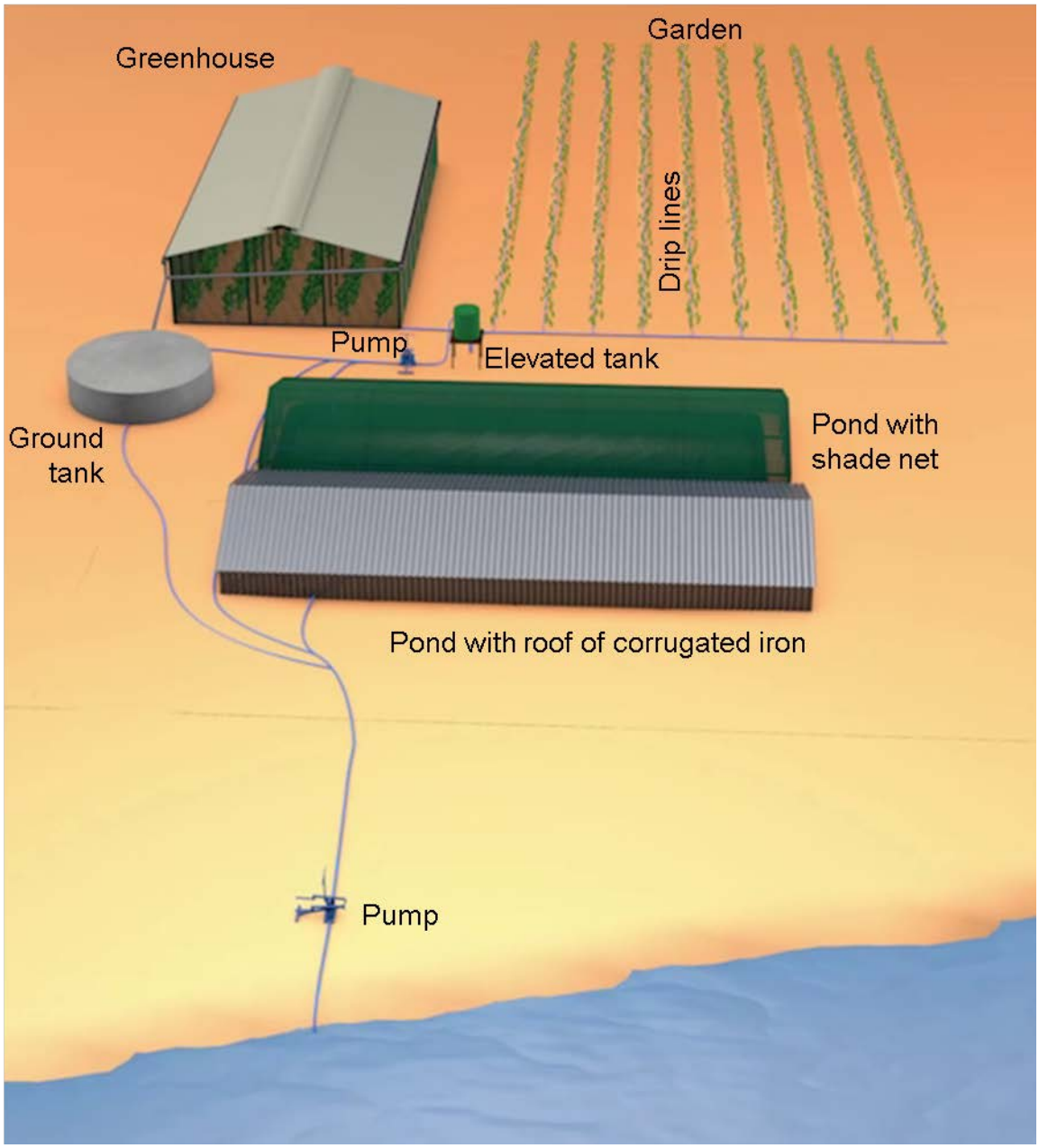


Floodwater harvesting facility with additional rainwater harvesting from Greenhouse roof

Factsheet

CUVEwaters integrated water resources management

Floodwater Harvesting in Central-Northern Namibia

Challenge

The landscape of central-northern Namibia is shaped by a system of so-called Oshanas. Coming from southern Angola, these very shallow ephemeral river streams branch far out into the countryside and reach the Etosha Salt Pan during flood events. Water quality in the Oshanas is fairly good only during the rainy season. It deteriorates rapidly during the dry season due to evaporation as well as pollution from humans and animals. To establish new gardens and irrigate them during the dry season with Oshana floodwater of appropriate quality, harvesting and storage techniques had to be introduced. Further challenges were to establish a new culture of crop production and build up a reliable group of novice farmers. Local staff also needed to be trained in construction and maintenance work, locally available construction material needed to be found, and the new system had to be implemented with local organisations and institutions.

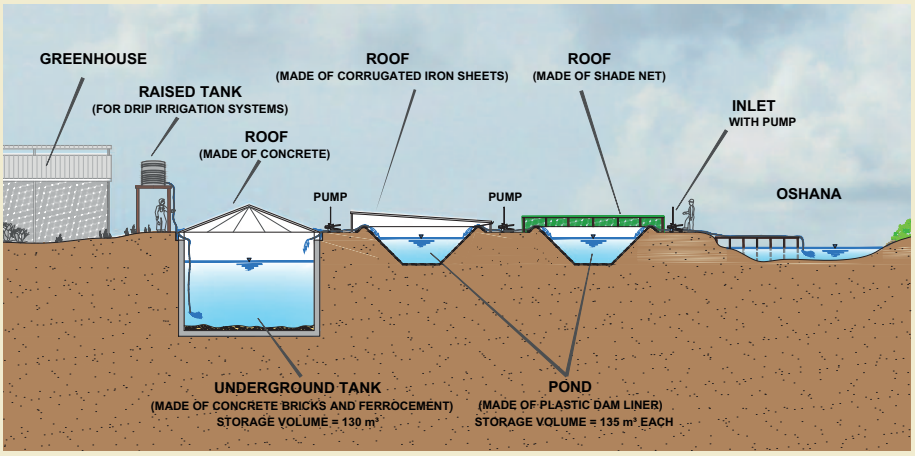
Approach

The aim of floodwater harvesting is to store floodwater in artificial closed ponds and tanks built next to an Oshana. To this end, the Oshana water is pumped into the storage reservoirs with a motor pump at the height of the rainy season, when the water quality is at its best. At the pilot plant in Iipopo, a water-saving drip irrigation system distributes the stored water to a greenhouse and an open garden area. The greenhouse and parts of the outside garden are jointly operated, meaning that the farmers share their work and revenues equally. Farmers also have their own field which can be used for self-consumption or market production of fruits and vegetables. Ten women from Iipopo and neighbouring villages cultivate these gardens and the greenhouse for small-scale horticulture. All farmers were trained in how to prepare the soil and plant the seeds, how to supply the plants with fertiliser, and how to use the water efficiently. To increase the water harvest, rainwater is collected from the roofs of the ponds and the greenhouse (see Factsheet for Rainwater Harvesting in Central-Northern Namibia). Because the region sometimes suffers from long periods of extreme drought, the pilot plant is also connected to the central pipeline system to bridge periods of water shortage.

Floodwater harvesting pilot plant at Iipopo next to an Oshana

Communal Approach for Floodwater Harvesting

The pilot plant for the storage of Oshana floodwater is a combination of different storage options (see figure below). It consists of an underground tank and two ponds, one with a shade net roof and one covered by corrugated iron. The pilot plant has a total storage capacity of 400 m³. The water is intended to be used for irrigation purposes in the greenhouse and in an open garden area. Market-ready vegetables can be grown inside the greenhouse, since the plants are protected from direct sunlight, wind, and pests.



Source: Christoph Treskatis

Findings

- Floodwater harvesting is restricted to places close to the main Oshanas, since water availability during the rainy season is more reliable here than in the distributaries.
- Cost-benefit as well as sustainability analyses showed that water ponds made of dam liner with roofs made of shade net are recommended materials for water storage.
- The lower water quality compared to rainwater harvesting does not seem to have a negative effect on the crops.
- Nearly all materials for construction can be obtained from regional hardware shops.
- Ponds, greenhouses and irrigation systems can be constructed by local staff supervised by trained technicians.

Type of costs	Material costs for the pilot plant	Calculated costs for roll-out (per plant)
Investments for construction		
Underground tank (130 m³)	N$ 42,000	N$ 32,000
Shade net covered pond (135 m³)	N$ 23,000	N$ 20,800
Corrugated iron covered pond (135 m³)	N$ 31,000	N$ 24,500
Garden (1,000 m³), including drip irrigation	N$ 47,000	N$ 35,250
Greenhouse (176 m²), including drip irrigation	N$ 43,000	N$ 30,000
Operation and minor maintenance (per year)		
Infrastructure (e.g. tanks, ponds, fences)	N$ 1,500	N$ 1,125
Garden (drip irrigation system, seeds, fertilisers, pesticides)	N$ 2,500	N$ 1,875

Due to various reasons, costs during pilot plant implementation are much higher compared to the calculated investment costs during roll-out. Calculated roll-out costs presume that materials for construction (initial investment and renovation) as well as for operation and maintenance are purchased in larger quantities and under optimal conditions. Especially in case of roll-out, it has to be kept in mind that all infrastructural components are modular and other floodwater harvesting plants could also only be composed of shade net covered ponds, which would also be the recommendation of the projects' research. The minor maintenance costs in both cases presume that good and regular maintenance (renovation) work is carried out. N$ 1,000 ≈ € 77 (May 2015)

Benefits and Risks

Benefits

- Harvesting and storing water mitigates the risks of climate change, mainly dry spells during the rainy season, and allows almost continuous vegetable crop production during the dry season.
- The diet and health situations of families have improved.
- Knowledge about agriculture and irrigation has been further developed.
- Ten permanent jobs have been created, leading to more self-confidence of the new farmers and to economic autonomy.
- Households have additional income from selling crops on the market.
- Maintenance, gardening equipment, seeds etc. can be financed by the group members.

Requirements and risks

- The costs listed are material costs only. Additional costs during implementation for: local workers, construction management, tools, training in horticulture and team management.
- Governmental financial support is needed for the initial construction and later renovations of structures.
- Future rain- and floodwater harvesting projects must be linked to upcoming Namibian policies.
- Risk of project failing due to problems within the group, mismanagement, restricted financial resources or minor technical problems.

Farmers from Iipopo Green Village seeding plants

Harvest of carrots at Iipopo Green Village

Success Factors for Implementation

Starting point

- Demand for additional water for local small-scale irrigation farming
- Sustained interest within the community to build and run floodwater harvesting tanks as well as gardens / small-scale farms

Social and organisational

- Training in group management: binding rules for common tasks, working times, how to market the products, maintenance
- Combination of different age groups of women & men to ensure continuity
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Technical

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Rainwater Harvesting for irrigation in Africa and beyond

Useful internet links and tips for further information and research

Tanks constructed within the CuveWaters project are just examples of how rainwater can be harvested. All over the world people are harvesting rainwater with different technologies and different materials for tank construction. The following list is intended to help you finding further information on the technology of rainwater harvesting and on small scale gardening and irrigation.

http://www.cuvewaters.net
Homepage of the CuveWaters project with several information materials and videos linked to rainwater harvesting in Namibia

http://www.rainfoundation.org/
The Rainfoundation offers information and contacts on rainwater harvesting all around the world.

http://www.rainwaterharvesting.org/
Information on rainwater harvesting with a focus on Asia

http://www2.warwick.ac.uk/fac/sci/eng/research/civil/dtu/rwh/
Several manuals on technological aspects of rainwater harvesting provided by the Development Technology Unit of the University of Warwick

http://www.rain4food.net/
Several useful information on rainwater harvesting for food production

http://www.mvula.co.za/
The Mvula Trust is one of South Africa's biggest NGOs active in the field of rainwater harvesting

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Rainwater Harvesting in Namibia

Useful internet links for weather forecasts and rainfall amounts in Namibia

Rainfall in Namibia is highly unpredictable and erratic. To plan irrigation and planting schedules it is very helpful to use weather and rainfall forecasts. For Namibia you will find information on that on two homepages:

http://www.meteona.com/
The homepage of the Namibia Meteorological Service, updated irregular but with long term forecasts and historic weather maps

http://www.namibiaweather.info/
The homepage of the Namibia Weather Network, with always up to date weather (especially rain-) forecasts and satellite pictures

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