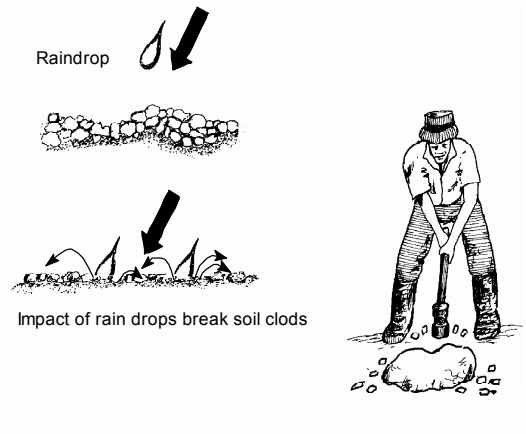
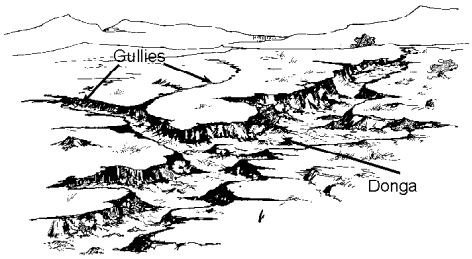
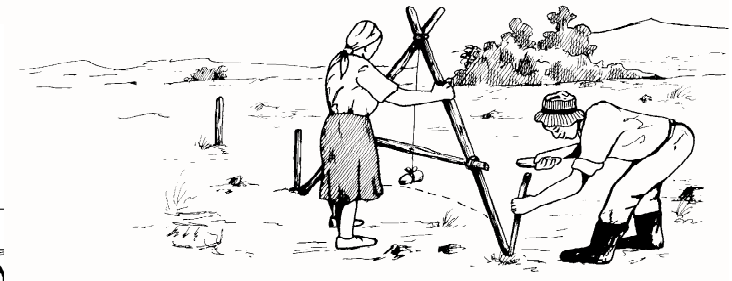
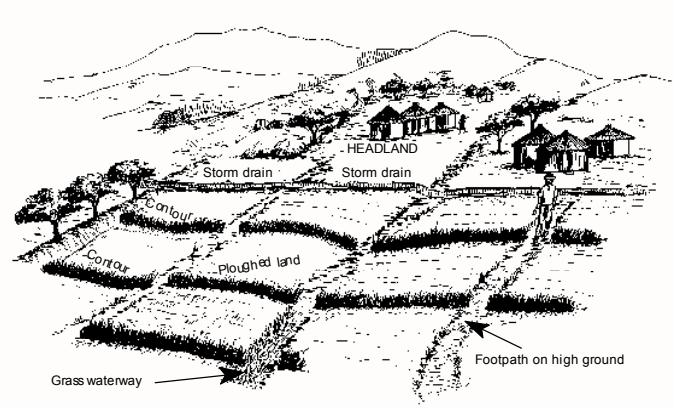
A Guide for
Farmers on Good Land Husbandry









Soil and Water Management

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Soil and Water Management

To be a good farmer means being good at many different things. The most important is of course to grow good crops that give us good yields, and even in difficult years with bad rainfall to be able to grow enough to feed the family. Some are able to do that, others are not. Here is a story about two brothers who did things in different ways:

To care for the land,

-does it make a difference?

Once upon a time in the village of Mutsvangwa lived two brothers named Kuziva and Tinashe.

Figure 1 Tinashe, who was the first born, got the best and most fertile land

The two brothers had inherited their land from the father, who was a good farmer who took good care of his land. When their father passed away, Tinashe, who was the first born, got the best and most fertile piece of land, while Kuziva got a smaller plot, that had been cultivated for many years.

Figure 2 Kuziva the second born got a smaller plot of land that had been cultivated for many years

Before the first planting season Kuziva was very busy trying to improve his fields. He knew that the land was not very fertile so he carried a lot of compost and manure from the kraal to the fields and he repaired the contours where they were broken.

Tinashe just took it easy, knowing that his land was good and would give him good yields. Time came for harvest and both brothers had good yields, so they had plenty of food in the house.

In the following years Kuziva continued to improve his land. He carried more compost and anthill material to the fields every year, and he tried different crops on the field at the same time; sometimes with good results, sometimes without much luck. He also realised that a lot of rain water was lost from the fields during heavy showers, so he tried to find ways to keep the water and the moisture on his land.

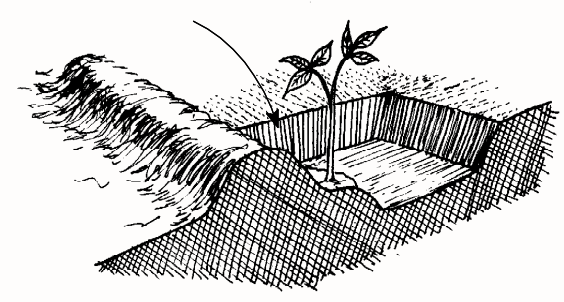


Figure 3 Kuziva dug pits to catch runoff water and planted fruit trees

He dug pits to store water in different places and he planted fruit trees in some of them. Where water was moving fast in his land he planted grass and put stones across the slope to slow down the flow of water.

Figure 4 Kuziva tried new ideas like planting grass across the slope to slow water

He was always busy trying out new ideas.

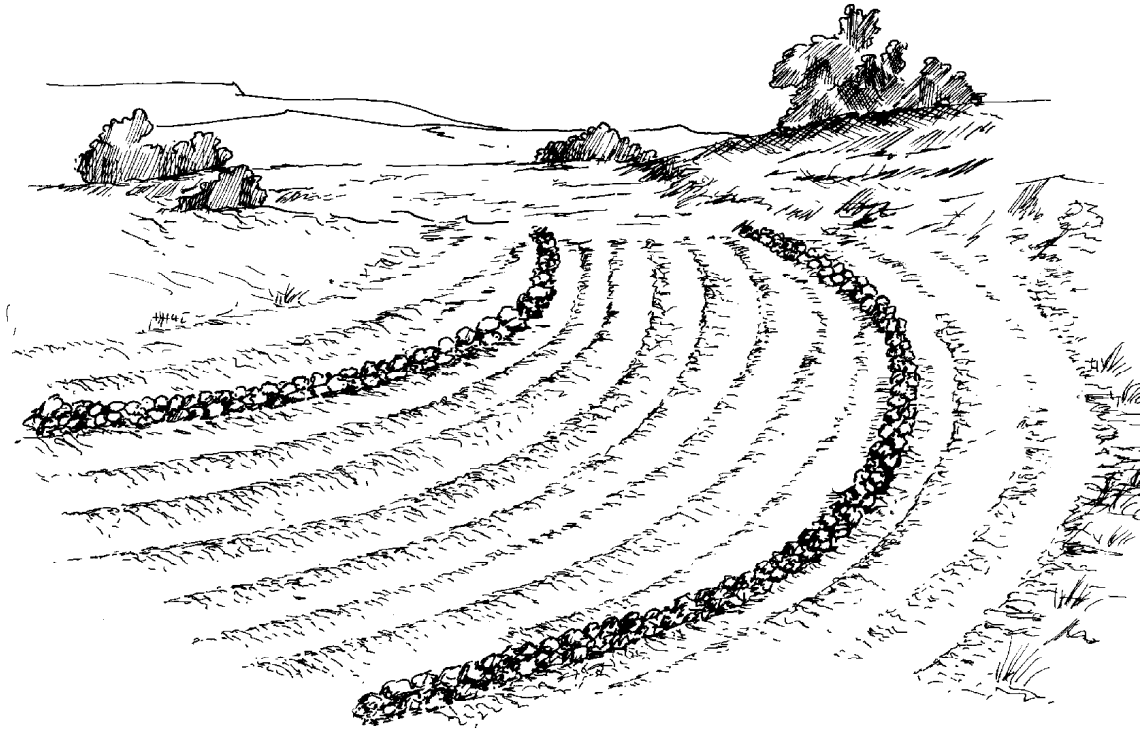


Figure 5 Kuzva tried new ideas like stone lines across the slope to slow water

Meanwhile, Tinashe just ploughed every year and palnted his maize

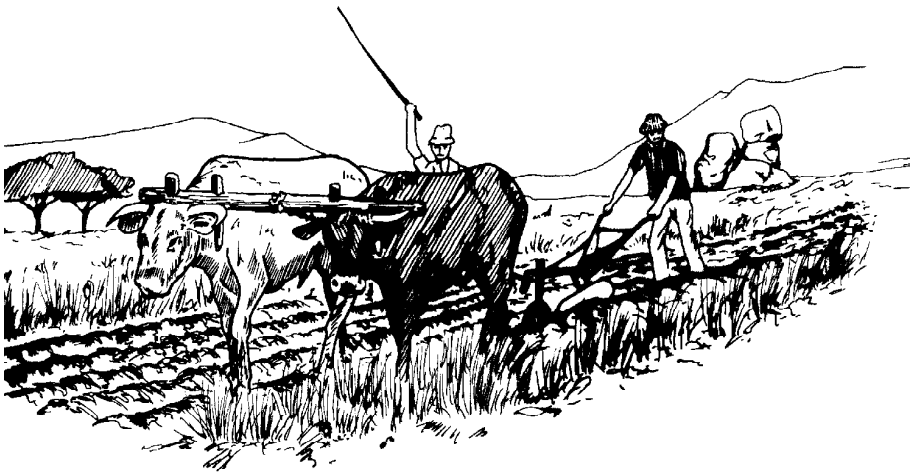


Figure 6 Tinashe ploughed his land every year

Figure 7 In the first years Tinashes' maize yields were good

His yields were good in the first years, but after 4-5 years his yields were less than they used to be. He tried to buy some fertiliser, which was very expensive and only worked for one season. So he opened up more land and ploughed closer to the waterways, but still his crops were poor.

Figure 8 After 4 or 5 years Tinashes' crops were very poor

Some 10 years after the loss of their father, Kuziva and Tinashe sat down under a tree and had a talk. Tinashe was complaining about the bad times, that he did not have enough money for clothes and school fees for his children. He then asked Kuziva how he was doing. Kuziva explained that he was quite comfortable. He almost always had enough food, his animals were healthy and he said that his wife had just bought new school uniforms for the children.

Figure 9 Tinashes' farm after ten years of poor management

*Tinashe then asked: "**How can it be that I got the best land from our father, but you seem to be making much more from yours, which is smaller and not so fertile?"***

"I think**" Kuziva said, **"it is because good land can turn bad if you do not look after it well, and poor land can be improved if you are prepared work hard. I always make sure that almost every drop of water that enters my land stays there. Water that flows fast steals my soil by taking it away from the field, down the waterway to the stream. I don't want the rain to steal my soil, so I make sure that no water flows fast on my land. Thereby I keep my soil which I have improved with compost, manure, leaf litter and anthill material and I keep the water for my crops."

*Tinashe thought about it a while and then said: **" But isn't it a lot of hard work to do so?"***

*"**Well yes**," said Kuziva "**-but if I want to look after my family well I have to care for my land also. It gives me a lot of pleasure to learn from the land. You know, by the end of the day, I win. Now I control the water and the soil, they do not control me or my crops very much anymore."***

*He then continued: "**Why don't you come to my place early tomorrow morning, then we can take a walk around the fields and I will show you what I have done?"***

Tinashe then went home and thought about it.

The following morning just around sunrise, the two brothers were seen walking Kuziva's fields. Kuziva was explaining and his brother listened and asked many questions...

Figure 10 Kuziva explaining how he grows good crops

•Kuziva is an example of a farmer who has realised that good farming practices must always combine conservation and production.

•Good soil and water management is a requirement for a good and stable production.

•Instead of simple solutions that are supposed to work everywhere, Kuziva applies different methods for different parts of his land with very good results.

• He experiments and tries to learn from his land, because there are no simple universal solutions to good soil and water management.

• In the following sections you can read about some ideas on soil and water management, some might work for you, some might work for others.

• We must experiment to find out what will work best on our land and suits our families.

1. How to Observe Our Soil & Water in the Field

The best way to start is to take a walk around our fields to see where the water comes from and where it goes. We must notice what damage fast flowing water causes.

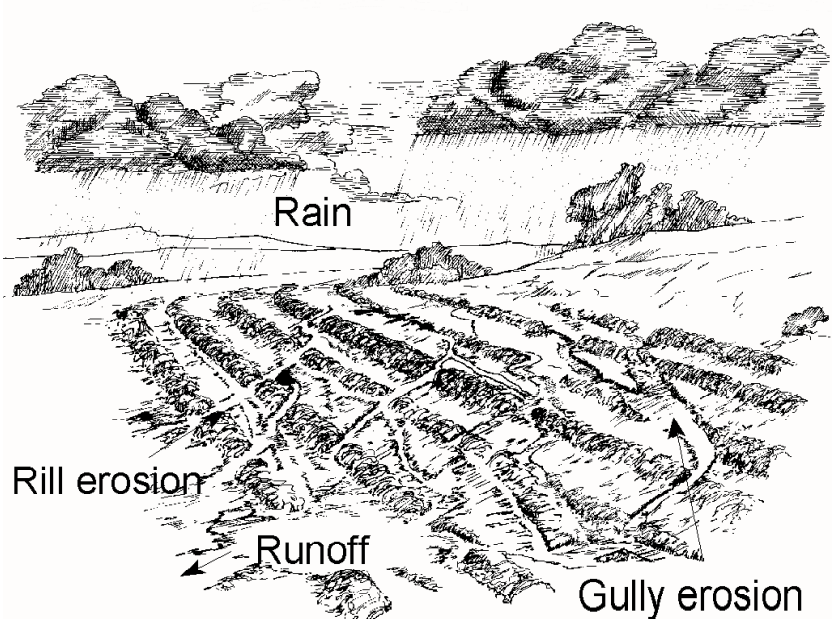


Figure 11 Damage cause by uncontrolled water flowing across field

The best way to learn about the water on our land is to ***walk around the fields when it rains heavily***. Try to follow water flows from the top of our land to the bottom. We might get wet, but it is worth doing because it is easy to see the damage flowing water does when it rains.

Then we know where flowing water ”steals” our soil and this is where we should start. Typical places are below rock outcrops, in grazing areas, along roads, footpaths or waterways, or in poorly constructed contours.

Signs of poor water conservation are:

- *Poor or broken contour ridges*
- *Sheet erosion*
- *Rills and gullies*
- *Silted waterways, streams and dams*

Principles of Soil Erosion

Soil erosion means the movement of soil from one place on our farm to another. Usually the cause of erosion is water, but it can also be wind if the soil is dry and bare, like a bare winter ploughed field exposed to strong November winds before the first rains.

Water is however the most serious cause of erosion, and the faster the water flows the more power it has, which means the more soil it can erode. So fast flowing water should make us concerned and we should take action immediately if we observe it on our land. Fast flowing water steals our soil and and with it the soil's fertility which our crops need.

> ***Water is our friend because it gives life to the crops and the trees and it fills the rivers and streams with the water we need. But fast flowing water is our enemy, because it steals our soil and disappears very quickly. We want the water to stay with us, we do not want it to run away with the soil. (Mr. Mafuta, farmer in Zaka, Masvingo)***

Let us look at the different stages of erosion caused by water:

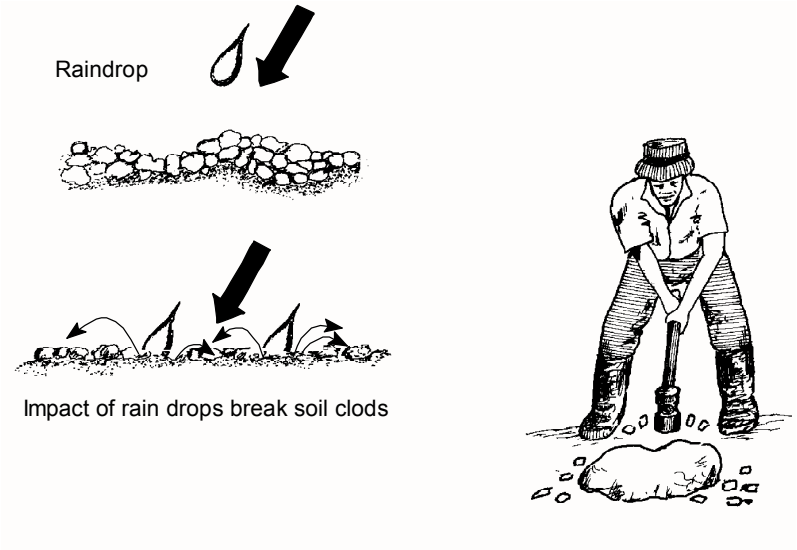


Figure 12 The impact of raindrops on small clods of soil is the same as a sledge hammer hitting a rock

Raindrop Erosion: When raindrops fall on the ground they have a certain power or energy. The larger the raindrops the more energy they have. During heavy showers the energy is high and the raindrops are actually able to damage the soil structure by breaking up the clumps or aggregates of soil particles. (See the chapter on Soil Fertility)

By breaking up the soil aggregates into smaller bits, the soil becomes less resistant to water moving on the soil surface, because smaller soil particles are easily dislodged by flowing water. Water that flows on the surface is called run-off.

Sheet Erosion: When water runs on the surface in a uniform way without flowing into small channels or depressions it is called sheet erosion. This can typically be seen when the roots of a tree are becoming exposed and all the soil that used to cover the roots is eroded.

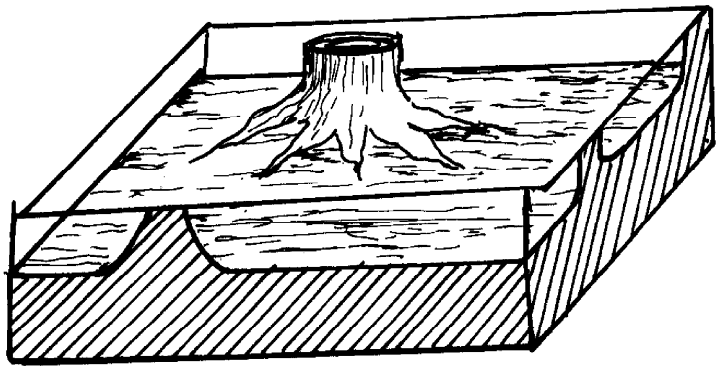


Figure 13 Tree roots exposed after soil erosion

Rill Erosion: When run-off starts to "meet" in small channels or depressions in the land it is called rill erosion. The channels or depressions are called rills. In the picture below a typical situation is shown, where water flows in rills onto a newly ploughed field. The rills cross the furrows and will eventually break the contour to the right.

Figure 14 Uncontrolled runoff from grazing areas creating rills and breaking contours in field below

Rills are a sign of serious problems and we should be alarmed if we have rills on our land. Water flows fast in rills. Therefore it is very important to take action when we see rill erosion because very soon the rills will get deeper and deeper, water will flow faster and faster and more and more soil will be stolen from us. During heavy showers even crops may be stolen from us or seriously damaged, which means that we also loose money and food.

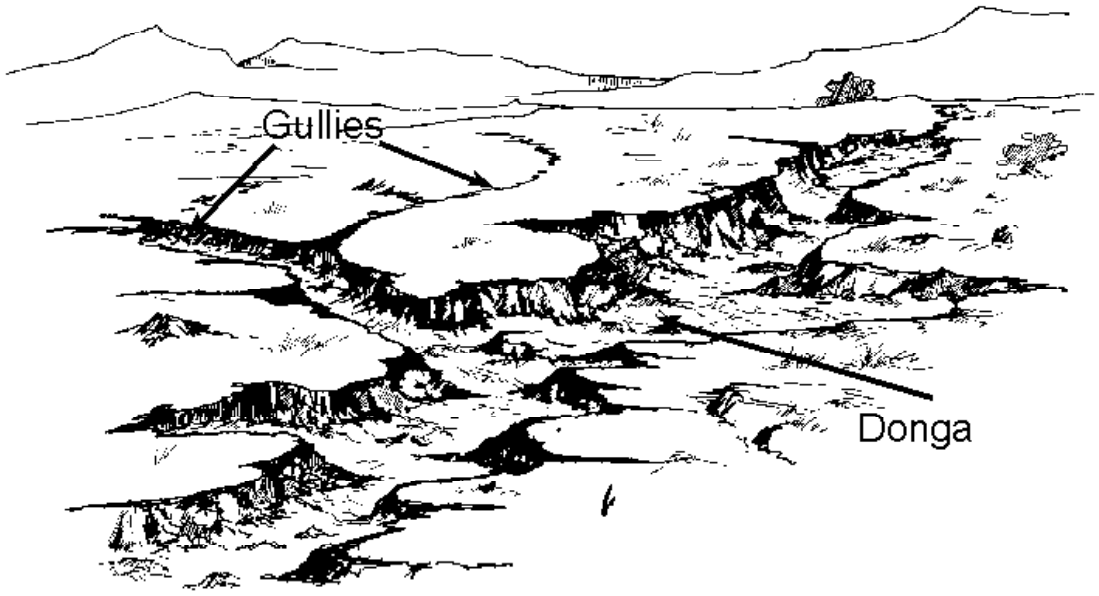


Figure 15 Rills developing into gullies and dongas

Gully Erosion: When rills become very deep, say more than 0.5m, we call them gullies. A gully is therefore a place where a lot of rills meet and a deep "scar" is made in the land. When a rill has developed into a gully it is very difficult to reclaim and it demands a lot of work. But it is possible through a common community effort where everybody works together!

Gullies can grow up to very large formations, hundreds of meters long, more than 30m's wide and to a depth greater than 20m. They do not only take soil, they also take land that used to be fields or grazing areas. And only if the earlier stages of erosion are controlled can we avoid gully erosion.

- **Try to think about the way water flows on your own land, what you do about it, and maybe how you coul avoid rill damage on your land.**

- **How can you make water flow more slowly and gently?**

- **How can you keep water and moisture safely in your land?**

2. How to Improve Our Soil & Water Management

Identify the Critical Areas Together with Neighbours and Other Community Members

The place to start our work is where water obviously flows very fast and where rills or even gullies have developed. The best way to do this is to walk around our land (both the fields and the grazing areas) *when **it rains*** to see what happens.

As we walk around our lands we must try to find out where the water comes from and find ways of controlling it right at the source, which is usually at a kopje or at other people's fields.

We must discuss the problem with our neighbours and agree on a plan to reduce the flow of water. We must explain to them that if the water is trapped on their land it will benefit their crops and it will prevent further soil erosion down-slope. We must help them and also try to see things from their point of view, and thereby reach a common understanding of the problem and how to solve it. We must prioritise what we must do *together.*

How to Control Rills and Gullies

Many ways of controlling rills and gullies exist. Most of them are cheap and easy to apply, but they do require some labour input.

The key issue is to reduce the speed of the water and increase the amount of water that seeps into the soil, the infiltration.

The easiest way to do this is to "block the road" for run-off. This can be done by planting grasses like vetiver grass in a dense hedge or several dense hedges straight across the rill. Sisal planted very closely together can also be effective. Another option is to lay out stones across a rill, a so-called stone check or cross dam.

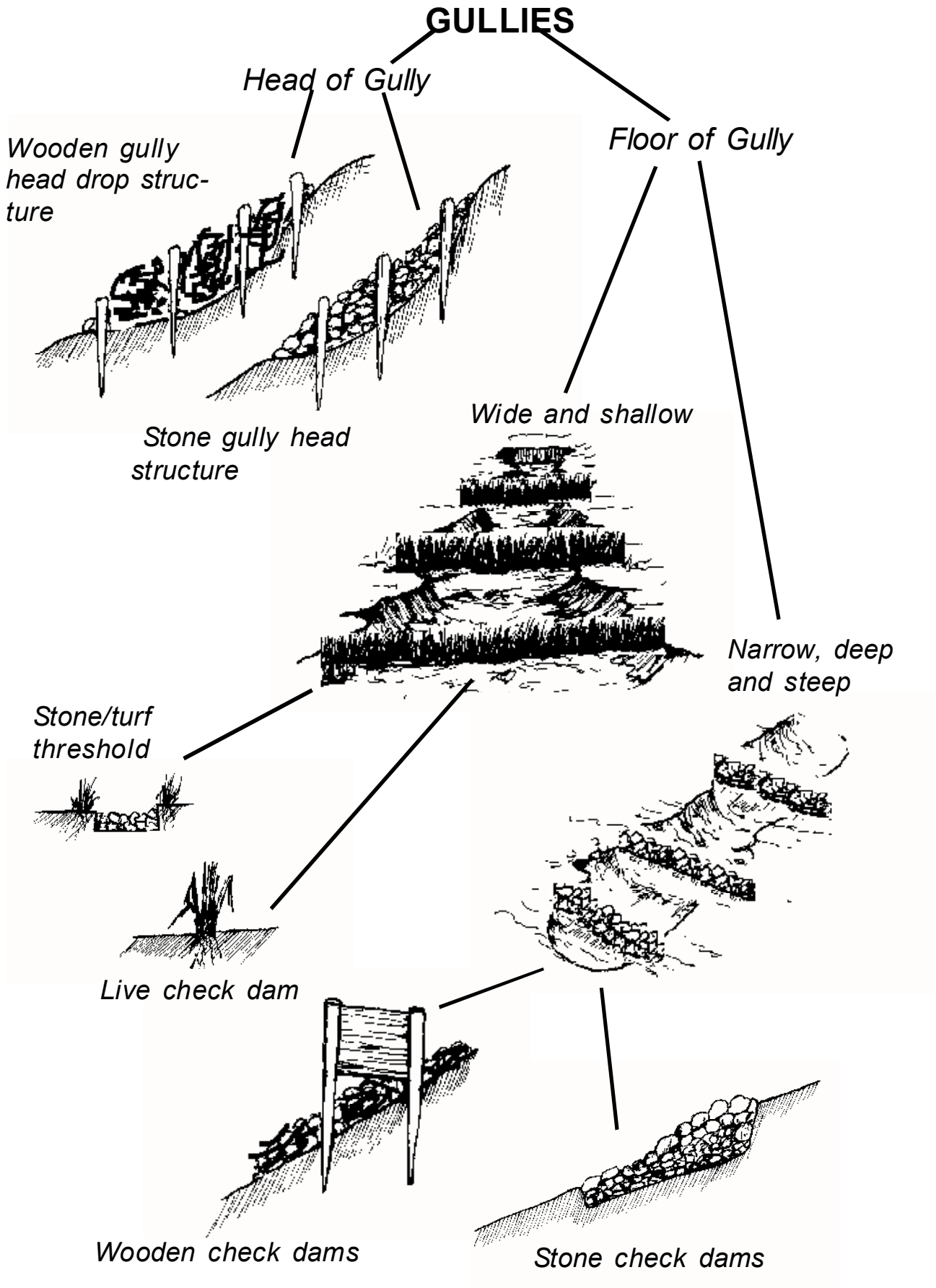


Figure 16 Some ideas on how to control rills and gullies (after Wenner 1980a)

How to construct a Stone Check for rill control

STEP 1: Collect stones in varying sizes from fields, grazing areas or mountains in wheel barrows.

STEP 2: Dig a shallow trench straight across the rill. The trench should not be more than 0.3 m deep and 0.5 m wide.

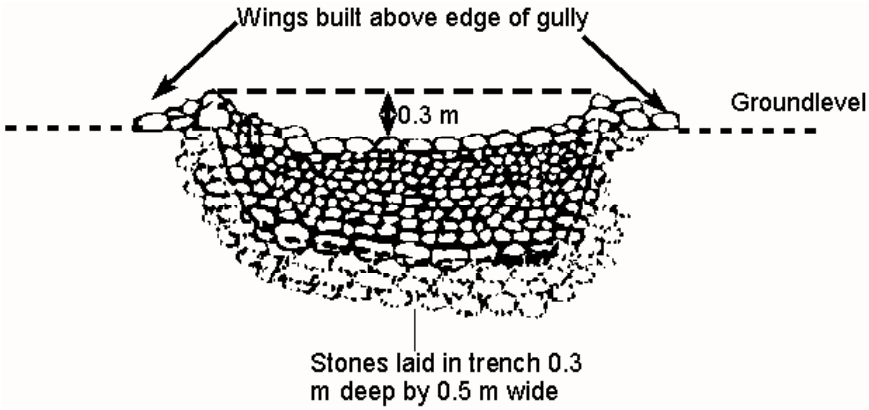
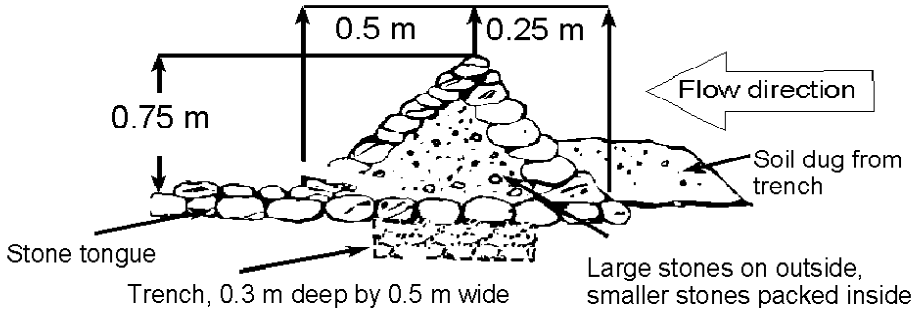


Figure 17 Side view of bund, looking up the gully

STEP 3: Fill the trench with stones and build it up so that the lowest point of the stone check is in the middle/centre. This is where water will overflow in when heavy rains occur. Construct a "tongue" of stones right below the point of overflow to reduce the speed of overflowing water and minimise



damage.

Figure 18 Cross section of stone bund

STEP 4: Make sure the "wings" of the stone checks go all the way up to and above the normal ground level beyond the flanks of the rill to prevent Step

Useful Ideas:

- A stone check can be improved by planting e.g. sisal or grasses right in front of it or just below it.

- Brushwood from thorny trees is often tried as a means to reclaim small gullies and rills. It works well to keep the livestock away from the area but does not control the water flow. Try to plant sisal or grasses like vetiver grass or star grass in dense strips before throwing the brushwood into the gully or rill. The grass will then be protected, establish well and control the water flow under the brushwood.

- Sometimes a contour ridge is broken every season at the same place. This could be because of a rill in the field above. If we cannot control it, it maybe better to allow the water to flow there, but make sure that it flows slowly by checking it with dense strips of grass, sisal or stones like a small waterway.

- Rills where water flows in or near the field are often very moist. Try planting bananas there, they will give us valuable fruit and help control the speed of the water flow. Even in a poorly pegged contour drain that is becoming a gully they can do a very good job in terms of both production and conservation.

- After establishing our grass, stones, sisal, bananas or other control measures, go to the fields again during rains. Then we can see whether things work and check whether something needs to be improved. We must improve our fields continuously by checking and trying to control the water.

Gullies are much more difficult to deal with than rills. But gullies can be considered as a system of rills or as very large rills. Basically the measures are the same; to reduce the speed of run-off and to increase infiltration.

A gully is like a disease, and the land is sick when there is a big gully. But the cure for the disease does not lie in the gully itself. When you work there, you only treat the symptoms, not the root-cause of the disease. The cure for a gully lies in the catchment, in our contours, on our fields, in the grazing areas, in the waterways and along our footpaths. Mrs Marozva, Zishiri, Zaka, Masvingo

Gully reclamation usually requires a community effort, with **everybody** in the community improving the existing conservation works in their own lands and working together in the communal grazing areas and near the gullies. Therefore, good conservation work in the fields and control of rills leading to the gully should be the main activities. These activities can be combined with tree planting around the gully or construction of stone checks or planting of bananas or vetiver strips within the gullies to conserve soil and water.

- **Gullies can only be reclaimed through good soil and water management**

- **Gullies cannot be reclaimed through work inside the gully alone.**

- **Good soil and water management is required throughout the whole catchment**

The Importance of a Soil Cover

We have now learnt what causes gullies and rills to form and how they can be controlled, but even the destructive impact of raindrops can be reduced or prevented by covering the soil with a mulch of stovers and other plant residues.

A mulch will act as a coat for the soil protecting it from the heavy impact of raindrops. The energy or power of the raindrops will be taken out by the "coat" and water will reach the soil gently and will not destroy the soil aggregates. More water will infiltrate and the soil will become wetter and better for the crop.

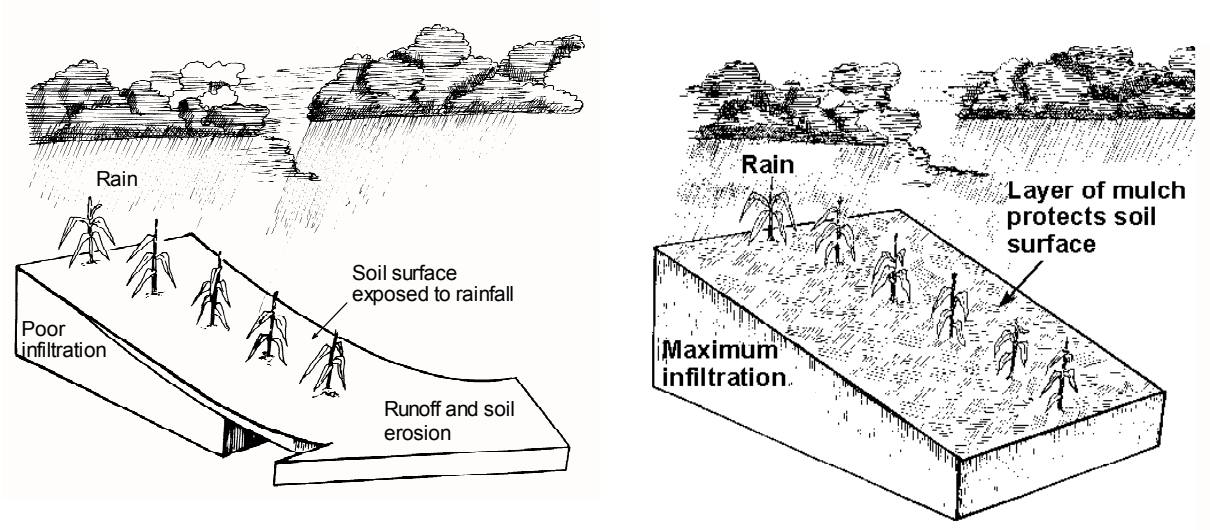


Figure 19 A mulch of crop residue protects soil surface from raindrops and encourages infiltration

Another option is to grow cover crops that also protect the soil or to plant crops densely, e.g. by intercropping them. To intercrop means to grow different crops on the same field. For example, an intercrop of maize and beans will provide a good leaf cover for the soil and at the same time it will increase our yield potential.

It used to be considered "backward thinking" to intercrop, but intercropping has been proven to have many advantages both in terms of yields, soil protection and soil fertility. Many of the "traditional" ways of intercropping are very valuable ways of improving our soil and water management and our yields.

So when old people continue to mix maize with rapoko or beans we should

not laugh at them or look down upon them, but respect their wisdom gained through many years of experience. **We can learn from them!**

How to Peg or Re-peg Our Fields?

If there are no contour ridges on your land, it is necessary to have it pegged, so that contour lines can be laid out. However, you do not have to use the standard contour ridge that has been used and enforced in Zimbabwe for the last 50 years. In the following sections you will see that other options to the contour ridge exist.

➔But in all cases pegging is a requirement for good soil and water management.

Existing contour ridges may be poorly pegged, and if that is the case re-pegging for new contour lines is necessary.

We can peg our own fields if we use the right methods. Two methods will be presented here as options, and they are both cheap and easy to use:

Figure 20 Option A: The Line level

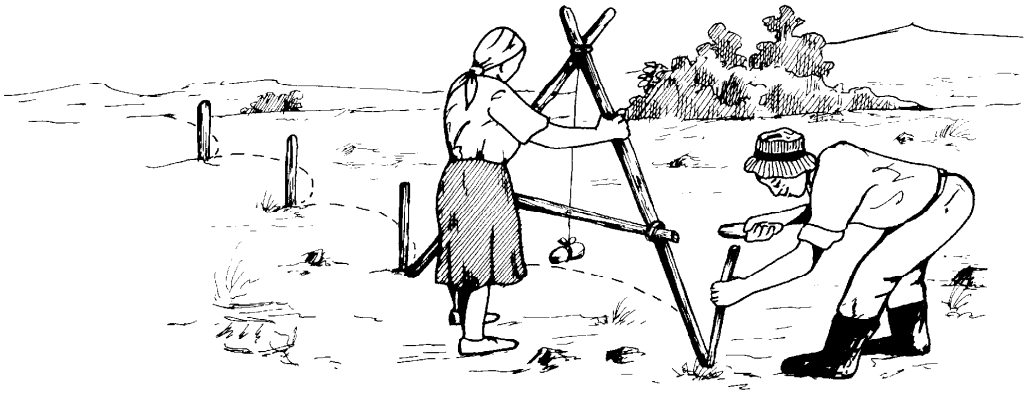


Figure 21 Option B: The A frame.

If after reading the following sections you are still not quite sure on how to peg a contour, or you have questions, you should ask the Agritex Extension Worker in your area for further training.

➔It is always a good idea to consult him/her the first time you try a new technology.

➔The extension worker can also help to find out the distance between two contours, which depends on how steep the land is.

➔As a rough rule of thumb contour lines should be spaced 20 to 30 m apart on gentle slopes (less than 5%).

➔On steeper slopes they should be only 10 to 15 m apart (more than 10%).

➔The steeper the slope, the closer the contour lines

Pegging Option A: The Line Level

Resources Required:

- A small spirit level to put on a line or string (can be bought or ordered at most hardware stores)
- Two straight poles with flat ends (3-8cm thick, about 1,5 m high)
- 11m of nylon string (the yellow ”Builder’s line” is good)
- A ruler
- A knife
- Stones or wooden pegs to mark contour lines
- 4 people (1 leader who reads the spirit and 3 assistants referred to as A, B and C)

Preparing the line level:

STEP 1. Mark a groove (with the knife) on both poles at exactly the same height. Make sure the poles are standing straight upright. The grooves should be at chest height.

STEP 2. Mark another groove exactly 4cm lower on each pole using the ruler.

STEP 3. Tie a knot a the centre of the string where the spirit level is to be attached

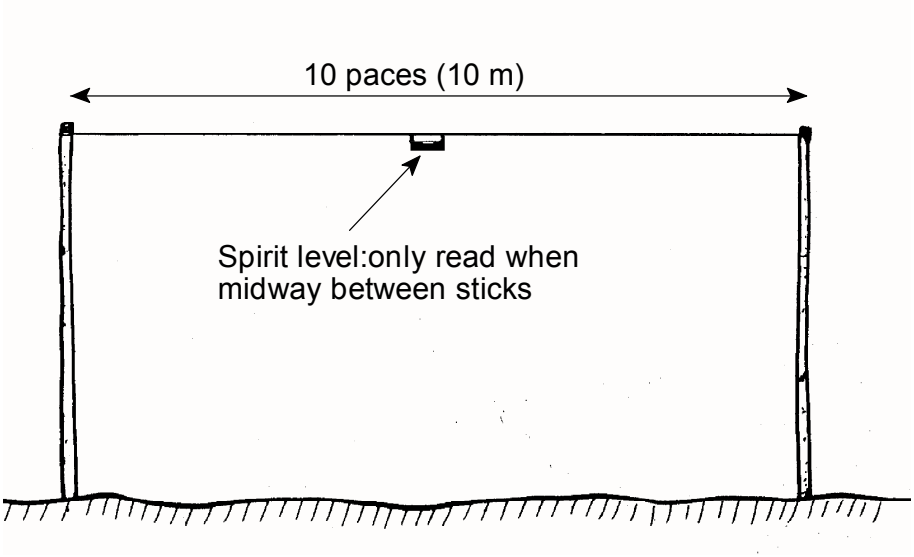


Figure 22 The basic line level for dead level contours

STEP 4. Tie the string or line to the top grooves using about half a metre at each end so that the line is approximately 10 m long. When the two grooves at the same height are used we are pegging at a **dead level,** which means that water will not flow in any direction

STEP 5. The 4 cm lower groove is for pegging at a gradient and should be used on **one** of the poles if we want water to flow in one direction. **Water will always flow in the direction of the pole with the higher groove,** because that pole is standing in a lower position when the bubble in the spirit level is in the level position.

- **The 4cm groove indicates a gradient of 1:250 using a 10m line, which is the gradient Agritex recommends for standard contour ridges.**

STEP 6 . For tied ridging we should use the 10 cm groove to give us a gradient of 1:100.

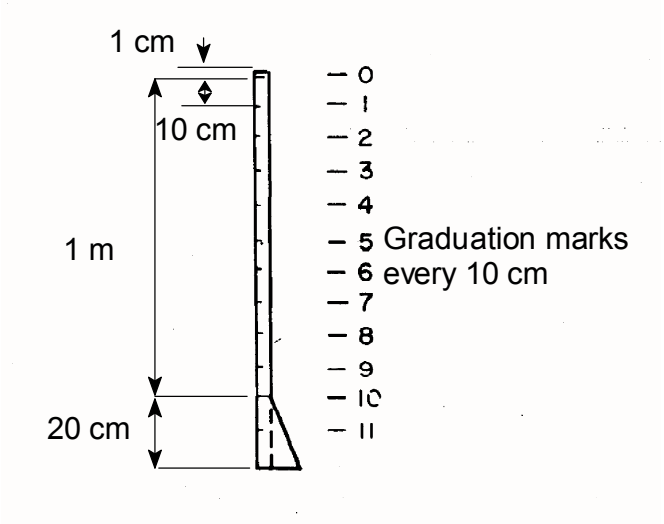


Figure 23 The line level stick

Pegging with line-level

Figure 24 Step 1 - line level

STEP 1. Go to the centre of the field that should be pegged, and mark it with a peg. The first assistant (A) holds his pole vertically right next to the peg while the second assistant (B) goes in the direction we want to peg until the string is very tight. Both poles should be as straight upright as possible.

Figure 25 Step 2 - line level

STEP 2. Attach the spirit level to the centre of the string. Based on the readings, the leader directs the second assistant (B), who is not standing next to the first centre peg, up and down the slope unti the bubble in the spirit level is right in the centre position.

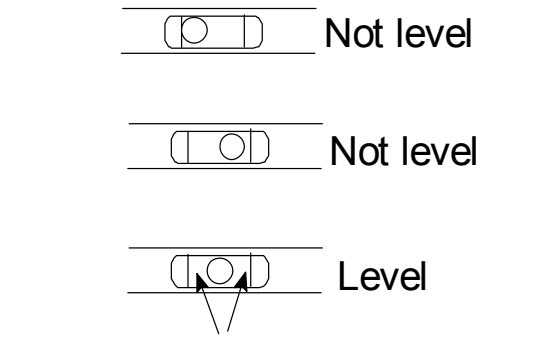


Figure 26 Step 3 - line level

STEP 3. When the bubble is in the centre position, the third assistant (C) puts the second peg in the ground right next to the second assistant's (B) pole, so that the position of both poles is now marked.

Figure 27 Step 4 - line level

STEP 4. The first assistant (A) goes to the second pole, while the second assistant (B) goes in the direction he/she thinks is right for the contour. The leader then attaches and reads the spirit level again and directs the second assistant (B) up and down the slope till the bubble is at the centre position.

Continue like this (steps 2 to 4) until we reach the field boundary

Figure 28 Repeat steps 2, 3 and 4 until the field boundary is reached.

STEP 5. When we have reached the field boundary, we should go back to the first peg at the centre and start pegging in the other direction, until we reach the field boundary at the other end. The field is now ready for conservation works along the pegs.

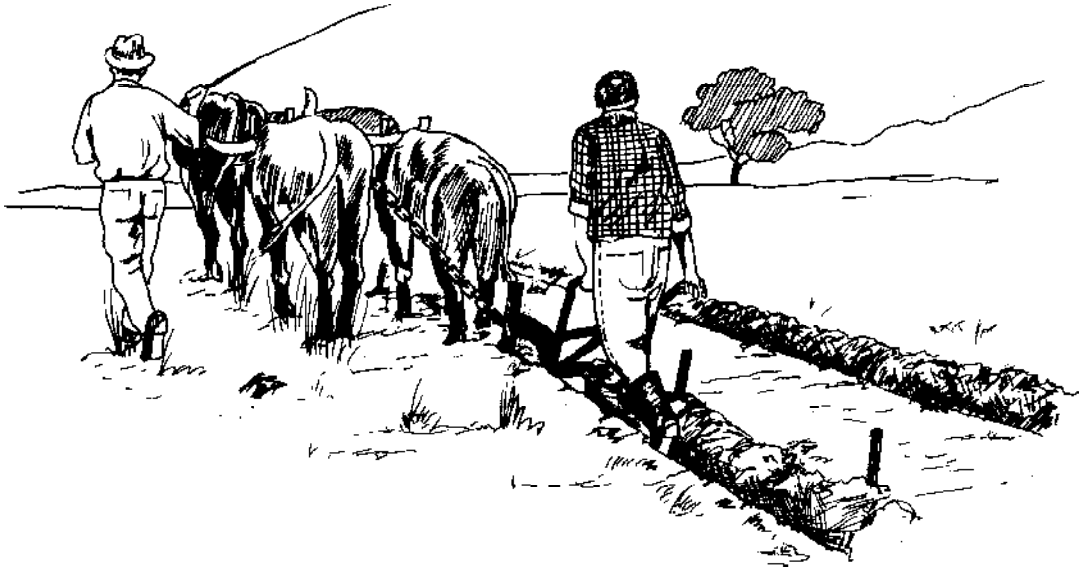


Figure 29 Ploughing along a marked contour

- **For dead level contours we should use the same height on both poles**
- **For graded contours we should use the 4 cm groove for a gradient of 1:250 using a 10 m line.**
- **For tied ridging we should use the 10 cm groove for a gradient of 1:00 using a 10 m line.**

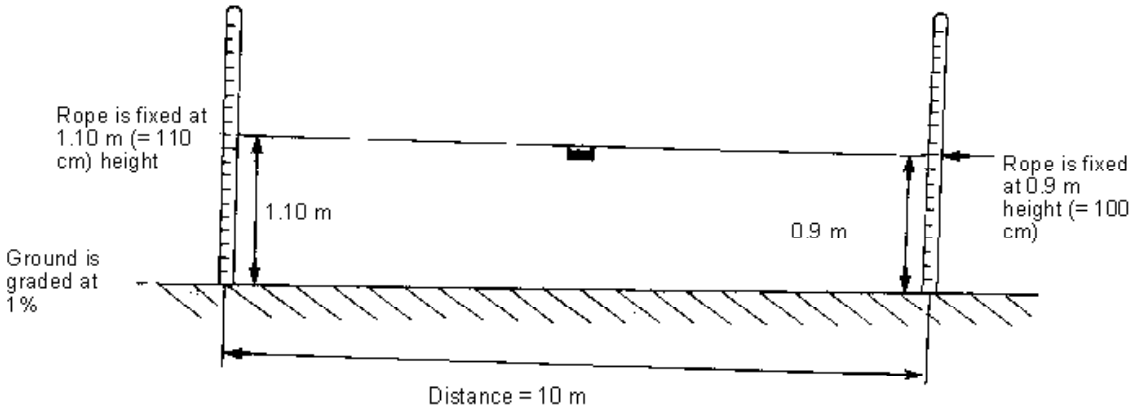


Figure 30 The line level used to peg tied ridges

Useful Ideas:

- **If we are not sure whether to peg at a dead level or at a gradient, we must ask our local extension worker**
- **Do not use a string that stretches when wet, that will make the line level inaccurate.**
- **If the ground on which we peg is not level, we must make sure that the poles are not standing in a furrow, on top of a ridge, or on an anthill.**
- **If at all possible, the poles should be placed on spots that are representative of the field and do not push the poles in the loose soil.**
- **To avoid sinking, poles should never have sharp ends.**
- **Attatch a small plate to the end to prevent sinking.**

IF IN DOUBT ASK YOUR EXTENSION WORKER TO HELP PEG GRADED CONTOURS

Pegging Option B: The A Frame

Resources required:

- Approximately 2m of strong string
- 1 stone (oblong, about the size of a fist)
- 2 straight poles that are about 3m long
- 1 straight pole that is about 2m long
- A knife
- Stones or wooden pegs to mark contour lines
- 2 persons

Preparing the A frame:

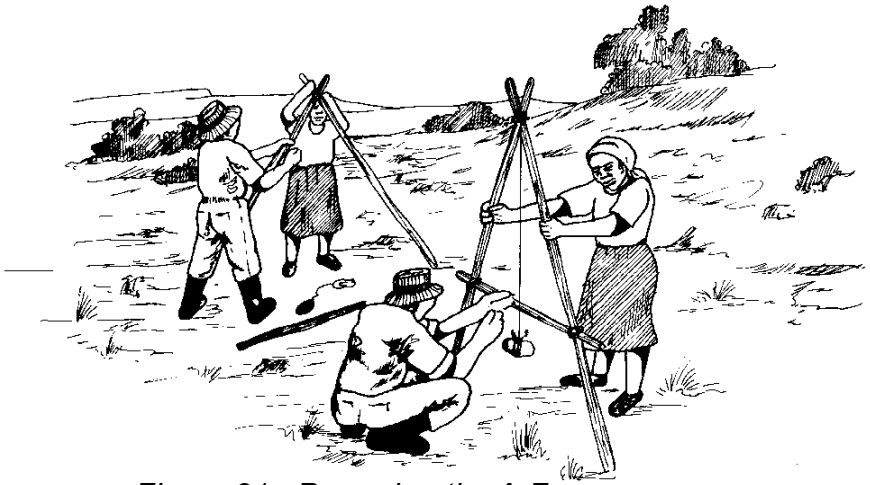


Figure 31 - Preparing the A-Frame

STEP 1: Tie two long 3 m poles tightly together at the top. Then tie the shorter pole across the two others to form the shape of the letter 'A'

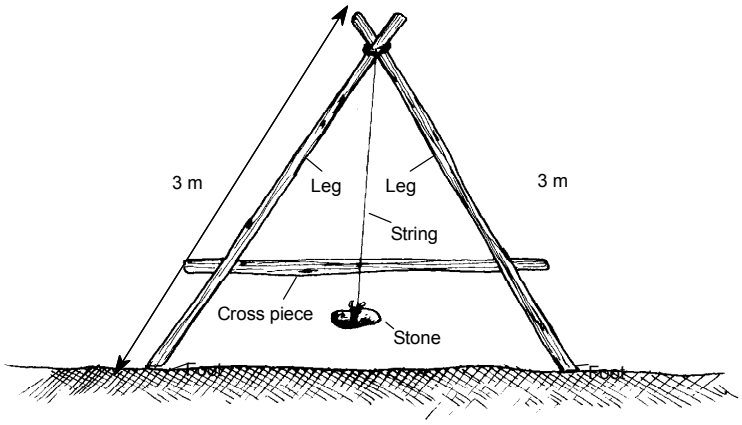
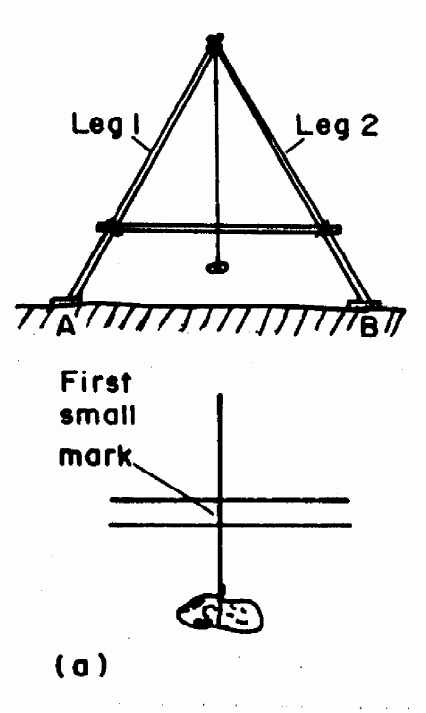


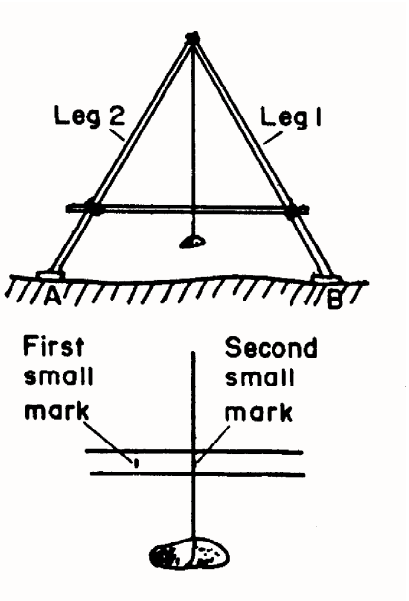
Figure 32 - The A-Frame

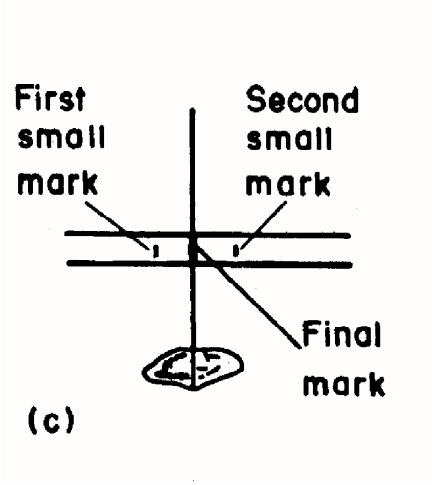
STEP 2. Tie one end of a string tightly around a stone, and tie the other end of the string to where the two 3 m poles are tied. Raise up the A-Frame and make sure the stone hangs about 15 cm below the cross pole.



STEP 3. Go to a house or an area with a level floor and stand the A-Frame with one end (LEG 1) resting on a flat stone or a book (A). Make a small temporary mark on the cross pole where the string that holds the stone passes.

STEP 4. Move the A-Frame so that the other leg (LEG 2) of the frame rests on the book or stone (A), and make another temporary mark where the string passes.





STEP 5. Make a very clear and permanent mark exactly in the middle between the two temporary marks.

Pegging in the field with the A frame:

STEP 1. Go to the centre of the field that should be pegged and mark it with a peg. Place one leg of the A frame right next to the peg.

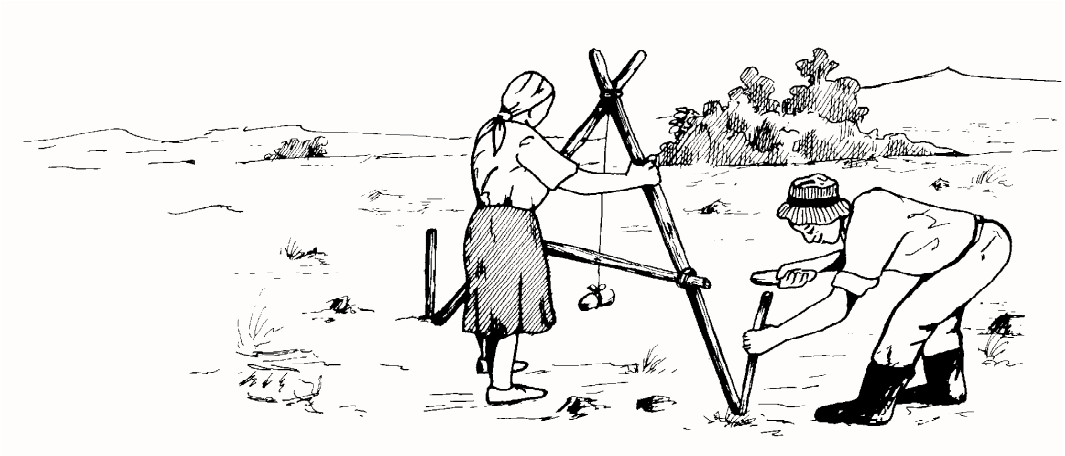


Figure 33 Steps 1 and 2 A-Frame

STEP 2. Hold this leg in place while slightly moving the other leg up and down the slope till the string is exactly in front of the permanent mark in the middle on the cross pole. Mark this point on the ground with a second peg. The string should be very close to, but never touch, the cross pole.

STEP3. Pivot the first leg around while holding the other leg at the second peg. Move the first leg slowly up and down the slope until the string is again right in front of the middle mark.

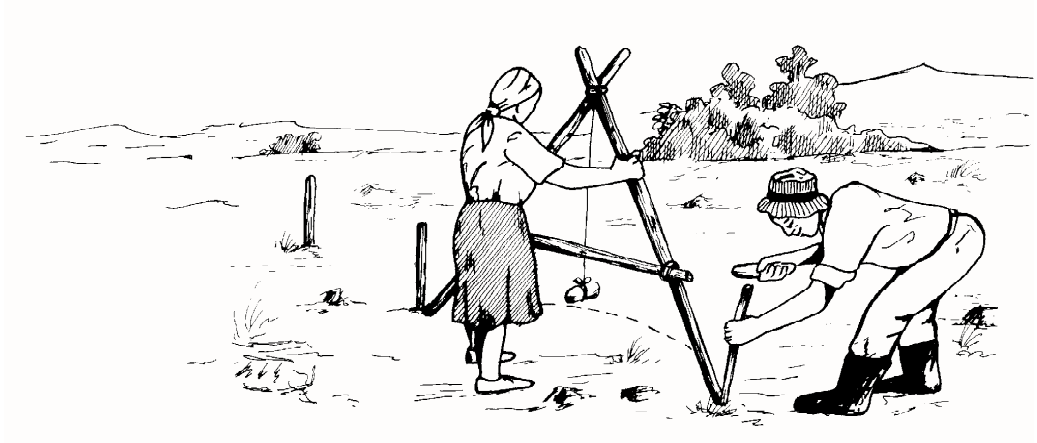


Figure 34 Step 3 A-Frame

Continue like this to the field boundary.

STEP 4. Return to the centre of the field where the very first peg was placed and move in the opposite direction to the other end of the field following steps 2-3.

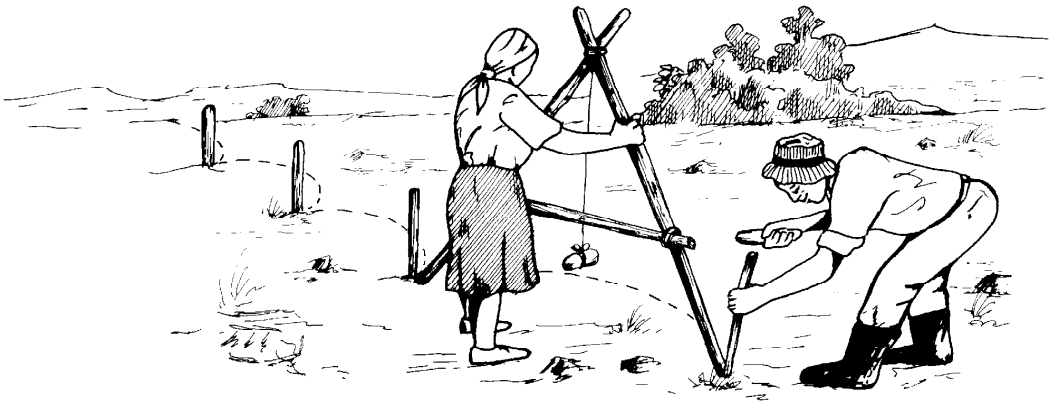


Figure 35 Steps 2 and 3 repeated across field

Useful Ideas:

- **The accuracy of the A-Frame should be checked regularly on a level floor. If the poles are not tied together the A-Frame wil be inaccurate! Check each time you use it.**

- **Do not use the A-Frame when there is a strong wind as the string will be disturbed and you will not be able to do accurate work.**

What are the Options to Improve Contour Ridges?

For many years in this country when we have spoken about conservation we have always spoken about contour ridges. However, in many cases, the standard contour ridge has not proved to be the best, nor the only solution to good soil and water management. Many other solutions exist and have proven their value in other parts of Africa.

A few of these other ideas have recently been introduced into parts of Zimbabwe, with some very good results, especially in drier areas. On the basis of that experience the following sections describe some of these alternatives, compared to the well known ”contour”.

First, the contour ridge will be described as Option A.

Option A: The Standard Contour Ridge & Storm Drain

The standard contour ridge and drain is designed to divert excess water away from the field and thereby prevent erosion between fields. Surface run-off water is lead to a waterway that receives water from a chain of contour drains. In order to divert water it must be pegged at a gradient, usually 1:250, and therefore the ’A’-Frame cannot be used for pegging standard contour ridges, but a line level is required.

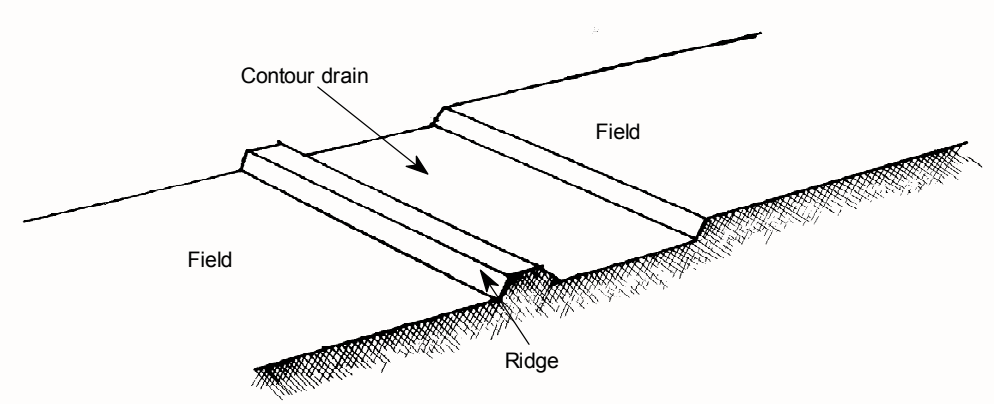


Figure 20 The standard contour ridge in Zimbabwe

The standard contour ridge and the construction principles are well documented and most Agricultural Extension Workers have received some training in their design and construction. Unfortunately, not everybody is applying the knowledge correctly.

Maybe some of the advantages and disadvantages are not that well-known:

Advantages:	Disadvantages:
• The standard contour ridge can prevent rill erosion between fields if laid out well. • With a standard contour ridge the fields are being drained. This is useful in high rainfall areas, but not very appropriate in low rainfall areas where most communal lands are situated	• A standard contour ridge and drain does not conserve moisture or harvest water. • A standard contour ridge occupies a lot of land that could be used for cropping. Some of the alternatives suggested later in this chapter use much less land. • Top soil, manure and fertiliser from the field is lost by being carried away in the drain. • A standard contour ridge does not prevent sheet erosion in the field. • It is hard work to dig and maintain contour ridges.

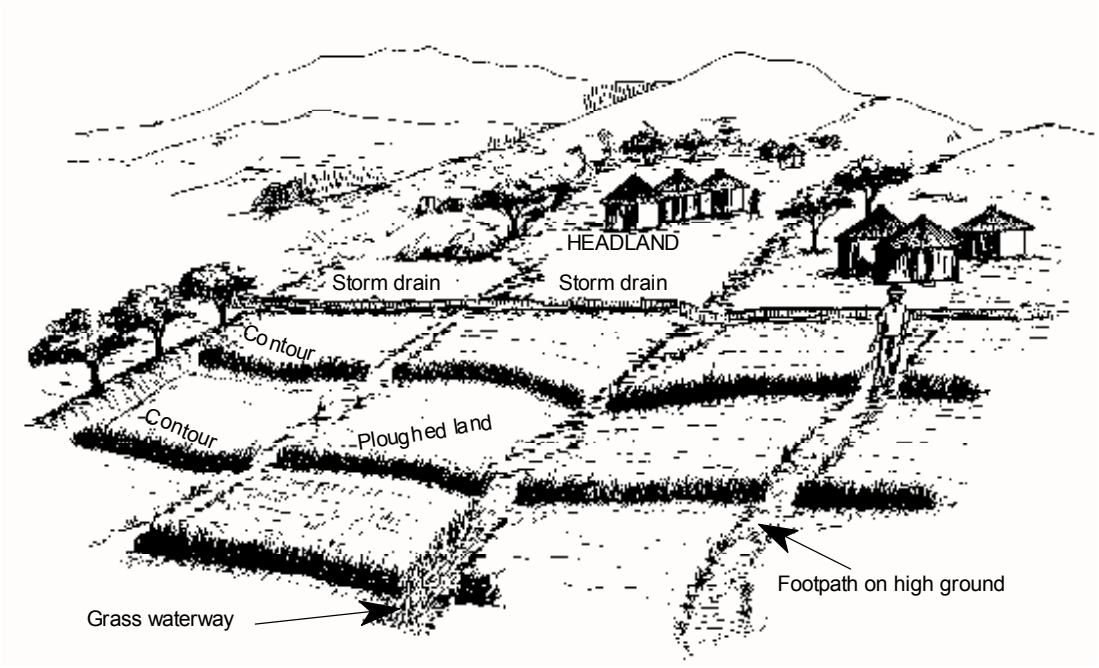


Figure 36 A typical contour layout (after Elwell, 1986)

Waterways are supposed to become wider down slope in order to have the capacity to absorb the water from an increasing number of contour drains down the slope. But the opposite is often the case as many people do not respect demarcations of field boundaries and waterways.

The highest field on a slope should be protected at the top with a storm drain. A storm drain is a kind of enlarged contour ridge. The idea is to lead away excess water from the mountain or kopje and thereby prevent rill and gully erosion in and between the fields.

The contour ridge and the storm drain should have the following dimensions:

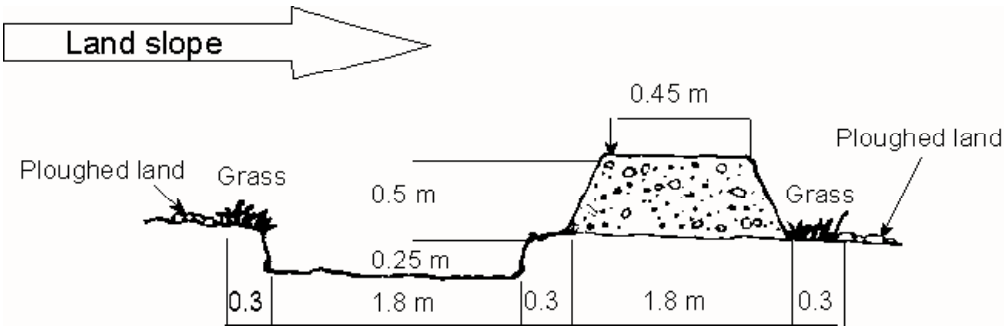


Figure 37 A typical Contour Ridge

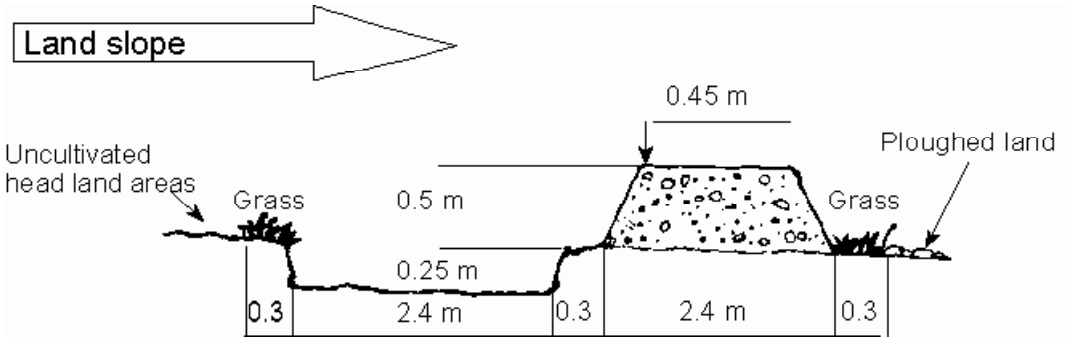


Figure 38 A typical Storm drain

In principle, the standard contour ridge and storm drain work well and do what they are supposed to. However, in many drier regions too little water is more often the problem, rather than too much. In such regions every drop of water that falls on the soil must be conserved to benefit the crops during the frequent dry spells. Therefore we may wish to try other soil and water conservation works than the standard contour drain. However, we may still need storm drains just below a steep mountain or big rock outcrop that will lead excess water towards a waterway.

Option B: Infiltration Pits in the Contour Drain

The standard contour drain is designed to divert water from the field, but a lot of water can be harvested in the drain by digging water infiltration pits that trap the run-off water from the field. This is an easy way to improve the standard contour.

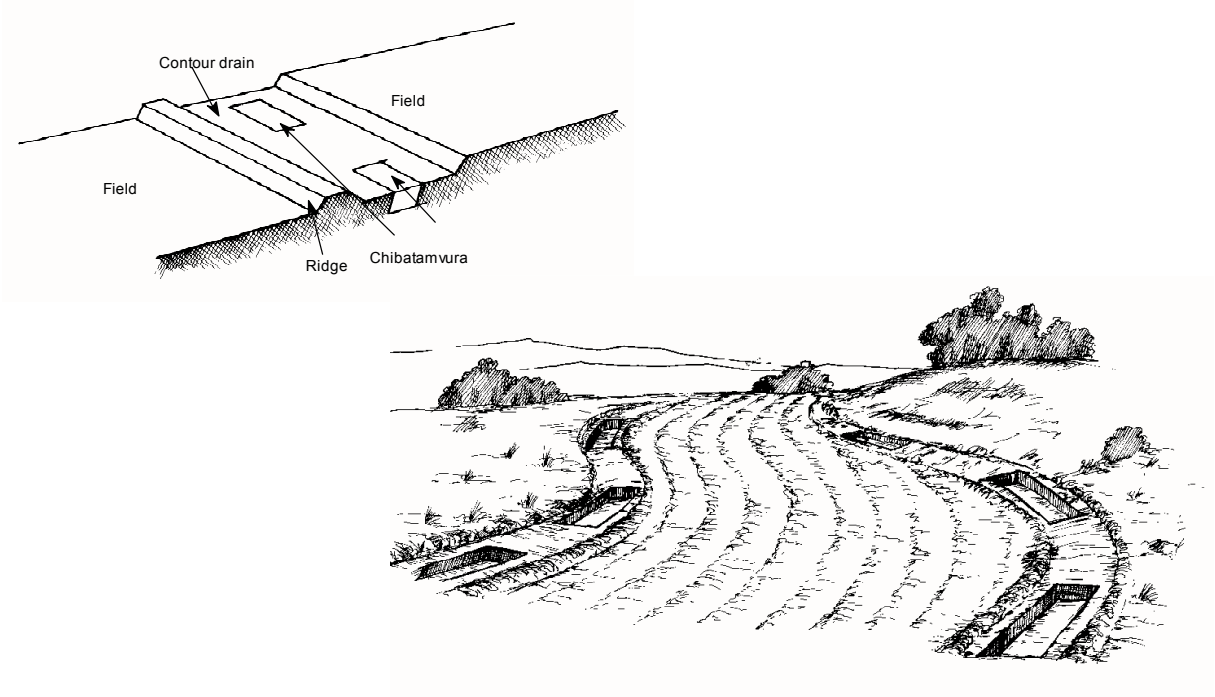


Figure 39 Infiltration pits dug into a Contour Drain

How to make infiltration pits?

Infiltration pits are very simple to make. Simply dig square pits in the contour drain. We do not need pegging or any instruments except picks and shovels.

The amount of run-off water that can be harvested depends on the size and spacing of the pits. Farmers around Zimbabwe that have tried the pits have used a range of different sizes and spacings, but they have all claimed that the pits work very well.

A guideline to the dimensions of the pits based on Zaka farmers' experience could be:

· Length : 2m, · Depth: 0.5-1m
· Width: 1m, · Spacing: 10m between the pits

Advantages	Disadvantages
• Infiltration pits do not require re-pegging of the land, old contours can easily be improved with them. • Infiltration pits conserve water and moisture that will benefit crops, especially during dry spells. That increases the yield potential. • Infiltration pits reduce the amount of water flowing in the contour drain and the waterway; thereby it reduces soil erosion. • Infiltration pits trap the fertile top soil that otherwise would have been carried away in the contour drain and into the waterway. Top soil trapped in the infiltration pit can be carried back to the field to restore soil fertility • With infiltration pits the risk of overflow or breakages in the contour ridge is reduced.	• It can be hard work every year to carry soil back from the pit to the field and spread it. • If infiltration pits are to be efficient they must be re-dug almost every year to maintain their capacity of harvesting water. • Infiltration pits may cause water logging in years with excessive rainfall. This is the price we must pay for the more important benefits gained in years with little rainfall or long dry spells. • If you have small children do not make the pits too deep, as they could be dangerous

Useful Ideas:

- Many farmers who have tried infiltration pits have also used the pits for compost making. This is done by throwing stover and other plant residues that are not harvested into the pits. Let it stay there during winter and then spread it onto the field just before ploughing. During late rains and winter showers the material becomes useful compost that works just like fertiliser.

- If we turn the compost in the infiltration pit with a shovel every 3-4 weeks it becomes even better. For more ideas on compost making, please check in the soil fertility manual of this series.

- If we decide to dig small or shallow pits of less than 0.5m's depth, they should be spaced closer than 10m. Preferably at every 4-*5m.*

Option C: Fanya Juu Contours

*F*anya Juu is Khiswahili for “Throwing soil up-slope”, and that is exactly how this kind of contour ridge is constructed. Originally the system is Kenyan, but it is now being used in many parts of Africa, especially in mountainous areas.

Where a Zimbabwean standard contour (option A) is constructed by throwing the soil down-slope, a Fanya Juu is done the opposite way, like this:

Figure 41 Digging a Fanya Juu

The Fanya Juu contour conserves soil and water behind the ridge, and in a few years the trapped soil develops into a bench terrace. Bench terraces mean more level fields where less or no sheet or rill erosion takes place.

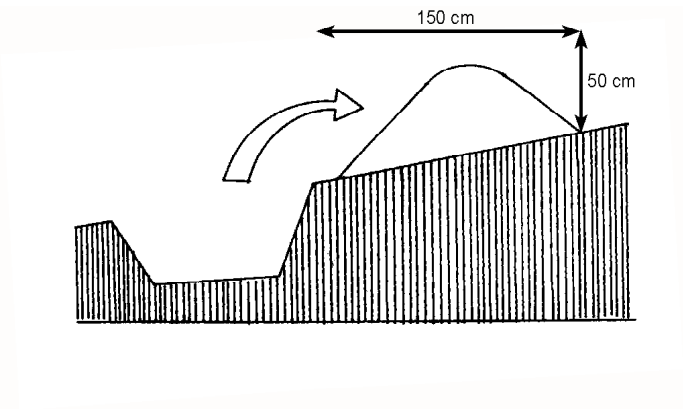


Figure 42 Construction of Fanya Juu Terraces, throwing soil up slope

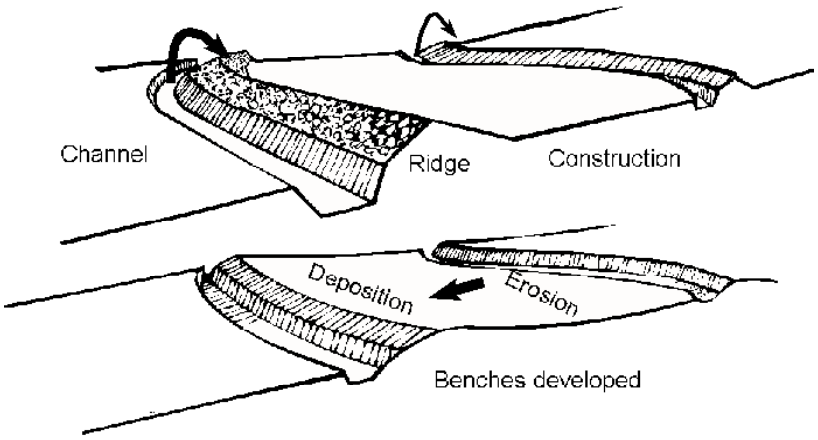


Figure 43 Construction and development of Fanya Juu Terraces

Advantages:

- Top soil that would have been carried away in a standard contour drain is kept in the field by the *Fanya Juu*. Together with the conservation of water that means higher yield potential.
- In the case of dry spells the water and moisture kept by the *Fanya Juu* will reduce or delay water shortage and wilting.
- Compared to the standard contour ridge, a *Fanya Juu* demands the same labour for construction. But *Fanya Juus* do not need the same permanent maintenance as the standard contour ridge, which means less labour in the long run.
- A standard contour can easily be transformed into a *Fanya Juu* by digging a channel in front of the ridge and throwing soil upon the ridge. The former contour drain should be cultivated and the fertile topsoil trapped there will give very good crops.

Disadvantages:

- In wet years *Fanya Juus* may cause water logging in the fields, but since dry spells are more common than wet years it should be worth trying!
- *Fanya Juus* work best in mountainous areas, on flat fields their impact is less marked.

How to transform a Standard Contour Ridge into a Fanya Juu:

A *Fanya Juu* can easily be constructed from a standard contour ridge, like this:

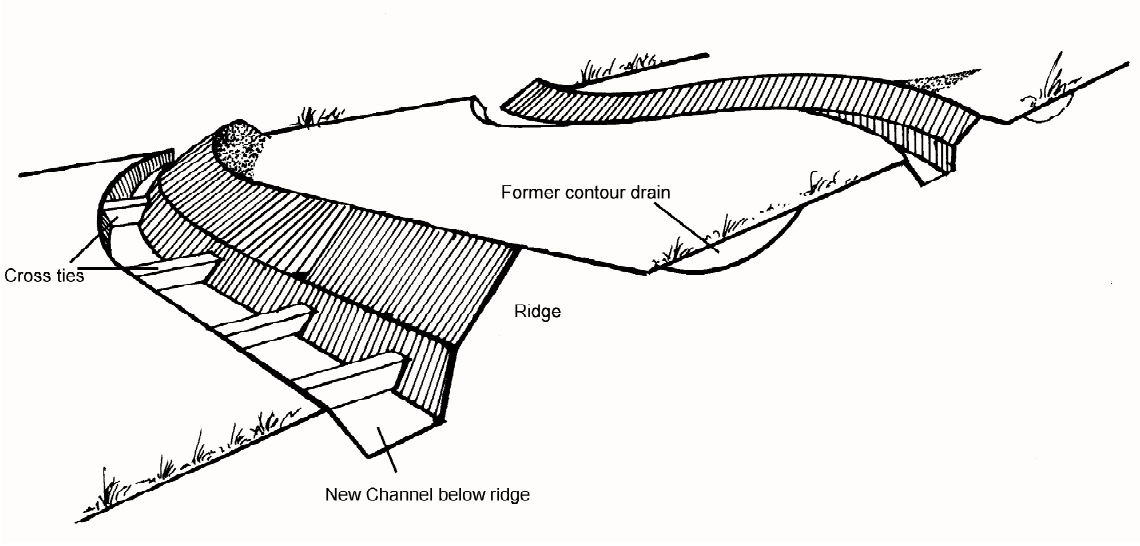
STEP 1: Choose an old contour ridge that you want to change into a *Fanya Juu.*

STEP 2: Start digging the trench in front of the ridge and throw the soil on top of the ridge, which will then become higher and higher.

STEP 3: Make sure to connect the trench to the waterway where the contour drain used to spill into the drain, so that excess water will go to the waterway.

STEP 4: When the trench is as long as the ridge it is a good idea to construct stone spillways or overflows to allow water to fall into the trench in cases of heavy rains.

STEP 5: Plough the old drainage channel when the field is ploughed. Very good crops will grow there because of the fertile soil deposited



there.

Figure 44 A Standard Contour Drain Transformed into a Fanya Juu

The dimensions of a Fanya Juu differ from one area to the other; sometimes even from one farmer to the other. A useful guideline to the dimensions that have proven valuable in Zimbabwe are:

Guidelines for Fanya Juu Dimensions

Ridge height: *50-60cm*

Ridge width: *40cm (top) to 100cm (bottom)*

Channel depth: *50-60cm*

Channel width: *50-60cm*

Cross tie height: *10-20cm lower than ground level*

Cross tie width: *20-30cm*

Cross tie interval: *10m*

Stone spillway interval: *10m*

Stone spillway width: *50cm*

- **The depth of the channel can be adjusted according to how much water that flows from the field to a particular part of the Fanya Juu.**

- **If the amount of water is excessive in that part of the field, the channel can be made a lot deeper (more than 1m) to increase the capacity of the channel and thereby avoid overflowing into the field below.**

How to construct a new Fanya Juu:

Resources required:

Picks, shovels, stones, and if pegging is needed also a pegging instrument (e.g. an 'A'-frame or a line level).

STEP 1: If we have an existing standard contour that is well pegged just follow the instructions on how to transform a standard contour ridge into a Fanya Juu described earlier in this chapter. If there is no conservation works along the contour lines, the fields need to be pegged either at a gradient of 1:250 or at dead-level.

- In Natural Region I, II and III pegging should be done at the 1:250 gradient using for example a line level (with the string attached the 4cm groove on the one pole).

Figure 45 In natural regions I, II and III new Fanya Juus should be pegged on a gradient using a line-level

- In Natural Regions IV and V we can peg at a dead-level. **Remember that the A-Frame should only be used for dead level pegging.**

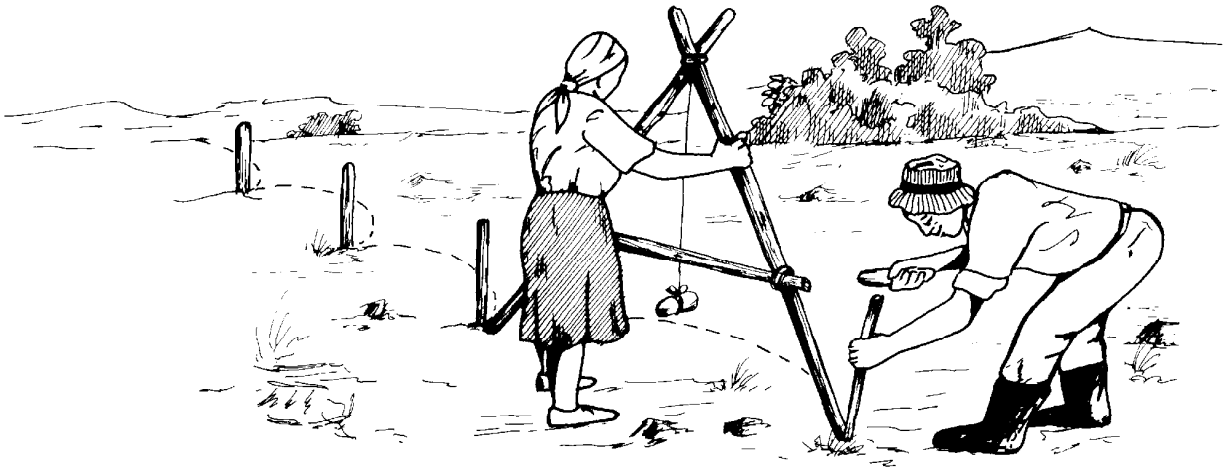


Figure 46 In Natural Regions IV and V new Fanya Juus can be pegged on the contour using line-levels or an A-Frame.

STEP 2: Start by digging the channel and throw the soil up-slope. After digging 10m channel, leave a small "wall" of about 30cm's width. This is for the cross tie. Shape the cross tie with a shovel so that it is lower than the ground level but still around 40cm above the bottom of the channel.

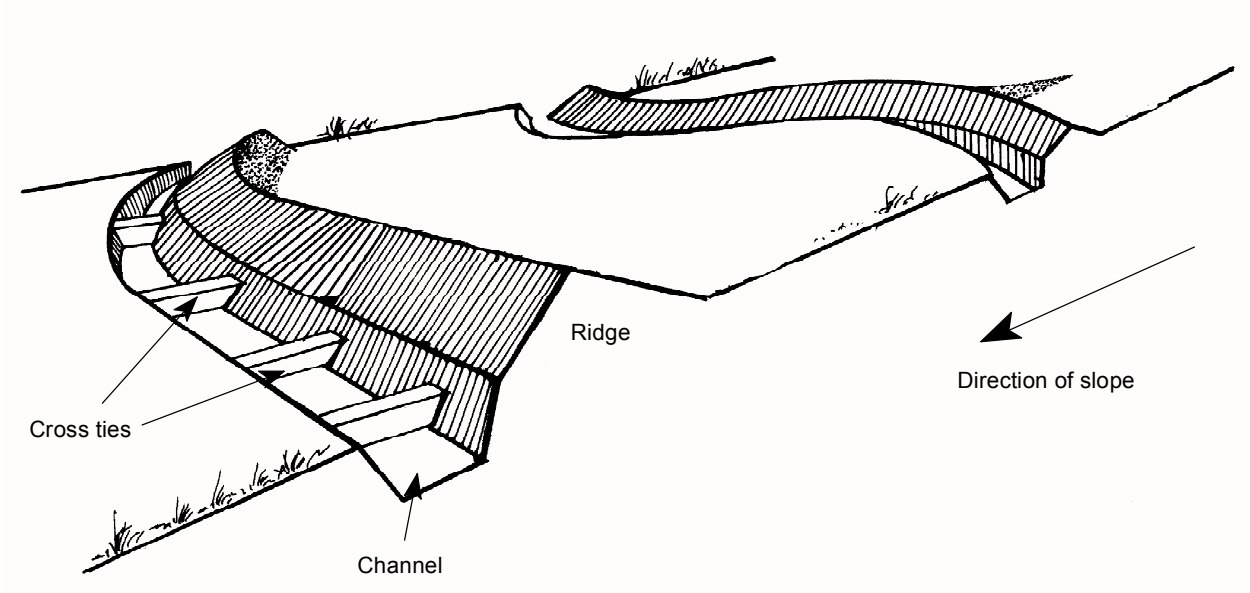


Figure 47 Construction of a new Fanya Juu

STEP 3: When the Fanya Juu is dug to its full length, we should make stone spillways or overflows in the ridge for about every 10m, so that cross ties and stone spillways are staggered. This means that every stone spillway flows into one basin between two cross ties.

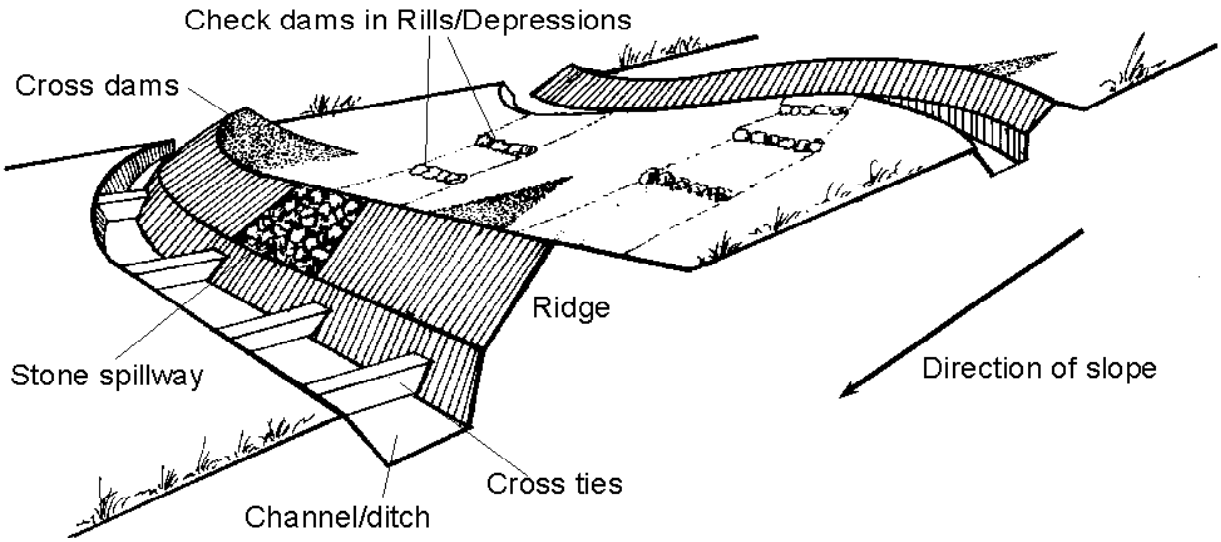


Figure 48 A new Fanya Juu with cross ties, stone spill ways and cross dams

Useful Ideas

- **Planting grass on the ridge immediately after construction will consolidate ridge and reduce the risk of breakage.**
- **If a footpath crosses a Fanya Juu contour ridge and we want to avoid people falling into the channel, construct a cross tie where people are crossing and consolidate the ridge by adding stones to the top of it. Thereby we construct a safe bridge for people to use**

Option C: Vetiver Grass Hedges

While the other options mentioned so far all require a lot of digging, establishment of vetiver grass hedges simply means planting a strip or hedge of vetiver grass.

- A vetiver hedge can then replace mechanical contours such as the standard contour ridge or a *Fanya Juu.*

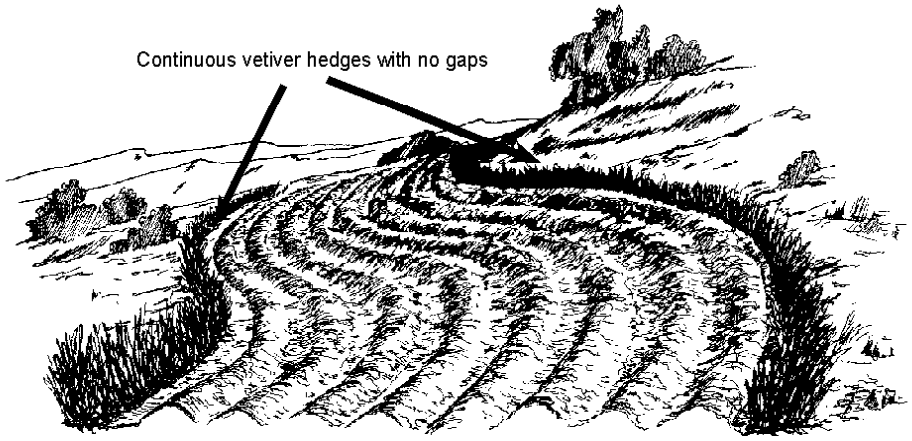


Figure 48 Vetiver grass hedges

A continuous and dense hedge of vetiver grass will conserve soil and water just as good or in some cases even better than the other options. Vetiver grass is an infertile plant which means that the seeds of the grass do not germinate when sown. And since vetiver does not produce root shoots either, it never becomes a weed that spreads into the field. It simply stays where we plant it!

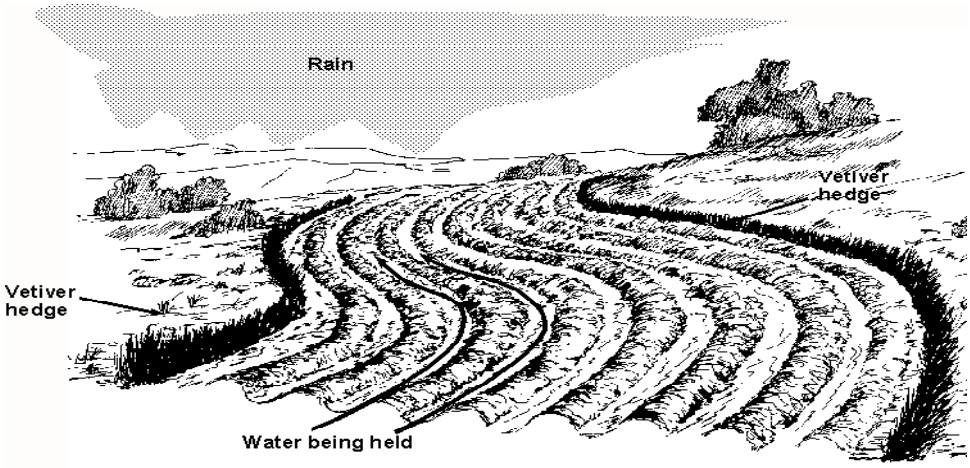


Figure 49 Vetiver hedges helping to control water

Advantages:	***Disadvantages:***
• 6-8 weeks after planting Vetiver it becomes very drought tolerant.	• If vetiver is not planted in a dense hedge it does not work properly. There must not be any gaps in the hedge.
• Vetiver does not suffer from water logging, the more water the better for vetiver. This means it can also be used for river bank protection.	• Fresh planting material is needed to establish a vetiver hedge because the seeds are infertile.
• A vetiver hedge occupies very little space in the field (a hedge is about 50cm wide), which means that more land is available for cultivation compared to contour ridges.	• Planting material is at present not available everywhere in Zimbabwe. Try asking at the District Agritex Office where it can be obtained from.
• Vetiver grass can be used for many purposes; for example for roof thatching (it grows up to 3m high), for gully or rill reclamation, or as a snake repellent when planted around a homestead.	• Newly planted vetiver must be watered during the first 6 weeks if it does not rain.
• It is not vulnerable to veld fires or burnings. On the contrary, fire encourages tillering (more shoots = a more dense hedge)	

Establishing and Managing a Vetiver Nursery:

Since vetiver can only be grown from fresh planting material (planting slips), it is a good idea to establish a vetiver nursery from where we can "harvest" planting slips every year for our conservation works. The nursery should therefore be a permanent thing. How to maintain it so that we always have grass in the amounts we need is explained below.

Requirements:

- -A site for the nursery,
- -fresh vetiver planting material,
- -a hoe.

STEP1: The site for our vetiver nursery does not need to be fenced, and if we plant our grass in December to February it does not even need to be near a water source (e.g. a borehole or a dam). It can be almost anywhere, but since vetiver grows very well in wet areas, a vlei, an area close to a vlei is ideal or any other moist site will be ideal. There we will always get a high production of grass.

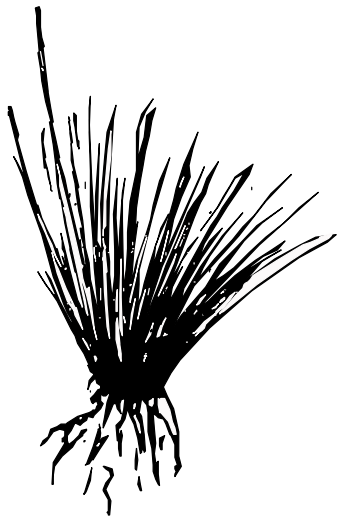


Figure 50 A slip of Vetiver grass

STEP 2: When planting vetiver grass, a larger plant is split into small planting slips, just like when shallots are planted. Then we simply put the planting piece or planting slip in a small hole in the ground. Make sure that all the roots are all covered with soil. Plant the slips at 20-30cm (about 2 fists) between each plant in the nursery and water unless the soil is moist.

A *B* *C*

Figure 51 Harvesting Vetiver grass from nursery

STEP 3: During the first weeks we must check regularly whether the nursery is ok. The slips should start shooting within the first 2-3 weeks. Water if it does not rain.

STEP 4: When the grass has grown tall, it should be cut or trimmed down to 10cm height above the ground. This will enhance tillering which means a higher productions in the nursery.

STEP 5: When the time is right for planting vetiver contour hedges in the fields, we should uproot as much grass as needed, but we must make sure that we use a bit of the grass to re-establish our nursery. By doing this we will ensure that we have supply of grass to plant new hedges in the following season. The nursery should be permanent.

Planting Vetiver Contour Hedges

STEP 1*:* First we must find out where we want to have our vetiver hedge. If it is in a field where we already have a contour ridge, we should establish the vetiver hedge in front of the drain, so that run-off water from the field will meet the vetiver barrier before entering the drain. If the land does not have any contour, it must be pegged at dead level.

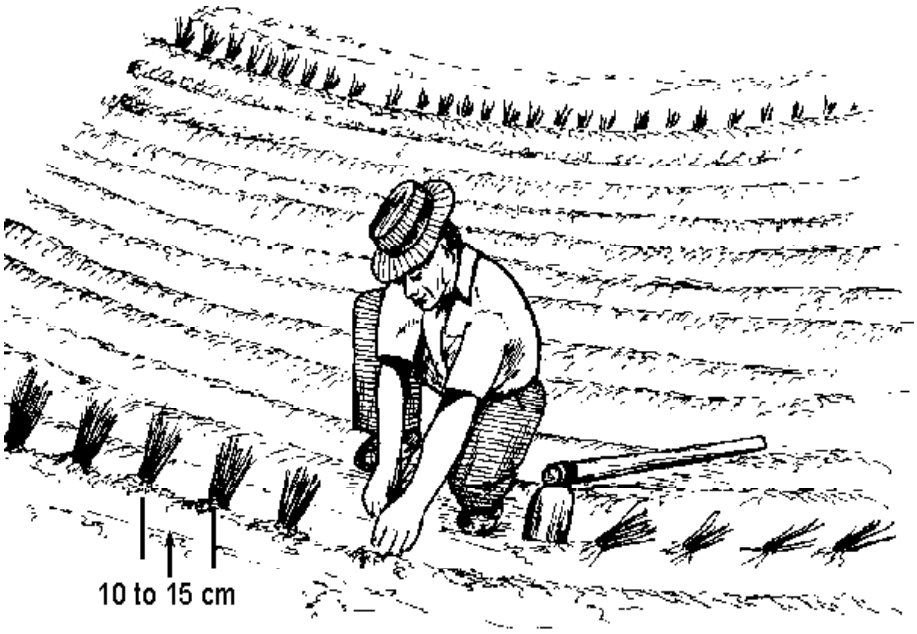


Figure 52 Planting a Vetiver Grass hedge in front of a drain

STEP 2*:* Plant the vetiver slips very closely together. In the nursery we used 20-30cm spacing, but for a vetiver contour hedge, we must plant much closer, i.e. at only 10-15 cm spacing (less than one fist).

Figure 53 3 to 4 weeks after planting any slips that have not begun to grow should be replaced

STEP 3: After 3-4 weeks we should check our vetiver hedge for plants that have not started shooting. They should be replaced immediately with new slips from the nursery, because it is essential for a vetiver hedge to be continuous with no gaps; otherwise it does not work very well.

STEP 4: 3-4 years years after the establishment our hedge will be big and strong and all the soil trapped by the vetiver grass will be forming a strong and permanent terrace of fertile soil.

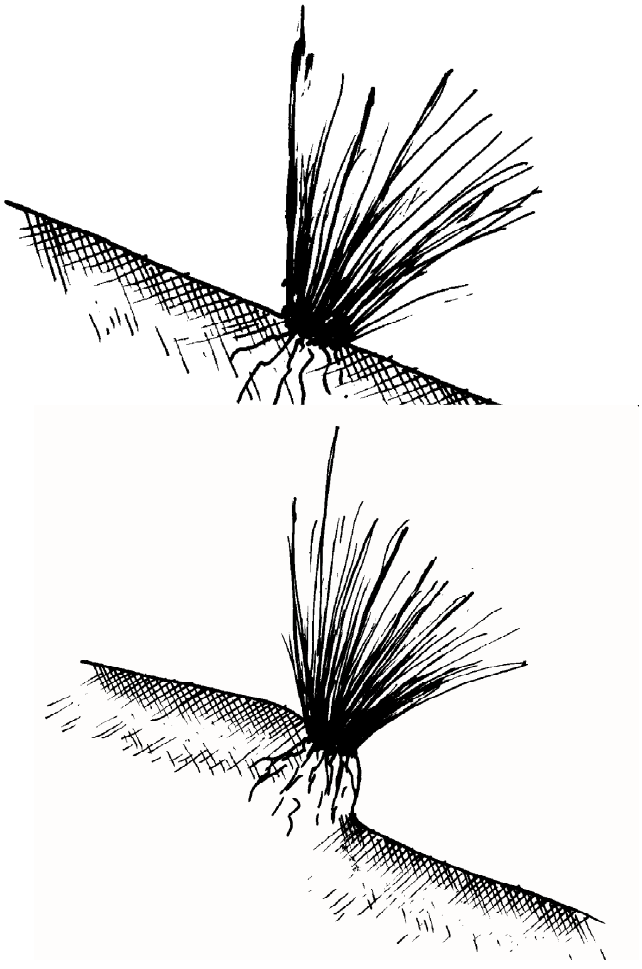


Figure 54 Terraces forming behind Vetiver grass

The terrace is formed by all the soil from our field that used to be carried away from our field by run-off water, and which is now being trapped behind the vetiver hedge.

Useful Ideas:

- **For checking rills and small gullies try to plant small but dense vetiver hedges across where the water flows.**

- **Try planting fruit trees in front of a vetiver hedge, the moisture and soil trapped there will provide an excellent environment for fruit trees.**

- **The roots of Vetiver grass are very aromaic. In Zimbabwe they have beenn used as snake and insect repellant**

Option D: A Dead Level Contour Ridge

A dead level contour ridge looks exactly the same as a normal, graded standard contour ridge.

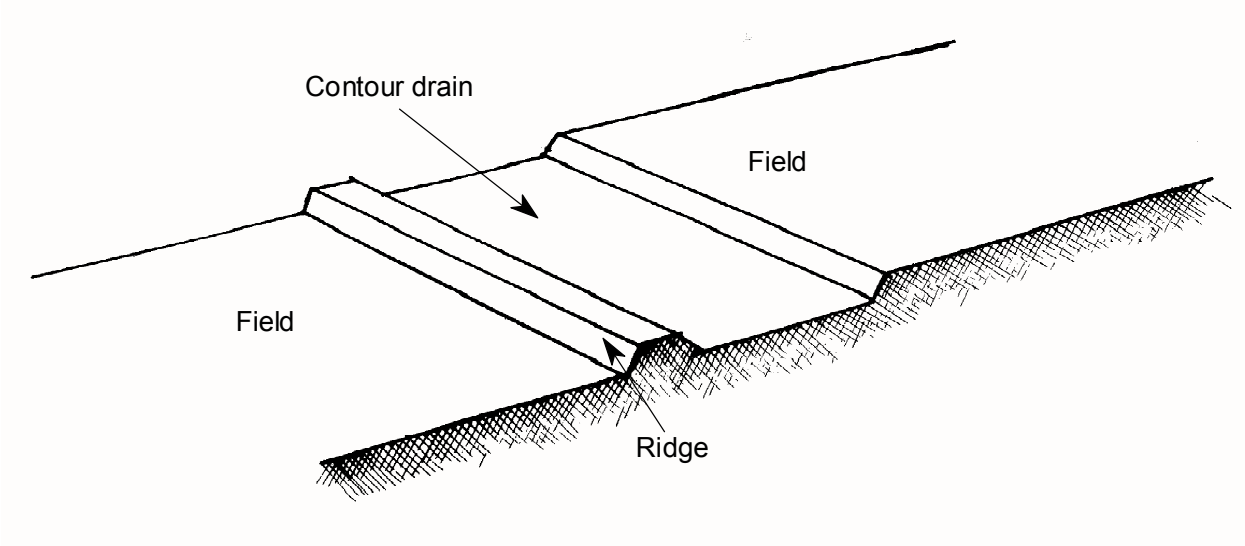


Figure 55 A Dead Level Contour Drain - It looks the same as graded contour drain, but is pegged differently

Where the standard contour ridge is pegged to be graded and thereby divert excess water away from the field, the dead level contour is constructed to keep water in the drain. Thereby we keep the soil and the water in the field, and we can grow crops that require more water in the ditch with less risk of them being eroded by flowing water.

- Apart from the pegging the dead level contour ridge is constructed exactly the same way as a standard contour ridge.

Advantages:	***Disadvantages:***
• The dead level contour conserves soil and water in the ditch and prevents erosion. • The design of the dead level conntour is well known to most people as it resembles a standard contour	• The dead level contour requires re-pegging of the land. • A standard contour cannot be converted into a dead level contour.

Useful Ideas

- **Dead level contours can be further improved with infiltration pits as described under option B.**

- **By increasing the dimensions of the ditch (making it wider or deeper) we can store more water. Thereby we reduce the risk of breakages in the ridge from standing water in the ditch.**

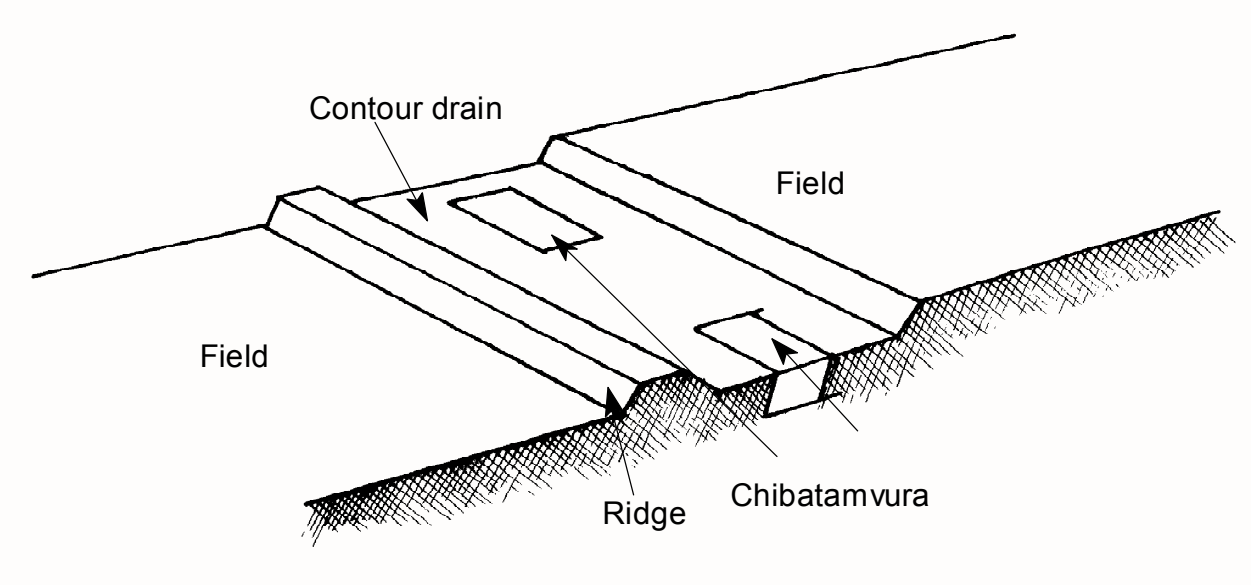


Figure 56 Dead Level Contour Drains with Infiltration Pits

Other Options

In a number of African countries other solutions to conservation works have been tried successfully. Some are indigenous, others have been introduced from elsewhere and then adapted to local circumstances.

One option that does not require much labour in the form of digging is ***Trash Lines.*** These are simply lines of previous crop residues laid along the contour across the field in 1 to 2 m wide strips; pegging is therefore still needed. One could also call trash lines a line of mulch. The trash will simply serve as a barrier that reduces the speed of run-off and increases infiltration.

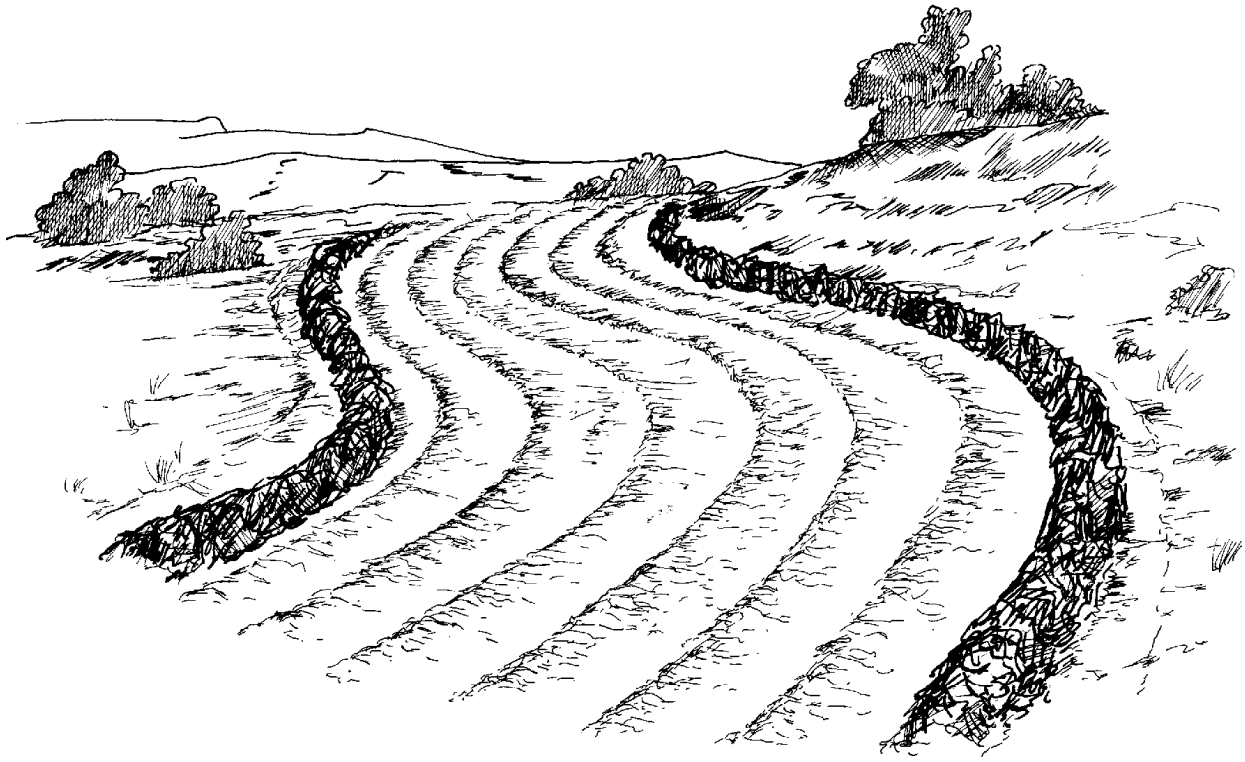


Figure 57 Trash Lines laid along the contour serve as a simple barrier to run-off and increase infiltration

Trash lines can be very useful and efficient in low-rainfall areas where the slope gradient is low and the landscape is almost flat. One big advantage of trash lines is that they easily can be moved if one wants to change the lay-out of fields or if pegging was not done well enough. Compared to the conservation works that require digging this is a big advantage.

Another option is ***Stone Lines***. These are lines of stones that just like trash lines are laid out according to pegging. Both trash line and stone lines are permeable barriers that will allow some water to flow through them, but a lot of soil and water will be trapped and infiltration will be increased markedly.

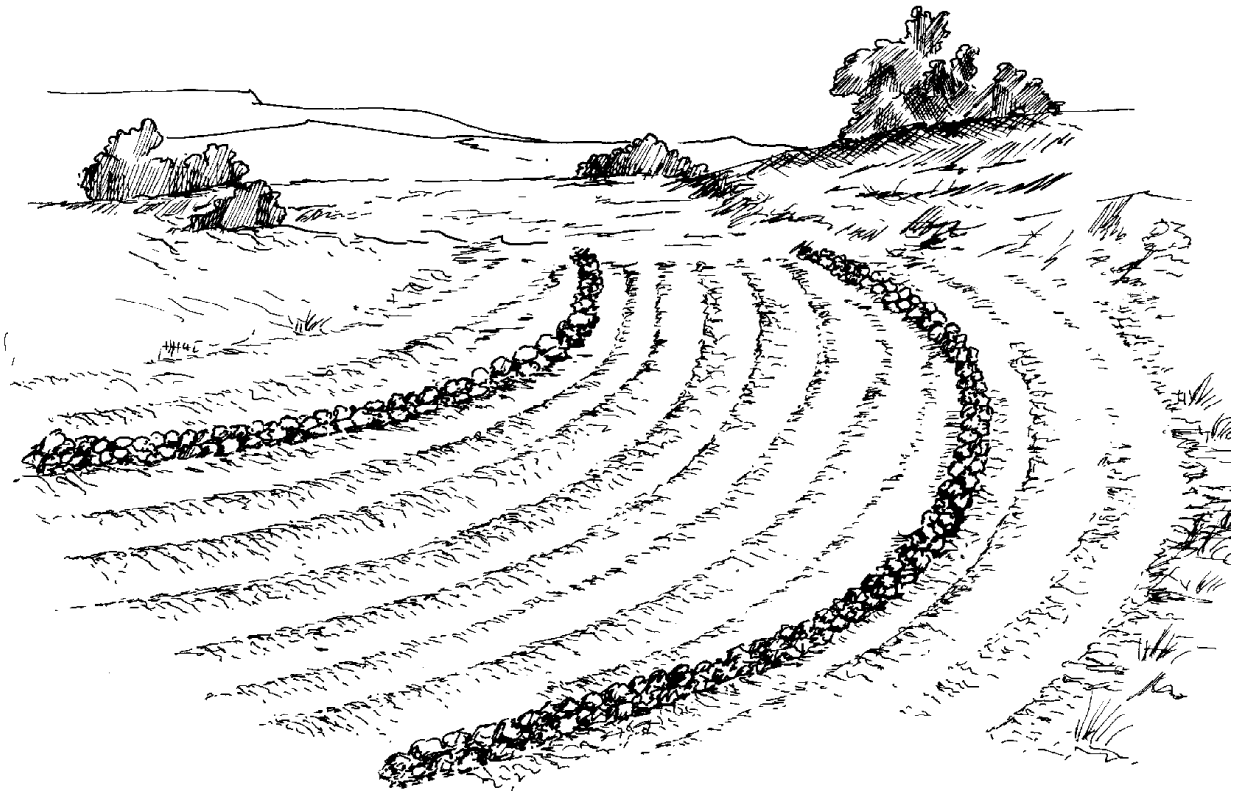


Figure 58 Stone lines laid along the contour forming a permeable barrier that slow runoff and encourage infiltration.

Before placing the stones in a line, a shallow trench, 10-15cm deep and about 30-40cm's width is prepared by digging along the pegs. Larger stones are first laid in the the bottom of the trench as a foundation and smaller stones are placed on top to a height of 25-30cm.

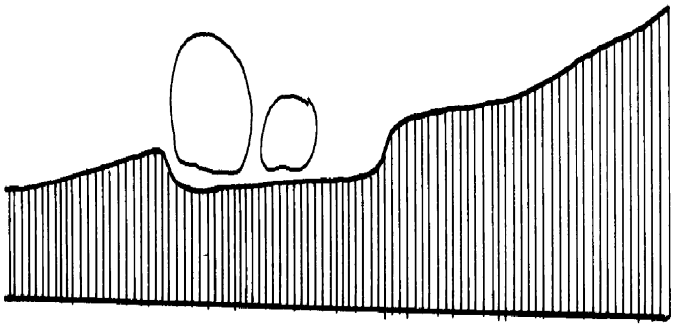


Figure 57 Before placing stones in a line a shallow trench, 10 to15 cm deep and 30 to 40 cm wide is dug.

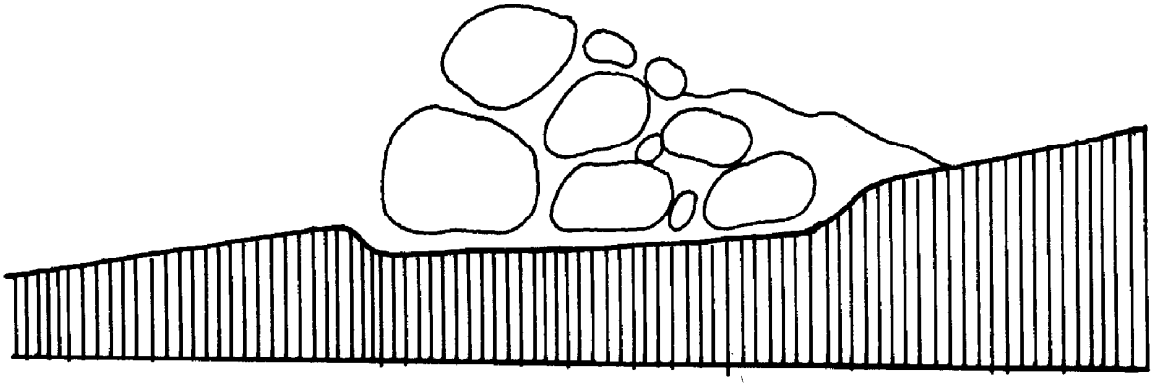


Figure 59 Over time soil builds to create a bund.

Stone lines can be further improved by planting grasses or fruit trees just in front of the stone line.

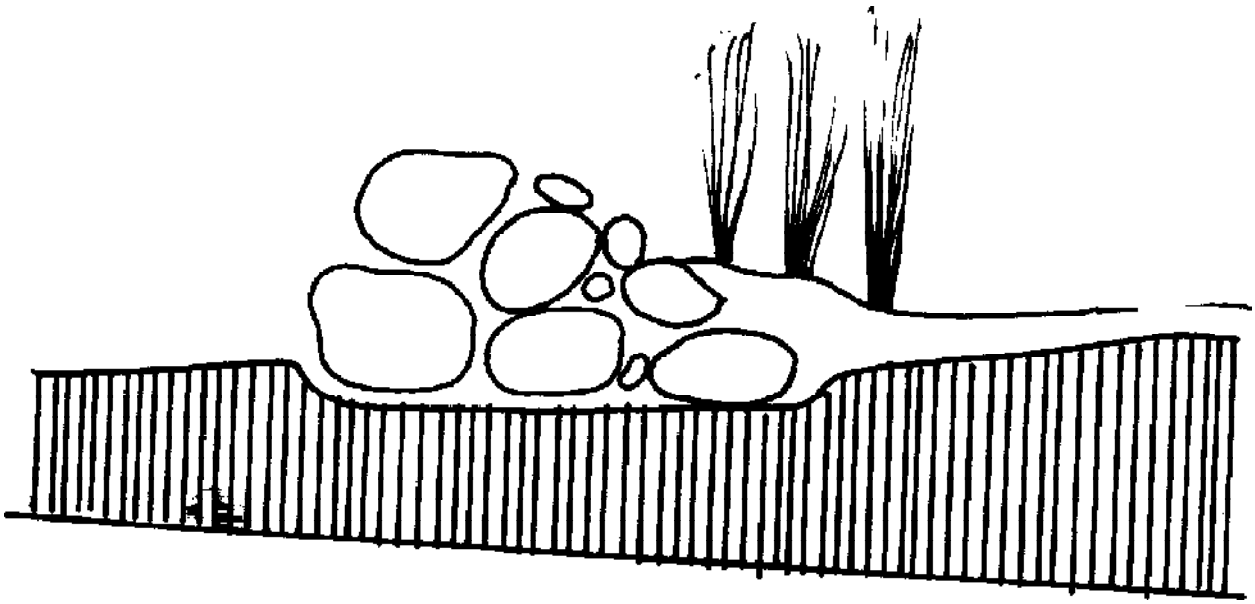


Figure 60 Stone lines can be improved by planting grasses on the upslope side

Rain Water Harvesting

Many ways of harvesting rain water exist. The design and lay-out depends on the requirements, the financial resources and the type of rain water harvesting project.

For most of us, the construction of a big water tank may be too expensive but still, we can do something. We can harvest water from thatched houses in oil drums, or we can divert water falling from the roofs to a banana stand.

For schools, that usually have more resources, a lot of rain water can be harvested from the roofs of school blocks either through gutters fixed to the roofs or in channels on the ground leading to an underground tank. The construction of such a tank should be supervised by an experienced builder.

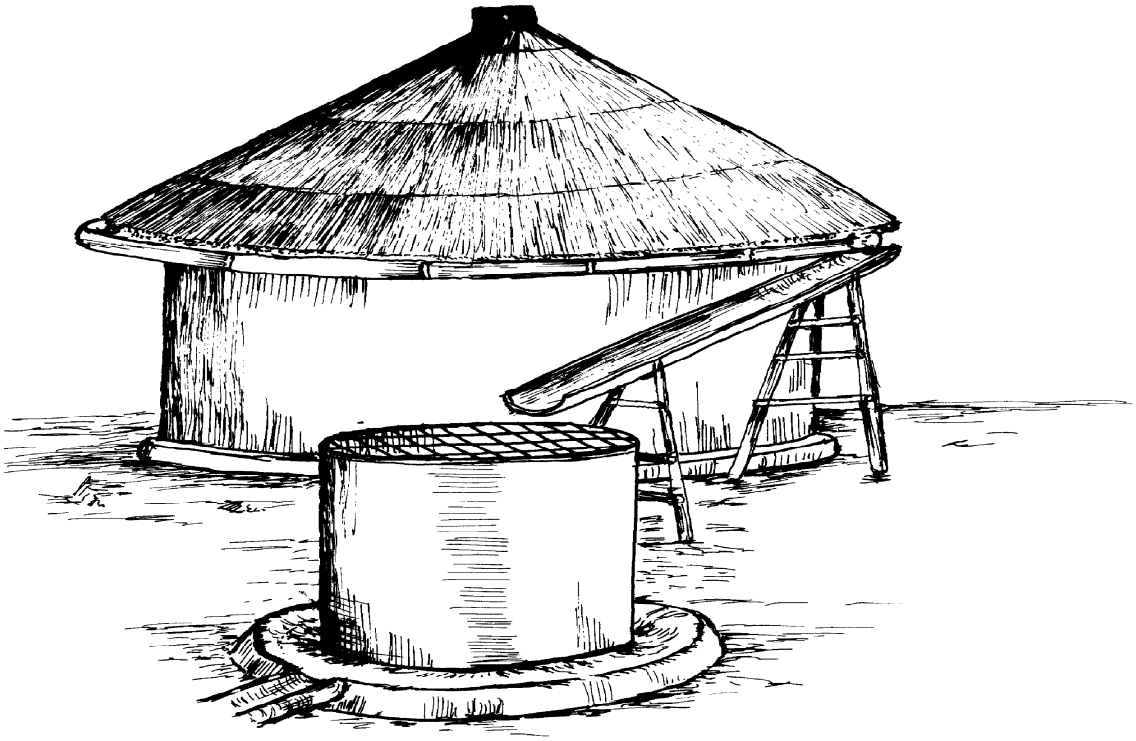


Figure 62 Gutter used to collect rain water from the roof and stored in large tanks

Another option is to harvest the run-off from the ground around our homesteads to a stand of fruit trees. These are called run-off orchards, and consist of small basins made around every tree where run-off water is harvested. This will increase water available for the tree markedly and provide extra valuable fruit. This is discussed in more detail in Booklet ***Alternative Soil and Water Conservation Ideas.***

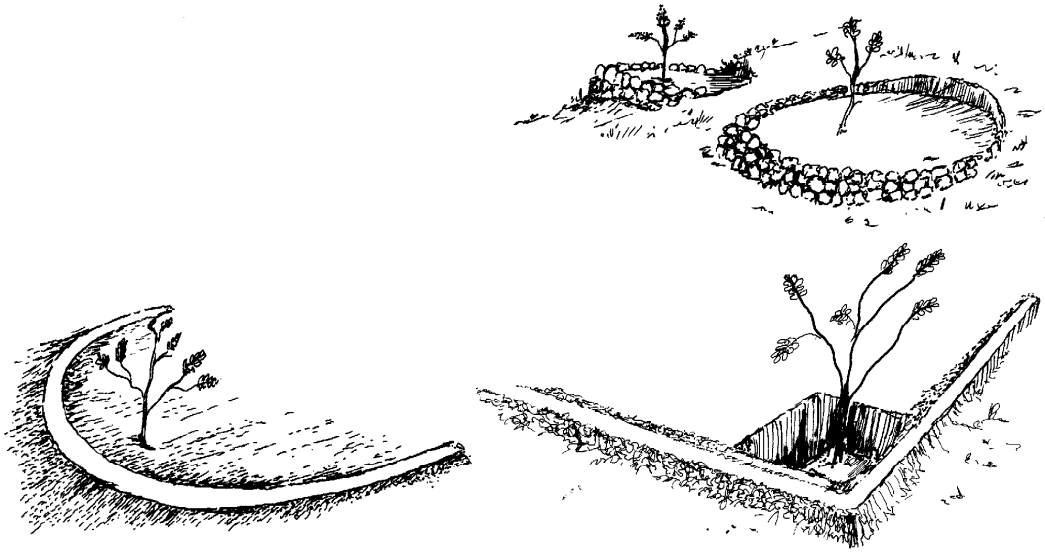


Figure 63 Different methods of harvesting water for fruit trees

A Guide for Farmers on Good Land Husbandry

Titles in Series

·Introduction to Good Land Husbandry

·Soil and Water Management

·Soil Fertility

·Primary Tillage and Land Preparation

·What is Important for Good Crop Establishment

·Planting Option 1 – Hand Planting

·Planting Option 2 – Traditional Third Furrow Planting

·Planting Option 3 – Open Plough Furrow Planting

·Planting Option 4 – Ripper Planting

·Weed Management

·Conservation Tillage Option 1 – No Till Tied Ridging

·Conservation Tillage Option 2 – Low Input Tillage and Weeding

·Alternative Soil and water Conservation Ideas

·Draught Animal Harnessing

·Tillage Implements