partageons les connaissances au profit des communautés rurales

sharing knowledge, improving rural livelihoods

Rural Radio Resource Pack

No 07/1

RAINWATER HARVESTING

The Technical Centre for Agricultural and Rural Cooperation (CTA) was established in 1983 under the Lomé Convention between the ACP (African, Caribbean and Pacific) Group of States and the European Union Member States. Since 2000, it has operated within the framework of the ACP-EC Cotonou Agreement.

CTA's tasks are to develop and provide services that improve access to information for agricultural and rural development, and to strengthen the capacity of ACP countries to produce, acquire, exchange and utilise information in this area.

Rural radio

Radio remains, despite all the interest in the new ICTs, one of the most important communication tools in ACP rural communities. CTA began supporting rural radio back in 1991. Every year since then we've produced a set of Rural Radio Resource Packs (RRRPs).

Each pack is on a specific topic – anything from crop storage and cassava to small ruminants and soil fertility. The choice of topics depends on what ACP partners suggest. The number of topics covered has now reached 51. Inside each pack are materials for a radio programme on that topic – interviews on cassette or CD, a transcription and a suggested introduction for each interview, technical information on the topic, advice for how the pack can be used and a questionnaire for users to provide feedback to CTA.

You can find most of the RRRP material on CTA's RRRP website (http://ruralradio.cta.int/).

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CTA

Rural Radio Resource Pack - 07/1

Rainwater Harvesting

TECHNICAL INFORMATION

Introduction

Rainwater harvesting has been practised for thousands of years. It can take many different forms. For example, in both cities and rural areas, people often store some water as it flows off the roof of their house during rain. This may be used to water plants in their garden, or, in areas with poor water supply, for drinking, washing or giving to livestock. Rainwater can also be harvested from the land, from roads and homestead courtyards, from rock outcrops, and can be stored in a variety of structures, such as tanks, ponds or reservoirs.

For farmers, however, the most common method of storing harvested rainwater is in the soil. There are many techniques that farmers can use to do this, for example by breaking up the soil to increase infiltration, or building structures in the field such as contour ridges or level ditches. These trap runoff during rainfall, giving the water more time to enter the soil, and reducing soil erosion. Adding organic matter, such as compost, to soil is another way of increasing the amount of water that can be stored.

One impact of climate change appears to be more erratic or unpredictable weather patterns. Rainy seasons seem to be less reliable, and dry spells have been longer and more frequent in some areas. In such situations, rainwater harvesting has a lot to offer rural populations. For dryland farmers it can make the difference between harvesting a crop and losing it, and can also be of great value in livestock production. For crop farmers, harvesting rainwater can enable production of high-value crops, such as fruits and vegetables. And simply by increasing the quantity of water that their soils can hold, farmers can increase their chances of producing a harvest, even if the rains finish early.

Who is responsible for rainwater harvesting?

To harvest rainfall normally requires some investment, either of effort or of money, or both. For example, harvesting water from a house roof may require the house owner to put gutters on the house, connected to a storage tank. If farmers decide to build contour ridges in their fields, or to add organic matter to their soil, this will take time and effort, and may (for the ridges) involve hiring labour or machinery, or buying materials.

Often it is the farmers' responsibility to pay for these costs, as an investment in their faming business. However, in some cases they may be given support by government departments or non-government organisations. In this pack, the interview ***Government support for upland rainwater harvesting*** highlights the work of a government project in The Gambia which is offering financial support to farming communities in the building of soil and water conservation structures. ***Water harvesting pans for dry areas*** features work being done in northern Kenya by the NGO Action Aid, which is similarly offering technical and financial support for rainwater harvesting. In both cases, however, community participation is also essential, both in terms of decision-making and their contribution of labour and locally-available materials.

Communities and outside organisations will be particularly important for large-scale projects.

Some projects collect rainfall from *macro-catchments*, large uncultivated areas often at quite a distance from where the water will ultimately be used. The water is channelled, perhaps over several kilometres, to the farming area, where it may be distributed to fields or stored in a reservoir. Large scale projects such as these will clearly need a lot of community involvement and considerable resources.

Projects that are implemented without community participation are very unlikely to succeed, as most water harvesting technologies need regular maintenance to remain effective. Ponds or pans must be de-silted, ridges must be repaired or rebuilt, ditches may need to be re-dug, and some form of maintenance is likely to be needed on an annual basis. If the users of the technology feel no ownership over it, they are unlikely to maintain it and it will quickly become useless.

A complementary technology

As rainwater harvesting schemes can require substantial and ongoing inputs of labour and resources, there is a strong argument for integration of the technology among a more holistic programme of community development. For example, if rainwater is harvested for use on irrigated, high value crops, this may need to be combined with a marketing programme, to ensure that farmers can sell their produce for a good price. Alternatively, a rainwater harvesting scheme may be used to irrigate fodder crops, providing increased year-round grazing and drinking water for larger herds of livestock than previously. This will also need to be complemented by systems for exploiting the increased livestock numbers, such as development of value-added livestock products, or access to a reliable and rewarding market. Rainwater harvesting can also be used to complement health and sanitation initiatives, for example to tackle high rates of diarrhoea in children.

Pans, ponds and dams

Livestock farmers with large herds or flocks need access to large amounts of water to keep their animals watered and healthy, particularly during the dry months. For these farmers, pans may be an appropriate technology. Pans are essentially ponds, usually between 2-4 metres deep, which are dug either by hand or by machinery. They vary in size: large ones may be 200 metres long, while small ones may be just 10 metres square. Water collects in the pan from small streams that form during rainfall on the surrounding land. The streams may be channelled into a concrete channel before entering the pan, sometimes passing through a silt trap to reduce siltation of the pan.

A similar technology is called the *charco dam*, a term which comes from a Spanish word. Charco dams are small reservoirs, constructed by building a dam from soil, thereby containing the water, which is collected from streams that form during rainfall.

Pans are a traditional technology in some areas, for example in northern Kenya. However, both the effectiveness of the pan, and how the water is used can be improved. For example, it may be possible to line the pan with an impermeable layer to prevent loss of water through seepage. It is also common for livestock to have free access to the pan, potentially polluting the water and causing health problems for human users. ***Water harvesting pans for dry areas*** includes a project that is pumping water from a number of pans to a raised tank, from where it is supplied to communal taps. The pans are secured so that animals and people can't access them directly, thereby protecting the water quality.

Tanks – above ground and underground

Tanks are a more secure, but also more costly way of storing water. They can be above ground, in which case they are usually made from hard plastic or from bricks and cement.

Tanks can also be dug into the ground. They differ from ponds in that the walls of the tank, constructed inside the dug hole, are typically made from bricks and cement, or else are covered with a plastic liner. Tanks are also covered by a roof, made either from iron sheets or from another material, such as grass. Thus the tank is not accessible by animals, and people do not wash in it directly. Water is drawn from the tank, either by a tap, a pump or a bucket. The roof not only adds security, preventing access, but also reduces loss of water through evaporation. Water stored in tanks may be safe for human consumption, or it may need to be boiled to make it safe.

Low cost water storage tanks and ponds is mostly concerned with the underground type of tank, and looks at ways that farmers can reduce the cost of constructing this kind of tank. It also covers the digging of ponds and the value of these technologies for farmers.

Ridges and ditches

Contour ridges and level ditches are two methods that farmers can use to protect their fields from soil erosion and to increase infiltration of rainwater, which is then stored in the soil. They are both appropriate for sloping land, although if slopes are steep the size of the structure needed to harvest water increases, often making them too expensive for farmers to implement.

A contour ridge (also called a contour bund), is simply a raised bank of soil or stone constructed across a sloping field which stops runoff, thereby encouraging the water to enter the soil. Farmers normally build a series of ridges at a regular distance apart. Level ditches are planned in a similar way, but instead of being a bank rising above the level of the field, the ditch is dug into the field; rainwater flowing down the slope collects in the ditch and then seeps into the soil.

The most important thing about constructing contour ridges is that they must exactly follow the contour i.e. not rise and fall, but keep at the same height on the slope. If one part of the ridge is lower, the water will tend to collect at this lower point and will erode a hole in the ridge, allowing the water to escape. However, in areas where the rainfall can be very heavy, farmers will sometimes deliberately construct mini-spillways in their ridges, to allow water to escape if the level of water gets very high. This protects the ridge from possible damage.

It is an important skill to be able to build ridges that follow the contour, but there are some simple technologies to help farmers do this. Common methods include the use of an A-frame, which can be simply constructed from local materials. Factsheets on the construction and use of A-frames are included in the *Further information* section of this pack. Another device is a tube level. This is a clear tube, like a hose-pipe, filled with water, which can be laid out along the slope between two points. By looking at the height of water in the tube, people standing at either end of the tube can plot the line along which the ridge will need to be built.

The same techniques can also be used when digging a level ditch, which also needs to follow the contour so that water does not gather at the lowest point in the ditch.

Building ridges or digging ditches can be an expensive business. On very hard ground it will need to be done by heavy machinery. On steep land, it may need to be done by hand, which can take a long time and potentially cost the farmer a considerable amount in labour. The availability and cost of labour and other raw materials, such as stone, will therefore be important factors in deciding how appropriate the technology is.

Government support for upland rainwater harvesting describes the use of contour ridges – referred to as ‘bunds’ in this interview – for soil and water conservation in upland areas.

Storm drains and level ditches describes the use of level ditches, as well as storm drains, in a hilly area where farmers mostly use the structures to support fruit trees and fodder shrubs for livestock. ***Contour ridges on steep slopes*** gives a farmer perspective on the value and practice of using contour ridges.

Increasing the water-holding capacity of soil

Apart from building structures like ridges and ditches, there are many other ways that farmers can harvest more rainwater in their fields. Any method of slowing runoff will help to increase the amount of water that enters the soil. For example, leaving crop residues on the soil surface can help, as can planting a cover crop – although obviously some water will be taken up by that crop. Many soils, particularly those that suffer from compaction through vehicles or animals, develop hard pans. These impermeable layers are often found close to the surface of the soil, and they prevent water from penetrating deeply into the soil, thereby also preventing recharge of groundwater aquifers. Breaking through hard pans can be done by deep ploughing or by using a soil ripper.

Once the water has entered the soil, the farmer wants as much of that water as possible to remain available to the plants. Increasing the organic content of the soil is the best way to ensure this. Organic matter, such as farmyard manure or compost, can hold a lot of water, so that even during dry months the soil still retains enough moisture to keep plants alive. In ***Helping the soil to hold more water***, a farmer describes how he builds the organic content in his fields, explaining the different ingredients that farmers can use in their compost, and how best to use livestock manure.

One factor that can discourage farmers from applying manure to their fields is the labour involved, compared to applying chemical fertiliser. However, in the long term organic material builds soil health more comprehensively than chemical fertiliser, and has the added benefit of increasing water holding capacity and resistance to erosion, something that chemical fertilisers do not do.

Roof top rainwater collection

Roof top rainwater collection can be as simple as putting some buckets or basins at the corners of the house when it rains. However this will only capture a small part of the water available. To maximise the potential of the rain that falls on their roof, people need to install gutters along the bottom edge of the roof to catch all the water and direct it into a tank of some kind. This does not need to be very expensive. Bamboo poles or pipes made from thin plastic can be cut in half to form sections of gutter. The tank could be made of metal or plastic, but a brick and cement tank may be a cheaper option.

If the tank is constructed at the same height as the gutter, the height and weight of the water will allow it to be piped quite long distances, for example to vegetable plots. In ***Drip irrigation – an efficient system of water use***, small-scale vegetable farmer Mike Richter describes how he pipes water from a tank at gutter level to a second tank next to his vegetable plot. This gives him double the amount of storage space. The water in the second tank is then fed to the vegetable plots through a series of pipes laid on the soil surface. The pipes have small holes which slowly emit drops of water, a method called drip irrigation. It is a very efficient way of using water; even though the total amount of water harvested from the roof may not be very great, it is still enough to irrigate the plot of vegetables.

It is probably more common, however, for families to use the roof top water for domestic purposes, or to irrigate garden plants immediately around the home. Before the rainy season starts, it is important to sweep the roof clean of dirt and dust, so that this does not contaminate the tank when the first rain is collected. The first water harvested should not be used for

drinking, but should be used for plants, since there may still be dirt from the roof in this water. This, and other practical details about roof top rainwater harvesting are covered in ***Roof top rainwater collection***.

An innovative system for transporting harvested water

The final interview in the pack is an account by a farmer in Malawi of how he is using harvested water to irrigate banana and maize crops in a field two kilometres from his ponds. What is surprising is that the fields are on higher land, yet by clever innovation he is able to pipe the water uphill to reach the fields, without using a pump or an engine. His secret is to use pipes of different diameters – starting wide, and ending up narrow. In ***A natural pumping system for rainwater*** he explains how he discovered the system, and the difference it is making to his farming.

Using this Rural Radio Resource Pack

Choosing which interviews are relevant

Several of the interviews in this pack will be relevant to a general rural audience, regardless of the topography or rainfall patterns of the area they live. These include the interviews on roof top collection, low cost water tanks and ponds, increasing organic matter in the soil and drip irrigation.

The interview on pans – ***Water harvesting pans for dry areas*** – will be most relevant to dry areas where livestock keeping is a dominant activity. ***Government support for upland rainwater harvesting***, ***Storm drains and level ditches*** and ***Contour ridges on steep slopes*** will be most relevant for hilly areas.

Subjects to discuss – based on interviews in the pack

Role of non government organisations – ***Water harvesting pans for dry areas*** features a project being carried out by the NGO Action Aid. You could investigate whether either Action Aid, or another NGO, is doing similar work in your country, and cover the work of that project either by telephone interview, studio interview or field visit.

Role of communities – Both ***Water harvesting pans for dry areas*** and ***Government support for upland rainwater harvesting*** describe rainwater harvesting work in which communities have a strong role to play. Talking to community members who are participating in rainwater harvesting work locally would be valuable. What input do they have? Is the project demand driven or top-down? How sustainable do they think it is?

Role of government – ***Government support for upland rainwater harvesting*** and ***Storm drains and level ditches*** feature rainwater harvesting promotion being done by government departments in Zambia and The Gambia. Your listeners may be interested to hear whether similar government projects are happening in your country, and if so, how they can benefit from this work. This could also include discussion of what regulations or recommendations are in place to ensure responsible, sustainable management of soils and water, following on from Kebba Manka's comments in ***Government support for upland rainwater harvesting***.

Keeping harvested water clean and healthy – Keeping livestock away from water that is used for human consumption is one of the messages in ***Water harvesting pans for dry areas***. In practical terms this may be difficult to achieve, especially as the use of ponds and pans for both livestock watering and domestic uses is normal practice in many areas. It is a subject that would be interesting to discuss, for example with a public health worker and with a livestock specialist, to see whether this is an area where a change in established practice would be beneficial, and how it could be achieved.

Links between soil/water conservation and deforestation/desertification – In ***Government support for upland rainwater harvesting*** Kebba Manka also makes the point that conservation of soils and water reduces the need to clear forest to get new land for agriculture, and helps prevent desertification. If either deforestation or desertification are important issues in your country, it could be worth discussing with a soil and water management expert some practices that farmers could adopt to maintain their land and water resources.

Technologies for sloping land – There are many water harvesting techniques that are appropriate for sloping land, and only a few of the main ones are covered in this pack. It could be useful to identify either farmers or advisers who could describe some of the other strategies that are used in your country, to complement those that feature in ***Government support for***

upland rainwater harvesting, ***Storm drains and level ditches*** and ***Contour ridges on steep slopes***. A simple technique for marking the contour line on a slope is a very important skill, and is not covered in this pack. Either an expert farmer or a technical adviser could be asked to describe the technique practised locally.

Hard work but worth it – One message to come from ***Contour ridges on steep slopes*** is that harvesting rainwater in sloping fields is a hard task, but is justified by the benefits. This could make an interesting subject for a phone in, with farmers giving their experience with harvesting rainwater, and whether it is worth the effort that it takes.

Accessing and using organic manure – ***Helping the soil to hold more water*** gives the experience of one farmer in making and using compost. This is an important subject, one that a local extension officer could add more detail on. For example, what types of material are recommended in your country for making compost; what type of livestock would be the best choice if wanting to get livestock manure; are there any green manure crops (e.g. mucuna/velvetbean), that are available to farmers locally?

Low cost roof top collection and tank/pond construction – This would be another interesting subject to ask listeners to phone in their ideas. Ask listeners for their best tips/advice on low-cost guttering and tank and pond construction using locally available materials, plus how they are using the harvested water.

Drip irrigation – ***Drip irrigation – an efficient system of water use*** could be supplemented by input from someone locally who could comment on the availability of drip irrigation equipment and the possibility of financial or technical support, either from an NGO or government scheme. You will find a link to a factsheet on drip irrigation in the *Further information* section.

Farmer innovations – ***A natural pumping system for rainwater*** features a farmer who has taken an innovative approach to transporting water between his ponds and his fields. It could be used to begin a series of slots where farmers explain their own innovative practices, whether in water management or other issues. These could be done in the field, by telephone or in the studio.

Other aspects of rainwater harvesting not covered in this pack:

Breaking hard pans to increase infiltration of rainwater

If impermeable hard pans have formed close to the soil surface, this prevents water penetrating deep into the ground and recharging groundwater aquifers. This can increase problems of water scarcity in dry months, when these underground water bodies may be the only available source. Hard pans can also limit growth in deep-rooted crops. Hard pans need to be broken by ripping or deep ploughing.

Marking the contour line on sloping land

As already mentioned, this is a vital technique for farmers who want to build contour ridges or level ditches. There are several simple ways of identifying where the contour runs, including using an A-frame and a tube level, as explained earlier in the technical information.

Micro-catchments

There are many different techniques that farmers use to concentrate water in their fields, in order to grow crops. These are called micro-catchment systems. For example, the land between two contour ridges is a type of micro-catchment. Other examples include:

On flat land, crops are sometimes planted at the bottom of small pits, where rainfall concentrates. Farmers will normally put organic material at the bottom of the pit to provide nutrients and better water holding capacity. This is known as pit planting.

Half-moon micro-catchments are another design, often used to irrigate trees. The trees are planted at the lowest point of a curving low wall usually made from stones. The wall concentrates runoff towards the tree, providing enough moisture to keep it alive during the dry season.

Diamond-shaped micro-catchments – land is divided into a network of diamond shapes, made from low stone walls or heaped soil banks. Plants are put in the lowest corner of the diamond where runoff collects.

Vegetative strips are another type of micro-catchment. A strip is planted with a cover crop, increasing infiltration of rainwater. Immediately below the strip the farmer plants a crop, which will benefit from the infiltrated water.

Macro-catchment systems

Macro-catchments are the opposite of micro-catchments. They are large areas used to harvest rainwater, and are often several kilometres from where the water will be used - for example in a hilly area that receives a lot of rainfall. The runoff is collected and transported by cement channel or water pipe to the target area for cultivation. These schemes are large-scale and expensive and would normally require government support.

Stormwater harvesting

In tropical countries rain often falls in heavy storms. At this time, dry river beds become full of water and dangers of flooding and erosion are high. Learning how to control and use stormwater is therefore very important for farmers. Techniques include diverting water from streams into fields or into ponds, pans and reservoirs; this includes diverting water flowing on roads and paths. Rivers can be partially dammed, so that when flows are high water is diverted onto fields. This kind of system may need technical input from engineers.

If low walls are built across dry river gullies, these can trap both floodwater and soil sediment carried in the flood. In time this soil sediment can collect in sufficient quantity to enable crop production, with crops benefiting from the residual flood water left in the soil.

Further information

Useful websites, online articles and fact sheets

The **Practical Action** website – www.practicalaction.org has a large number of **factsheets**, available for free, online, covering many aspects of rainwater harvesting.

How to construct an A frame, a simple tool used to locate the contour on a slope
http://practicalaction.org/practicalanswers/product_info.php?cPath=24&products_id=63

Dead level contours, a system for storing rainwater in underground tanks
http://practicalaction.org/docs/technical_information_service/dead%20_level_contours.pdf

Roof top rainwater harvesting
http://practicalaction.org/practicalanswers/product_info.php?products_id=57

Collecting and storing ground runoff
http://practicalaction.org/practicalanswers/product_info.php?products_id=58

Constructing underground water storage tanks
http://practicalaction.org/practicalanswers/product_info.php?cPath=24&products_id=65

Micro-irrigation, including drip irrigation
http://practicalaction.org/practicalanswers/product_info.php?cPath=24&products_id=56

Sand dams, a technique for capturing rainwater in arid regions
http://practicalaction.org/practicalanswers/product_info.php?cPath=24&products_id=60

Water harvesting in Sudan, including stormwater harvesting and microcatchments
http://practicalaction.org/practicalanswers/product_info.php?cPath=24&products_id=66

The SEARNet – Southern and Eastern Africa Rainwater Network website has online factsheets on many aspects of rainwater harvesting, including:

- Road runoff harvesting,
- Water pans for runoff water harvesting,
- Rainwater harvesting with rock catchments,
- Micro-catchments for fruit tree production,
- Planting pits,
- Simple drip irrigation kits,
- Plastic lined underground tanks, and others.

See **http://www.searnet.org/rhtdatabase.asp?pn=3** for links to all these factsheets

The **Wikipedia** website has explanations of rainwater harvesting and links to other sites:
http://en.wikipedia.org/wiki/Rainwater_harvesting

International Rainwater Harvesting Alliance website (http://www.irha-h2o.org/) has information about this network to promote rainwater harvesting technology, including an article on **Rainwater Harvesting in Africa**
http://www.irha-h2o.org/index.php?option=com_content&task=view&id=43&Itemid=80

Factsheet: Domestic Roofwater Harvesting for Low Income Countries (http://www.ircsa.org/factsheets/lowincome.htm), is available on the website of the **International Rainwater Catchment Systems Association - http://www.ircsa.org/**

Books

Water harvesting and soil moisture retention, Agrodok 13, ISBN 90 72746 75 9, available from CTA (5 credit points)

The preparation and use of compost, Agrodok 8, ISBN 90 77073 09 4, available from CTA (5 credit points)

Erosion control in the tropics, Agrodok 11, ISBN 90 72746 074, available from CTA (5 credit points)

Learn how to make and use compost manure in farming, ISBN 9966 917 047, available from CTA (5 credit points)

Soil and water conservation for sustainable agriculture, ISBN 1406 801 1059, available from CTA (20 credit points)

The rainwater harvesting CD (CD-ROM), CD and booklet, ISBN 3 8236 1384 7, available from CTA (40 credit points)

Establishing and managing waterpoints for village livestock: a guide for rural extension workers in the Sudano-Sahelian zone, Agrodok 27, ISBN 9907246 90 2, available from CTA (5 credit points)

Ways of water: run-off, irrigation and drainage, ISBN 0 333 57078 2, available from CTA (40 credit points)

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CTA

Rural Radio Resource Pack – 2007/1

Rainwater Harvesting

Contents **Duration**

Rainwater harvesting

Water harvesting pans for dry areas

Cue:
In the dry parts of northern Kenya, water is very scarce, and harvesting rainfall is essential for communities to survive. Tribes in this area are livestock keepers, and harvest water for themselves and their animals. One of the most common water harvesting structures is called a pan. Pans are ponds dug in the ground, usually 2 to 4 metres deep. They can vary in size, with large ones being as much as 200 metres long, and smaller ones being only 10 metres square. Pans are dug in low-lying land, normally in flat areas. They collect water from small streams and rivulets which flow over the surrounding land during rainfall.

The NGO Action Aid is currently working in 20 districts in Kenya, helping people there to access clean, safe water, and to reduce the amount of time that villagers must spend collecting water. Part of that work involves helping communities to dig new pans, and to restore pans that have been lost to siltation. Siltation occurs when a pan fills with sand and mud, perhaps because of flooding or poor maintenance, reducing the amount of water that the pan can hold. Yusuf Artan, an engineer with Action Aid, spoke to Winnie Onyimbo about their work, and began by explaining how the pans are actually excavated, or dug.

IN: "The pans are either excavated by machine…"
OUT: "…thing could happen in that area."
DUR'N: 5'48"

BACK ANNOUNCEMENT: Yusuf Artan, an engineer with Action Aid, describing work in northern Kenya which has used rainwater harvesting to bring clean, safe water to livestock keeping communities. The interview comes from a radio resource pack produced by CTA.

Transcript

Artan The pans are either excavated by machine, or they can actually be excavated hand dug. Some of them are big, some of them are small. You can have a pan of 10 metres by 10 metres square; that is actually about 200,000 litres of water stored in that pan. The design is simple. It has to have an inlet, and after the pan has filled we try to make sure that the water does not come out. And in case there is excess, we have a spillway where the excess water can flow without actually affecting the pan itself.

Onyimbo *What are the benefits of the system?*

Artan The benefits of the system, first of all, is that they are simple to construct. The communities themselves can actually come together, do the excavations communally. It does not require a lot of technical expertise. It is just by observation that actually you can see that we can have this. The community themselves have been doing that for quite some time.

Onyimbo *And what kind of crops does this system support?*

Artan In the drier parts of the country the cushitic people actually don't grow any crops. They use it for livestock purposes, because livestock rearing is their main means of livelihood, and it is very important to them. So the livestock themselves get water from that area and the human beings also, they get their domestic water from those pans.

Onyimbo *What challenges have you faced in building and maintaining the physical structures?*

Artan Some of the challenges we have faced with pans is they are actually open to the air, and due to the high temperatures, the rate of evaporation is quite high. So as much as possible we try to dig pans which are deeper, so long as the bottom of the pan is actually not pervious, and we don't have seepage of water to the ground. And in areas where we find the seepage is quite high we try to use clay; either we import or we get clay from the neighbourhood, simply to make an impervious layer. Another challenge that we face also is mobilising the community to understand that we need to control that source of water. Because in most of the pans that you visit, the animals, the human beings all take water from that pan, where they actually just go into the pan. So the issue of hygiene is quite a problem.

Onyimbo *What kind of challenges do you face in terms of the environment?*

Artan First of all is the invasion of the water catchment areas by human beings. That is quite a challenge, that we see a lot of depletion of forests within the country, simply because of the explosion in human numbers. The other challenge we are also facing is that ground cover is actually being depleted in most of the areas, either through over-grazing, especially in the northern part of the country. And we find that the water structures, the pans that were there, one of the biggest challenges is actually siltation, and siltation is simply because the surface waters carry a lot of silt, that is sand and mud, to the pans. So with time you find these pans are actually slowly filled up by sand, thereby reducing their capacities. And that is actually one of the biggest challenges we have been facing in that area. And hopefully if we can involve the communities more in terms understanding what are the causes of siltation, building silt traps and ensuring that the catchment areas, the bushes and the grass and everything are not depleted, they will actually be able to link siltation to actually conserving the environment.

Onyimbo *What is the role of the community in managing the system?*

Artan One of the projects we have been doing is Takaba community water supply project. This is a project to supply water to the people of Takaba and their environs. The project was started in 2004. The project entails construction of about 3 pans, and joining them together, and the water is pumped to the top of a hill where it is filtered and distributed to the communities. The role of the community in terms of this project is that actually it has been from the beginning, where we actually have been doing the consultations with them. They were actually involved in the design itself. It was taken back to them, they validated the design. And they have also been doing the supervision of the works by the contractor. Because we believe that the inclusion of the communities is very important in management of water resources. Because a water project which the communities have not been involved with will not be sustainable in the long run.

Onyimbo *So how is the response from the community?*

Artan The response from the community initially is that they could not, first of all, believe it. The design itself was a little bit quite foreign, because we were trying to link up three dams and people were to get water from communal water points, or kiosks. And the communities there are used to getting water from the pans themselves, where actually the animals and the human beings, all of them go to the pans to get water. But what we are trying to do is we are trying to improve on the hygiene and to have water which is not actually contaminated. So we are distributing this water at communal points. And initially there was sort of some sense of disbelief that actually this system might not work. It has never been seen within that area. But eventually when they saw water coming out of the taps, there was actually a sense of happiness, there was joy and there was a lot of thanksgiving to the almighty, that actually such a thing could happen in that area. *End of track.*

Rainwater harvesting

Government support for upland rainwater harvesting

Cue:
Soil erosion and siltation of land are two problems that often go hand in hand. In The Gambia, for example, lowland rice fields frequently suffer from siltation, as erosion in upland areas washes soil particles down into the rivers that irrigate the rice fields. Solving the problem facing the rice farmers is only possible by finding a solution to the upland problem of erosion. For this reason, the government in The Gambia has launched an 8 year Participatory Integrated Watershed Management Project, known as PIWAMP. This is promoting soil and water conservation in entire river watersheds, including both the upland and lowland areas.

For the upland areas, the priority is to build field structures which can increase infiltration of water and reduce erosion. To find out more about how this is being implemented on the ground, Ismaila Senghore spoke Mr Kebba Manka, head of the engineering section of the government's Soil and Water Management Unit. Ismaila began by asking Mr Manka the implication of managing soil and water across a whole watershed.

IN: "We want to work both in the uplands …"
OUT: "…land degradation and all other implications."
DUR'N: **7**'20"

BACK ANNOUNCEMENT: Mr Kebba Manka, of The Gambia's Soil and Water Management Unit, emphasising the key role of soil and water conservation in raising productivity and reducing deforestation. The interview comes from a radio resource pack produced by CTA.

Transcript

Manka We want to work both in the uplands and the lowlands. In the uplands you apply techniques that will keep the soil where it belongs and then conserve also some of the moisture. Because the activities you employ to conserve soil also conserve water. In short, we are trying to protect the rice fields from the activities that are carried out in the uplands. Because activities in the uplands, they result in soil erosion and soil erosion causes deposition of silt sedimentation in the lowlands. That is why we are trying to work in the uplands to protect the rice fields as well.

Senghore *Now Mr Manka, what are the key technologies that you are promoting? Which ones would you really want to point out?*

Manka There are various techniques and what you apply depends on the nature of the area you are dealing with. But basically in The Gambia here we are dealing with what we call contour bunds. These are ridges that we insert across the slope in any given field, 50-60 metres apart sometimes, and this will help to prevent soil erosion. The basic techniques you apply in the upland are the contour bunds and diversion. Diversion is also another bund but then it is a big bund that is put in a location just at the beginning of the slope so that it will divert some of the water that would have entered the field and caused erosion. Then you divert it and let it go into another area where it will not cause erosion, where you will have prepared already a safe outlet.

Senghore *Now what is the role of the beneficiary farming communities in the development and use of the structures you helped establish?*

Manka Right now we are talking about the Participatory Integrated Watershed Management. That 'participatory' means that the farmers themselves have a role to play. Our activities are what we call 'demand driven'. Farmers see a problem developing and then we have agricultural agents in the area and they give them forms to fill and they bring these forms to us and we visit the site and this happens every year. We get a lot of requests for assistance from all over the country, but every year you can only do so much. So we go out and then do a reconnaissance survey and select sites that we can handle for the given year. And wherever we go, the projects that we work with, that are sponsoring this programme, would provide material that is unavailable locally. Like if they need cement or something like skilled labour, the project would provide it. And then the farmers are responsible for providing local material. Like if you need sand or gravel or if you need something like local manual labour, the farmers would have to commit themselves to participate in that area so that they will have a sense of ownership of the programme. Because they own the land, they own the crops they are growing there. So if it fails, they fail, and if it succeeds they succeed. So that if the project leaves, they will maintain these structures because they will have seen the benefits of the structures, they will have realised the importance of these structures in their farmland. So they will be an integral part of the farming system.

Senghore *How far are farmers adopting the practices that you are pushing?*

Manka The upland conservation techniques are adopted very slowly. They cost more than what we do in the lowlands. Because in the upland we normally have to use the service of heavy equipment to raise the bund because the ground is very hard and it is a little bit more expensive and it is not easy for the farmers to raise the bund by hand in that area. This is the situation. I mean the area we have covered is very limited. Like, in every division we have maybe worked in two or three villages that have benefited effectively from upland conservation. But with the advent of PIWAMP [Participatory Integrated Watershed Management Project] now, which is an eight year programme, hopefully we will cover more and more sites every year.

Senghore *Now would you say - given the situation that these projects and structures that you established are very capital intensive and labour intensive - would you say farmers will be in any way able to continue developing such structures even when you pull out and when your projects phase out?*

Manka Well, to develop them from scratch it may not be very easy without an outside support, for them to do this work very effectively. But once it is established and they have made an effort to maintain them, they are very easy to maintain. Because for the bunds, if you grow Vetiver grass, this grass is drought resistant, animals do not eat it and its root system is very fibrous and can hold the soil together and once it establishes on the bund, the bund can be stable and resistant to erosion almost indefinitely.

Senghore *How would you rate the potential of structure programmes to boost our agricultural productivity?*

Manka Agriculture is here to stay and the main ingredients are water and soil and they are all limited. So if you are to farm and you want to get something out of your farm you have to farm properly. These techniques, once integrated in your farming system would definitely maintain the yields or increase the yields. Because if you have, let's say during the rains, if you do not have enough rainfall but you have this structure in your field, the little rainfall that falls could be trapped in the field and that will serve the crop, even when there is a short period of lack of rainfall. And also if you apply a fertiliser it will not be taken away by the runoff and your crops will benefit from that. Whatever you put in your field, if you do not manage the land properly it can be washed away by water, and then the crops will lose it and then your yields will drop. So these structures that you put in the fields, they are to enhance productivity, maintain the soil fertility level and then by preserving moisture and preserving your input like the fertiliser you put in there, whether it is manure or artificial fertiliser, all will stay where they are.

If farmers understand and accept this, it should be an integral part of their farming system. There are some countries like, if I am right, in Kenya there is a legislation, that if you are not going to comply with the recommended policy you are not allowed to use the land. We have now a legislation for the forest, we have forest legislation; this should also be applied to soil and water management. Farming should be done in a manner that will protect the natural resources like soil and water. If it cannot be legislated it should be strongly recommended that governments should do all they can to protect the natural resources. These are very limited and water is scarce, land is scarce, populations are increasing. So forests are being encroached and we are having also some repercussions. So if you can apply conservation practices we do not have to cut down more and more forest for agriculture. We can use what is already being cultivated intensively without having to clear bigger areas, which will cause more and more erosion and cause more and more loss of vegetative cover, which can cause desertification, land degradation and all other implications. *End of track*

Rainwater harvesting

Storm drains and level ditches

Cue:
One of the most popular methods of trapping rainwater in fields, particularly on sloping land, is through the use of contour ridges or bunds. These are raised ridges of soil or rock constructed across the slope, which stop the flow of run off, thereby encouraging water to infiltrate into the soil and preventing soil erosion. Another method is to dig a ditch across the slope. As with the contour ridge, the ditch must not go up or down, but must be perfectly level, to prevent the rain water accumulating in one place; for this reason they are called 'level ditches'. Water collects in the ditch and slowly seeps into the ground: this water then moves down the slope through the soil and is available for plants. Many farmers use level ditches to irrigate either fruit trees or fodder shrubs for livestock, which they plant in a line just below the ditch.

Martin Sishekanu is the chief agricultural specialist responsible for land husbandry in the Zambian agriculture ministry. He spoke recently to Chris Kakunta about steps to encourage rainwater harvesting in hilly areas in the eastern part of the country. Chris began by asking him what technologies the Ministry was promoting, particularly to those cultivating fruit trees and fodder shrubs.

IN: "One, if it is a sloping ground…"
OUT: "…consider the area of water harvesting."
DUR'N: 5'54"

BACK ANNOUNCEMENT: Martin Sishekanu, a land husbandry specialist with the Zambian Ministry of Agriculture. The interview comes from a radio resource pack produced by CTA.

Transcript

Sishekanu One, if it is a sloping ground, we would like to break the slope by having a storm drain constructed by the foot of the hill. This storm drain, once it is constructed it will stop the water which comes and runs which adds also to the erosion of the ground, it stops it, it breaks the energy that erodes the soil and it gently and safely takes this water. Now where we take the water is important. In most cases we use natural depressions, and in some cases we can even divert this water into a water reservoir where we can store the water, which we can use eventually, even during the dry season, for irrigating our fruit trees. And in some cases we use level ditches. Now when the slope is not that great, when we use a level ditch, what we are doing is we would like to intercept the water that would have gotten lost and temporarily store this water, to allow it to filter into the ground. And as the water filters into the ground, it moves slowly down the slope and when we have our tree crops planted below this ditch, the tree crops will be continuously receiving the water that has been allowed to be stored in the ground.

Kakunta *That is very interesting Mr Sishekanu. Is it a system that you have been advising small-scale farmers to do here in Eastern Province?*

Sishekanu Yes in Eastern Province we have advised some farmers, particularly in the area of the utilisation of level ditches, which you can put and dig along the contour to store some water which eventually will be able to recharge the underground water system and make available some water during the dry season below where the ditch is. And then in some cases, like in the area of Chipangali, actually there is a rock that we have harvested water from. Using that rock catchment, we have put a rim, a small block where we have captured this water. Instead of the water coming from the rock to run and erode fields, we have diverted it into a water tank and from this water tank farmers are tapping the water to be able to apply in their fields.

Kakunta *Is this a new technology we are talking about? Because most often, like you indicated, rainwater is actually let go without being tapped the way you have explained?*

Sishekanu Well to some extent we may call it new but it is an old system. If you remember, even in the villages when the rain is falling you will find that we put either dishes or buckets by the corners of our houses and we capture water. That is already water harvesting. So the technology is old, but it is the mechanism in which to use and tap this water and utilise it for our own betterment that might be termed as new.

Kakunta *Now what are some of the benefits for a small-scale farmer to use this system that you have recommended in terms of raising fruit trees as well as fodder crops for livestock?*

Sishekanu The benefit is basically that without water our tree crops will not perform very well and therefore when we tap this water it will enhance the productivity of our trees and shrubs such that at the time when the browsing material in the natural environment is completely dry, there will still be some moisture that will be still available to support the growth of the shrubs from which we can be able to support our livestock.

Kakunta *Wonderful. Now what type of physical factors do you need to establish the system for it to actually work out well for the small-scale farmer?*

Sishekanu Well basically the level ditches would require that the area has some sandy-related soils where it is not going to over flood; it will be able to absorb the water and allow it to infiltrate. Now in the case of where run off might be higher because of clay soils, particularly when there is also a hill, we will need to capture that water and divert it safely. At the same time, there is also the system where you dig ditches. These ditches will also be capturing water and you plant your fruit trees just by the side of the ditch and in some clay soils that will be quite handy and helpful.

Kakunta *So from your own experiences here in Eastern Province, what lessons have you learnt in terms of rainwater harvesting which are practically useful for the small-scale farmers?*

Sishekanu The level ditch system has been practically useful for the small-scale farmers because it helps to recharge the underground water reservoir and therefore, even where they have shallow wells, the shallow wells will be facilitated to receive water for a longer period of time than when they are absent.

Kakunta *Is there anything that I have left out that you would like to put across in as far as the subject rainwater harvesting is concerned?*

Sishekanu Basically I would say that if we harvest the water we will reduce the destruction of our soils and meanwhile we will enhance the productivity of our crops and therefore it will be important that we consider the area of water harvesting. *End of track.*

Rainwater harvesting

Contour ridges on steep slopes

Cue:
Hilly areas by their nature tend to create clouds and receive large amounts of rain. For farmers this can be an advantage, but can also lead to problems. One of the biggest problems is soil erosion. If water falls on steep land with little vegetation, it can become a powerful force of erosion, carrying all the nutrient-rich top soil down into rivers, and ultimately out to the sea.

Preventing that damage is vital to a sustainable farming system. One way of achieving that is through contour ridges. These ridges, which can be made of earth or stone, are built across the slope, trapping the rainfall and encouraging it to enter the soil rather than flow down the slope. To be successful, contour ridges must be perfectly level. If one part of the ridge is lower than another, the water will simply form a pool at that point, which in time will create a hole in the ridge, allowing the water to escape.

Julius Mollel is a farmer from the village of Oltrumet on the slopes of Mount Meru in northern Tanzania. Lazarus Laiser visited him on his farm to find out more about how farmers can use contour ridges to capture rainwater and prevent erosion.

IN: "I visited one of the farmers living …
OUT: … used for feeding the animals."
DUR'N: 2'53"

BACK ANNOUNCEMENT: Lazarus Laiser reporting from Arumeru district in northern Tanzania, a hilly area where farmers are using contour ridges to capture rain water and prevent erosion. The interview comes from a radio resource pack produced by CTA.

Transcript

Laiser *I visited one of the farmers living in Oltrumet village, Arusha region, on the steep slopes of Mount Meru, the second largest mountain in Tanzania. Due to the steepness of the land he adopted the system of harvesting water to reduce the speed of water and the speed of eroding the soil. I can see the contours on the farm where I am right now standing. I can count one, two, three which is almost 1 metre high and they really did a good job of harvesting water. And Mr Julius Mollel, may you tell us briefly how the system works?*

Mollel (Vernac) The contours harvest water in the farm and the water remains in the soil instead of running and eroding the soil.

Laiser *Did you get any benefit?*

Mollel (Vernac) I can answer yes, I got a lot of advantages. First I got the soil, it was not eroded. Secondly the products increased, both trees and fruits like bananas and others as you can see. And all the rain that has dropped, I am sure it remained in my farm compared to other fields without contour. And lastly, if you come in dry season my farm is green.

Laiser *Now it is rainy season and I can see that there is a lot of water which remains on the farm, as Julius said. How difficult is it to plan the system?*

Mollel (Vernac) Difficulty is when you are making them because you need to measure. It is tiresome work and costs time. But when you continue you will be used to it. Of course you will forget all these things after the good product.

Laiser *Where did you get the knowledge?*

Mollel (Vernac) I got the knowledge from the project called SCAPA, Soil Conservation and Agroforestry Programme in Arusha, in our district Arumeru.

Laiser *Julius learned, got the knowledge from SCAPA, one of the projects which was helping the farmers. How much labour did it cost you?*

Mollel (Vernac) Time and my strength, nothing else. I did not use money.

Laiser *What lesson have you learnt personally in implementing this technology?*

Mollel (Vernac) I learnt to increase my income, to make the soil fertile without adding manure. I also learnt how to harvest the rainwater and the benefit of it. I urge my fellow farmers to apply this knowledge of contours to their farm to reduce soil erosion. Our land is small and easy to erode. If we do not put any control to harvest rain, water will not get good products.

Laiser *That is the farmer Julius Mollel and I can see that he has really benefited a lot, good maize, good fruits which are here. Also the cows can get good food and as I can see, some of the trees are being used for feeding the animals.* End of track.

Rainwater harvesting

Helping the soil to hold more water

Cue:
What kind of soil is good for growing crops? An obvious answer is a fertile soil, one that contains large quantities of the minerals and nutrients that plants need. It is also good to have a soil which can hold a lot of water. Soil with good water holding capacity can sustain plants for longer during dry spells, thereby saving crops that might otherwise dry up and die. Adding organic matter to the soil, such as compost or animal manure, improves the quality of the soil in both ways. It increases nutrient levels and also increases the water holding capacity. It also gives the soil a better structure, by creating larger spaces between the soil particles. This improves the infiltration of rainwater, and gives the plant roots the air that they need to function.

Mathias Ngong is a banana farmer in the village of Babungo in Cameroon's North West province. He is also an expert on using organic manure. Martha Chindong asked him what he had learned about applying compost and animal dung from his many years of farming.

IN: "Can you just tell us the methods …"
OUT: "…have your manure without straining."
DUR'N: 4'38"

BACK ANNOUNCEMENT: Mathias Ngong, a banana farmer from Cameroon's North West province, explaining to Martha Chindong about the value of manure and compost to boost the water holding capacity of the soil, and improve his harvests of bananas. The interview comes from a radio resource pack produced by CTA.

Transcript

Chindong *Can you just tell us the methods, better ways of applying organic manure?*

Ngong Yes first of all to make organic manure is simple. You get all this grass that we clear from the compound, get some wood ash, get soil, put it underneath. If you have some cow dung or any dung, put it on it and then you put your grass, just drop a bit of water and allow it there. It is good to do it before the rainy season and then when water drops on it, it gets rotten. It gives you very good compost manure which you can use. Anybody can do that very easily. Then for those who have the dung, either goat droppings, fowl droppings, cow dung, those are good manures too that you can use, but with this one you must allow it for sometime. You know before you apply on the plant you allow it to decompose. The heat will come out and then it will be soft, you will not damage the plant. Now even with the bananas you see, when I want to plant banana I dig the hole, sizeable - about 60 centimetres wide and 60 deep, put the compost manure which you have prepared, put it under, fine, mix it with soil, surface soil. The soil right deep under, take it away because that one has no use. The surface soil, mix it and then you plant your suckers and some people use very tall suckers to plant, this is not good. You plant suckers which have no leaves yet, sometimes very little suckers, put them, bury them in the ground, let them disappear and let them come out by themselves. Then when they come out the results will be very good.

Chindong *Can you just tell us the methods, better ways of applying organic manure?*

Ngong Well you get under the plants, soften the soil, you soften the soil around it

then get the manure, put it round the plant. As water is entering it is sinking into the soil, it will help the roots of the plant to gain food and it will grow very well. Then to protect it from sunlight, if you are a farmer you must prepare some of these things. When you clear your grass do not throw, pack it somewhere. This grass you will use to what we locally call you give the VIP treatment to the plant.

Chindong *That is mulching?*

Ngong Yes mulching, you mulch the plant now with grass so that the soil under the plant remains moist, wet. The sun will be there quite alright but you find the plant fresh because the underneath is soft and the grass prevents sun from heating directly into the soil to burn the roots and make it weak and dry up the water. That is how you can give some VIP treatment to your plant.

Chindong *That is what I am seeing in front of us?*

Ngong That is what I have done here, as you can see. If you like I can open the soil and you see, down there. Once in a while, if you planted vegetables and so on this hand fork is very important. You loosen the soil with it like this, soften it round. You are not damaging the roots but you are giving room for air to get into the soil, because if it is harder, you have been throwing water the surface is hard, the plant will not grow. You soften it once in a while. You know if you are a farmer you must devote time. You soften it as I am doing this one like this, when you soften, soften, it gives room for water to penetrate easily and air, because air gets into the soil too. It will help your plant to pick up.

Chindong *Ok if you want to broadcast, say you want to plant on a large surface, can you carry the manure like what we are seeing, in this bucket, and throw on the ridge before you hoe it? Is it necessary, is it important?*

Ngong Yes, it is important. If you have the cow dung in large quantities you soften the soil, throw the manure in it and at the time you are forming the ridges the manure is just getting into those ridges – that is, after you have dug the place put your manure. Then when you are forming the ridges the manure is already getting into the soil. It makes the whole place, even if it was barren it would be now rich for planting.

Chindong *The only thing is that to have a large quantity of it is difficult too?*

Ngong Well, many more farmers are understanding now the use of organic manure so the rush for it is high. So it is also advisable to do what we call mixed farming, because you had 3, 4, 5 pigs and some poultry around, you always have your manure without straining. *End of track*

Rainwater harvesting

Roof top rainwater collection

Cue:
When heavy rains fall, how much water goes to waste? Water that pours off roofs, forming muddy streams that flow down the streets, eventually finding their way to a drainage ditch or a river, or collecting in pools which slowly evaporate. That rainwater is a resource, one which could be used for drinking, cooking, washing and cleaning, or even to support income generation through crops or livestock production. Roof top rainwater harvesting is one method of ensuring that at least some of the rain is put to use. Simple systems to channel rain from roofs into storage tanks can be installed at very little cost, and constructed from locally available materials. A storage tank, for example, may just be a clay-lined pit, and a gutter can easily be made from a bamboo pole.

Ellen Mangore is a civil engineer who specialises in water resources. She spoke to Busani Bafana, explaining first what the basic ingredients of a roof top rainwater harvesting system are.

IN: "Basically this system consists of …
OUT: … specialises in groundwater resources."
DUR'N: 3'33"

BACK ANNOUNCEMENT: And that was Busani Bafana reporting from Bulawayo in Zimbabwe. The interview comes from a radio resource pack produced by CTA.

Transcript

Mangore Basically this system consists of three main components, the catchment, the conveyance and the storage. The catchment is mainly a roof which can be corrugated, thatch or asbestos and the conveyance is mainly the down-water pipe, the gutters. And the storage can be a tank; a plastic tank, a steel tank or even store it in a masonry tank underground.

Bafana *What is this water used for?*

Mangore In a rural set up we normally use it for domestic purposes, which can be cooking, cleaning and agricultural purposes, basically irrigation, livestock watering.

Bafana *So if a farmer is using this water to grow crops, what kind of crops would be most suitable?*

Mangore Usually orchards and vegetables, because we cannot actually expect to water very large fields with water that is collected off a roof. It is actually used as a supplementary supply, not that we actually depend on water that is harvested from a roof for all our requirements.

Bafana *I also want to find out how can we keep this water clean, should a farmer decide to use it for domestic purposes?*

Mangore Normally the catchment area or the conveyance system and storage system have to be kept clean, especially towards the fall of the rains. So you need to clean up just before the rains fall and we discard the first water that is collected after the first rains, use it perhaps just for irrigation, not for domestic purposes.

Bafana *Is it possible to have this system on a traditional hut or it applies only on a modern type of roof?*

Mangore It is possible but the quantity of water is decreased.

Bafana *How can then this system be adapted using locally available materials?*

Mangore For conveyance, we can use bamboo or animal skin and actually you can store the water in masonry tanks which are brick and mortar tanks built underground.

Bafana *If, say, in a rural setting you do not have mortar, what can you use?*

Mangore You can actually dig small ponds in a nearby area, and then you line it with clay, which is a material which is locally available most of the time.

Bafana *Are there any ways that this system can be improved on, maybe so that a farmer can collect more water or have a greater storage capacity?*

Mangore This system can be improved on by… you decrease seepage into the ground if you use ponds, by using an appropriate method for lining.

Bafana *Are there any other simple small-scale storm water harvesting techniques that farmers can use when they cannot afford gutters?*

Mangore Farmers can actually harvest water from the courtyard where, by virtue of the compaction of people moving around the home, then that ground is compacted, then it can act as a catchment area and it drains perhaps into a hand dug pond somewhere near the homestead.

Bafana *From your research in the techniques of storm water harvesting, what lessons would you say have been learnt using the rooftop technique?*

Mangore The rooftop technique is actually simple and low cost and it does not require much skill, so it is applicable almost everywhere this type of roof exists.

Bafana *Which time is it most cost effective to install this system?*

Mangore This system should be installed as part of a house when it is designed. As we decide to build a house we should bear in mind, because of the region in which you are building – if this is a dry region or one where the rainfall is very seasonal then we have to consider this as part of the design of our house.

Bafana *There you are listeners, I was speaking to Miss Ellen Mangore, a civil engineer who specialises in groundwater resources.* End of track.

Rainwater harvesting

Low cost water storage tanks and ponds

Cue:
When rain only falls for a few months each year, it is very tempting for farming families to try to store some of that rainfall for use during the dry months. Water storage tanks, both above ground and under ground, are one answer. Some collect water from roof tops, while others collect run off from the ground. Man made ponds, sometimes called charco dams, are another option. Depending on the soil type these may need to be lined with a plastic sheet, to prevent the water being lost.

But how affordable are these technologies for smallholder farmers? Can they afford to build them individually or is it best to work as a group? And what technical support will farmers need to build them? In general these structures are a more expensive system of rainwater harvesting, and most farmers will need some technical help in building them, or else they may quickly crack and leak and become useless.

Simon Mkwinda is the Chief Land Resources Conservation Officer in the Malawian Department of Land Resources. He spoke to Excello Zidana about how families can use tanks and ponds to harvest rainwater, and began by explaining that there are two types of water storage tanks.

IN: "Basically there are two types of tanks …"
OUT: "…change the materials to make them low cost."
DUR'N: **7**'48"

BACK ANNOUNCEMENT: Simon Mkwinda of the Department of Land Resources in Malawi, explaining that structures for storing rainwater, such as tanks and ponds, do not have to be very expensive. The interview comes from a radio resource pack produced by CTA.

Transcript

Mkwinda Basically there are two types of tanks. The first one is what we call 'above ground tanks'. They are constructed of course using different materials but mostly bricks with cement. And in most cases we advocate construction of this type of tank for domestic uses. Then the second type is what we call 'underground water tanks'. This involves digging a pit in different shapes, but in most cases we advocate what they call hemispherical shape because these are proved to be strong enough to store large quantities of water. Now in terms of catchments that we use for collecting water from on the ground, mostly they could be rock outcrops or even any cultivated area where it is a source of runoff. Now instead of this runoff just flowing uncontrolled on the ground, we advocate that the runoff should be channelled to these tanks to store the water for usage later on. But by doing so, the construction of these tanks, it means they are assisting in reducing the amount of runoff that would otherwise would be flowing on the ground uncontrolled thereby causing erosion, soil erosion. So by constructing these tanks in a way we are also trying to help in controlling soil erosion which is rampant in the country.

Zidana *How would you look at the materials used for constructing tanks. You talked of cement. Is it feasible for a local farmer to construct these things?*

Mkwinda Yes at face value you may say these technologies are expensive and farmers may not be able to afford. But there are different methods of constructing these structures. For example if you are talking of an underground tank, depending on the condition of the soils you are dealing with, instead of using materials like cement and bricks or reinforcement wires, chicken wires and the like, you may do just with a plastic sheet. Because the idea is to keep water and you want to prevent seepage of water that has collected in the tank. At the same time, some of the rooftops you may construct using iron sheets. Iron sheets are very expensive. But then you can modify that. You can just provide a plastic sheet or even just grass. Because the idea is that you want to reduce evaporation of that water that you have stored in that tank. So there are those modifications which can make the whole thing cheaper and manageable by smallholder farmers. But most important of all, let's not look at rainwater harvesting single-handedly, or in isolation. We have to empower farming communities with other initiatives that would assist them in generating income, so that some of these technologies they can adopt them quite easily. For example, World vision in Chingale. They are integrating in their programme issues that would bring a lot of income to the communities, like getting them involved in seed multiplication. The income they get from the seed multiplication programme is enabling the communities to source some of the materials on their own, as individuals or groups.

Zidana *What do you encourage farmers to do when they are thinking of constructing or having ponds?*

Mkwinda Pond construction is another technology that we are promoting among smallholder farmers, and you construct it in a strategic place, particularly near low-lying areas. The idea being that once you dig out a pond you should be able to let water, run off, to settle in that one, and the farmers should be able to utilise that water for different uses. If it is in low land it would be more ideal for irrigation, it may be ideal for fish farming. But then like I said, it depends on the conditions of the area where you are constructing these ponds. Sometimes it may be necessary for you to line the pond with plastic sheets to reduce seepage of the water.

Zidana *Do you see this technology to be good for farmers or worth promoting?*

Mkwinda It is worthwhile to promote it. In Malawi we have adequate rain for a limited number of months in a year, or in a season. We are talking of maybe at most 4 months of receiving rain. The other months are dry months. If we don't develop a culture of storing the water we receive in that short period, then year after year we will be crying that we are unable to do A, B, C, D, because we don't have water. This technology is coming into fill that gap. Let farmers harvest the rainwater as much as we can so that the stored water can be utilised for different purposes, domestic, livestock watering, irrigation, you name it. But then I should also mention that, yes, in our discussion here we have just looked at the structures. Those are the ones that we normally say are very expensive, because they require farmers to spend a lot of money. But there are other technologies we call *in situ* rainwater harvesting technologies which can be done right in the field, which are low cost, very simple, farmers can do them on their own, of course with guidance from extension workers.

Zidana *Can you cite some examples?*

Mkwinda Examples of these include pit planting, where you dig pits in the field, then you apply manure in those pits. The idea being after the rains have fallen most of the rains collect in those pits, and then you come and plant your crop in those pits. In this way you are assisting the crop to grow up so well because you have stored water in those pits. Another example is what we call swales. Swales are nothing other than small trenches that you dig on a contour in a field at a pre-determined interval. The idea is instead of runoff just flowing overland you store the runoff in those trenches, with the idea of recharging the soil profile, so that whatever crop you grow in that field should not suffer from moisture stress, especially in periods of dry spell. There are so many other technologies like water infiltration pits, rainwater harvesting from roadsides, whereby instead of just losing the water into drains, you channel the water into a field where you can grow a crop. Those are some of the techniques which are low cost, which we are already promoting. But like I said earlier, even the structures, you can try to modify them to suit the socio-economic status of the communities that you are dealing with, by modifying their design. You can change the materials to make them low cost. *End of track.*

Rainwater harvesting

Drip irrigation – an efficient system of water use

Cue:
For those who earn a living from crop farming in dry areas, making the best use of water can make the difference between success and failure. One of the most efficient ways of irrigating crops is drip irrigation. The system works by spreading water onto a field through a number of narrow pipes, which are laid out on the soil surface parallel to the rows of crops. Tiny holes in the pipes allow drips of water to come out, and this seeps straight into the ground, quickly reaching the roots of the crop. Although it is a simple system, it allows farmers a lot of control; by adjusting the tap that feeds water into the pipes a farmer can provide just the right amount of water to the crop. It is also possible to add fertiliser, such as urea, to the water, a practice called fertigation.

Drip irrigation systems can be supplied by pumped water, but farmers can also use gravity to power the system, by storing the water in a raised tank, which the pipes are connected to. South African vegetable farmer Mike Richter grows tomatoes, garlic, pumpkins and spinach on his drip irrigated plot; he gets the water by harvesting rainfall from the roof of his house and his farm buildings. Lucas Moloi visited his farm some 70 kilometres south of Johannesburg, to see the system in action. He asked Mike to firstly explain how it works.

IN: "First of all you have got to catch…
OUT: … is the best you can do."
DUR'N: 4'26"

BACK ANNOUNCEMENT: Mike Richter, a small-scale vegetable farmer from South Africa. He was talking to Lucas Moloi, and the interview comes from a radio resource pack produced by CTA.

<u>Transcript</u>

Richter First of all you have got to catch as much water as possible from your gutters into tanks, and from there via piping, drip irrigation onto your vegetables. That is the most economical way of using water. That means you can open the tap whenever you need it in a dry season and you can close it when it is raining, you do not waste any water.

Moloi *So what could be expenses and labour involved in getting that system together?*

Richter Labour is actually more your own because everything you can do yourself. Plastic piping is much cheaper than steel piping in the olden years, and you can use a thin plastic which is very cheap actually and you can cut it with a knife and put it together with your hands, without getting anybody involved from outside.

Moloi *And now from your roof gutters to the tank, how does water get to the plants?*

Richter From there you have got to take it via the pipes to the drip irrigation. Or what you can do is, if you have got your tank high enough in the gutter, you can lead it to a secondary tank close to your vegetable garden. That means you can double the amount of water which you can store. And after that of course it is just a question of opening taps.

Moloi *For somebody who may not know this, what is drip irrigation?*

Richter Drip irrigation is actually a thin sort of pipe with small holes in it and it drips water, say a drop of water every three seconds or something like that. And you can always, according to the temperature or whatever, you can open the tap as much as you like. In a very hot day you will open it a little bit more, while in coolish weather you will have one drop in ten seconds or something like that.

Moloi *So is this type of system advisable for one to use at any size of a farm or is it advisable for only small-scale farms?*

Richter They use this on huge farms. I have been in the northern Transvaal where they use it on maize; it was about twenty hectares under drip irrigation. But of course there it is not rainwater, it is pumped from the ground and the pump is running continuously to supply the drip irrigation with the water.

Moloi *What could be the risks associated with this type of irrigation?*

Richter As far as the irrigation is concerned there is not very much risk. There are a few small problems and one is if you have got hard water when you use a bore hole, it might clog up your little holes, it would not drip properly anymore. That means you have got to apply a little bit more pressure to get the drip irrigation to work properly. But otherwise there is not really a risk. It is normal farming risks, that is insects, hail and what have you.

Moloi *So can a farmer use this type of drip irrigation on a slope where he has planted his or her vegetation?*

Richter Oh yes, it is exceptionally good on a slope because there is no running water. It goes into the ground as it drips on it, because you can just adjust it to drip slow enough so it does not run.

Moloi *So do you reap any benefits from this type of irrigation?*

Richter Oh yes, it is not labour intensive at all, you do not need anybody to move the pipes you just open a tap. And you can always calculate how much water you want and close the tap after so many minutes; then you have got the result which you want.

Moloi *So about soil type, can you use it despite the type of soil that you have planted your vegetation on?*

Richter Yes you can use it on just about every soil except when it is very very sandy. What you find then is that the water goes right down to the bottom without spreading out, and this is about the only soil I would not recommend drip irrigation.

Moloi *So can you still use the drip irrigation during any season?*

Richter Yes, yes winter and summer. Of course being a plastic pipe it would not burst in winter when it is very cold and in summer, while it has got water in it the sun would not damage it. But if it has not got water in it then it would not last very long.

Moloi *I do not know if there is something that you think I have left behind that you would like to add?*

Richter All I can tell you is that put as much organic stuff into the soil as possible because it contains a lot of water, it holds a lot of water, it does not damp out very easily, and it is very good for the soil and very good for drip irrigation. It is the best you can do. *End of track.*

Rainwater harvesting

A natural pumping system for rainwater

Cue:
Thyolo district in the southern part of Malawi is very famous for its bananas which feed the whole of the district and the central region as well. It is also one of the two districts that grow tea. Tea growing is unique to this district because of, among other features, its mountainous features. In such an environment where most people grow bananas and tea, one innovative farmer, Friday Nikoloma, does something different, and is very successful. He traps rain water in ponds where he rears fish, and uses the same water to irrigate crops some two kilometres away. What is surprising, however, is that his crop fields are on higher land, and he manages to pipe the water to those fields without using any kind of pump or engine. Friday spoke to Patrick Mphaka about how he developed this system for transporting rainwater upland.

IN: "(Vernac) I thought about this for a …"
OUT: "…change the materials to make them low cost."
DUR'N: 5'01"

BACK ANNOUNCEMENT: Friday Nikoloma, explaining his system for transporting captured rainwater to his crop fields without using a water pump, even though the crop fields are on higher land. The interview comes from a radio resource pack produced by CTA.

Transcript

Nikoloma (Vernac) I thought about this for a very long time. This being a hilly area, during rains there is a lot of runoff. So, I decided to dig ponds for fish farming, but also so that I could use the same water to cultivate other crops in uplands. The main challenge was therefore how I could make the water reach the upland from the lower areas without using a water engine.

In the process of serious thinking, my mind focused on how water comes out of the ground through a spring. I remembered that at a spring, water gushes out of the ground with some force. I tried to think of how this force is created underground. I concluded that it happens because of the weight of the soil on top of a water body which forces itself on the water. The water then kind of escapes from this weight and forces itself out through a small hole we call a spring. I then seriously thought of what I would need to do to create the same scenario, where water would be forced to move from the low land to the upper land just as water comes out of a spring.

I made an experiment where I directed the water into a hose pipe, but the water stopped flowing when it reached an equal level as that of the source. I thought of using a water engine to force the water to reach the upper land. But I also thought of the downside of this alternative; that the engine is expensive, and maybe I would never get a good return on my investment. So, I decided to keep on experimenting with just hosepipes. I discovered that when a lot of water is forced into a hosepipe and the hosepipe has a small hole, water gushes out of that hole with more force, for up to three or five metres high.

This discovery gave me an idea that if the inlet is larger than the outlet, the water will come out with more force because the outlet is smaller. I then used a 5-inch hosepipe at the inlet, and connected it to a 3-inch hosepipe. In my connection, I found that water was coming out of the 3-inch pipe with a lot of force. I then connected a 1-inch hosepipe to increase the force. The result was splendid. The water was coming out of the smaller outlet with a lot more force and jumped to more than twice my height. I then decided that I should still direct this water into a hosepipe to determine the extent of reach. I found that the water was able to go upland but upon reaching a certain point, it stopped.

I tried to find out why the water was unable to reach the desired point. I found that it was because I had bent the pipe. So, I let it go in a straight line for some distance and bent it later after some distance from the source, up there. But since this water was not in very large amounts, though the flow was continuous, I thought of constructing a holding tank upland. This would act as a head for more water for a better irrigation system. This worked well.

This idea came up through experimentation when I discovered that there was a lot of water which was being wasted that would have been used in productive farming through irrigation, and again, when I did not want to use a water engine because it would be very expensive. I also wanted to demonstrate that we can use our brain and come up with useful innovations that can make water available where it would otherwise not have been available. Here, everybody has now seen that water can be moved from one place to another and enable irrigation farming.

From these ponds, water goes to those hills where I irrigate maize, bananas, and other crops. I even direct the water into my extended family's gardens to also enable them benefit from this water which is coming from a lower area. This is a demonstration to many people who live in the same conditions as mine, where the water is further away and in a lower area, where it can not flow through gravity. It is possible to direct this water upland and use it in many ways including irrigation without using a water engine, as I have done. *End of track.*