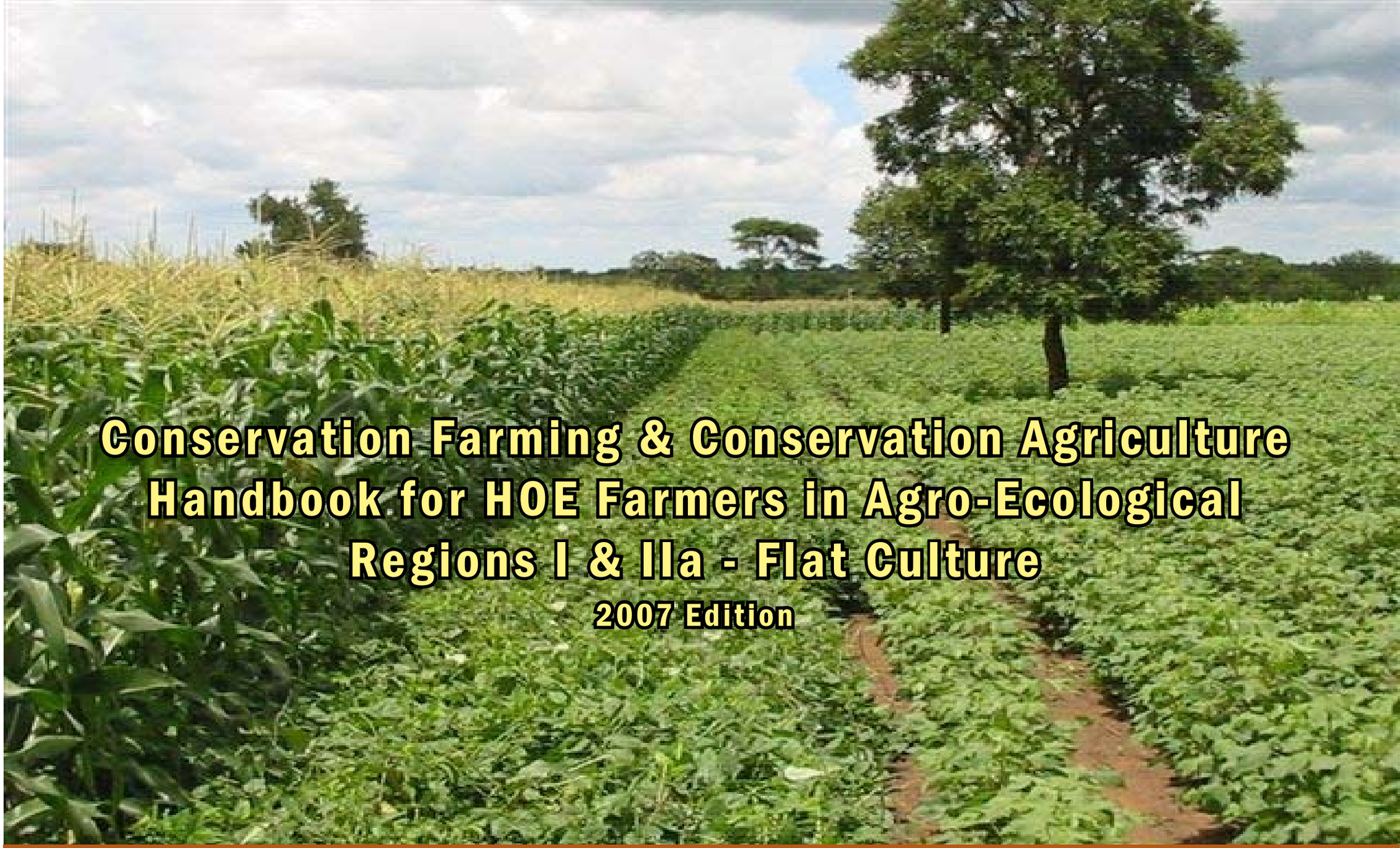

Conservation Farming & Conservation Agriculture Handbook for HOE Farmers in Agro-Ecological Regions I & IIa - Flat Culture

2007 Edition

Conservation Farming Unit

Our sincere appreciation to the Norwegian Government for supporting Conservation Farming in Zambia since 1996

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Foreword

In recent years, the threats posed by climate change, environmental degradation and food insecurity in Africa have risen to the top of the development agenda. However, beyond the rhetoric, the rock concerts and the clamour for increased aid, it is essential that rural families are offered practical solutions that can help them address these challenges themselves.

Farmers who adopt the simple and proven farming systems described in this Handbook can eliminate their dependency on food aid, produce excellent crops in all but the worst droughts, minimise their reliance on increasingly expensive fertilisers and regenerate rather than exploit the environments in which they live.

The distribution of food aid does not offer any long term solutions to the predicament of Africa's rural communities. Food aid is a quick fix that addresses the immediate symptoms of a much more fundamental problem. In its most unbridled and cynical manifestation it extends dependency, distorts local markets and undermines the will of communities to adopt the farming systems that offer them the opportunity to extricate themselves from the indignity of depending upon others to feed them.

If small-scale farmers waste resources, destroy the land upon which they depend and cannot even feed themselves, how can they be expected to engage in agricultural commerce and better their lives?

This updated handbook is for hoe farmers who farm in Agro-ecological Regions I & II and who follow flat culture rather than ridge culture. The results of Conservation Farming (CF) speak for themselves and many thousands of small-scale farmers in Zambia are now benefiting from these simple practices. We hope this booklet will encourage more farmers to adopt CF.

In this Handbook, we also explain the principles of Conservation Agriculture (CA). If conservation farmers adopt CA, the benefits to them will be even greater. If farmers are to reap the many benefits of CF and CA it is essential that they are carefully trained in the basic practices. We therefore hope that NGOs and other agencies engaged in the promotion of CF and CA use this booklet to make sure that farmers know exactly what to do and how to do it.

Conservation Farming and Conservation Agriculture can benefit farmers well beyond the boundaries of Zambia. If you work with small-scale farmers in a neighbouring country or even further away, CF and CA may provide the breakthrough you have been looking for. **Don't hesitate!** Take these ideas to your farmers, give them some practical training and let them try them out for themselves.

The CFU has also published a CF and CA Handbook for farmers who use oxen.

This handbook is dedicated to Ron Landless, who was always interested in small-scale agriculture and got the CF ball rolling in Zambia.

Peter Aagaard
CFU Lusaka, Zambia, June 2007

Introduction

There is ample evidence that the methods we currently use to grow crops are destroying our land and undermining our future. The purpose of this Handbook is to show how smallholders can shift from these destructive methods to a more productive, efficient and environmentally sustainable way of farming.

Conservation Farming and Conservation Agriculture methods are easy to follow and they work. Farmers who adopt them will reduce their costs, increase their yields, improve their nutrition, minimise the chances of crop failure in drought years, increase their profits and, in time, improve the fertility of their land. Many thousands of rural families can genuinely benefit from CF and CA. This Handbook is not about strategies, field surveys, planning sessions, training seminars, questionnaires or any of those things. It is about showing farmers what they can achieve by farming properly. All they need is a strong hoe and determination to succeed. It is about thinking ahead, being better organised, and getting the job done on time.

We are advocating a radical change from the way farmers have planted their crops for generations. **Why?** Let us first look at the 4 existing methods of land preparation, which we call **Conventional Tillage**, and explain why these systems are destroying the land upon which we depend.

Faidherbia albida: Notice the colour of the grass under the canopy. Notice how the tree has shed it leaves. Nature is telling us something!

A. The Disadvantages of Conventional Tillage Methods

A.1 Burning Residues

If there are any residues left on farmers' fields at the end of the dry season, they are raked up and burned. Residues are a nuisance because they clog up the plough. Burning also aids the hunting of mice. Burning is a very destructive habit and **must be stopped**. Residues protect the soil from sheet erosion, improve infiltration, reduce soil temperatures, which in October can rise to above 50°C, and protect top-soil from rain splash and capping. Termites and other soil fauna incorporate residues into the soil, maintaining its structure and organic matter.

Through ignorance, this farmer, like many thousands in Zambia, is destroying a valuable resource. He is also wasting his time. Residues improve rain infiltration and protect the top-soil from erosion and capping. Bare soil increases run-off and loss of soil.

A.2 Ploughing

Farmers who have to wait for the rains to plough their land will always be late. For each day of delay after the first planting rains, **1.5% of potential Maize yield is lost.** Oxen in Zambia are smaller than they used to be and are often malnourished after the long dry season. Ploughing may take several days, or even weeks, if the early rains are unreliable. If farmers have to stop ploughing they also have to stop planting. The ploughed soil is exposed to storms. Rain splash pulverises the surface causing capping, which encourages run off and interferes with crop emergence. If fertiliser has been used, up to **50% may be washed away**. Sowing seeds in the plough furrow leads to **uneven emergence** because some seeds will be planted too shallow and some too deep. By the time the farmer has finished ploughing his last plot, weeds are already infesting the earlier planted plots. Farmers who plough are at the mercy of a tradition that wastes inputs, reduces yields and ultimately destroys the soils upon which their future depends. **If you use oxen, get the CF and CA Handbook for Ox Farmers.**

Immediate Effects: Ploughing 18 days after first planting rains like in the photos above, results in **25%** loss of yield. **30%** of seasonal rainfall and **50%** of applied nutrients are also lost as storm flow.

Medium Term Effects: Loss of organic matter, increase in acidity, loss of moisture holding capacity, reduction in yields and soil compaction.

A.3 Ridging

This practice is common in Eastern and Northern Provinces, and in Malawi. Ridges are split each year and new ridges are made in the previous season's furrows. If ridges are not made on the contour they accelerate erosion by concentrating rainfall into the furrow in which the hard sub soil acts like a drain. Ridging is back breaking work and is done during the hottest time of the year when food stocks are low and the family is at its weakest. Oxidised top-soil is moved backwards and forwards each year and a hoe pan is created under the ridges. Precious rainfall is lost and erosion gullies soon develop. Trash, if present, is buried in the ridges. At the onset of the rains, bacteria use the early flush of Nitrogen to metabolise the residues leaving less nitrogen for the growing crops.

The photos above show hard, unnecessary and destructive work. The ridges are running down the slope and top-soil is being washed down the furrows. The soil that still remains is already infertile. Responses to fertiliser will be minimal and the harvest will be poor. In the long run, yields will decline further and the plot will become totally unproductive. **On steeper slopes and in higher rainfall areas where ridging is commonplace, farmers should be advised to ridge on the contour. Build up the existing ridges each year rather than splitting them and stop burning residues.**

A.4 Overall Digging With A Hoe

This method involves digging the whole field with a hoe. This is usually done after the first rains have softened the soil. It is slow, hard and unnecessary work that exposes the soil to erosion and creates hoe pans. This method is not widespread in Zambia.

Digging to the same depth each year causes **hoe pans**. These are hard layers that restrict root growth and make plants more susceptible to dry spells. The effects of panning can be seen in the photograph **on the right**. The maize in the foreground is stunted and wilting because there is a hard pan underneath.

A.5 Maize Mono-Cropping, Dry Spells and the Threat of Climate Change

Maize mono-cropping (planting Maize in the same field year after year), combined with the use acidifying fertilisers and conventional tillage, is a recipe for disaster. Organic matter is oxidised, soil water holding capacity declines, hard pans develop, acidity increases and fertility declines.

Even in seasons of moderately poor rainfall, crops suffer during dry spells and yields are reduced. Late planting increases the problem and total crop failure often occurs. In this situation, farmers generally blame the weather and hope for food relief. But after closer questioning they will often explain that their soils have changed and no longer produce crops like the used to!

Farmers cultivating degraded soils are particularly vulnerable to the threat of climate change.

B. Some of the Effects of Conventional Farming Methods

The photographs in this Section clearly depict why it is so important that smallholders need to change their farming methods.

Crops grown on soils that have been degraded by conventional farming methods are susceptible to total failure in seasons of poor rainfall. The financial and physical investment required to establish this crop has been wasted.

In seasons of heavy rainfall, compacted soils do not drain properly and become waterlogged. Farmers fail to keep up with weeding tasks and weeds compete with crops for nutrients.

As the table shows, average small-scale crop yields in Zambia are very low, often too low to support the livelihood of an average family.

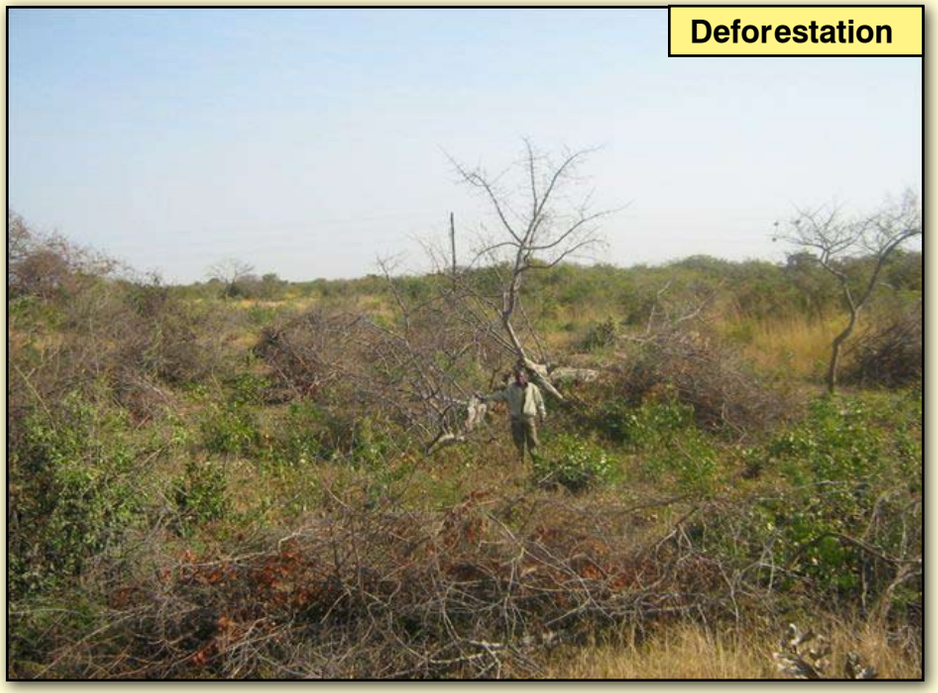
Crop	Average Yield kgs/ha	Acceptable Yield kgs/ha	Good Yield kgs/ha
Maize	1,100	3,500	5,000
Groundnuts	500	1,500	2,000
Cotton	550	900	1,500
Sunflower	400	1,000	1,500
Soya Beans	400	1,200	2,000

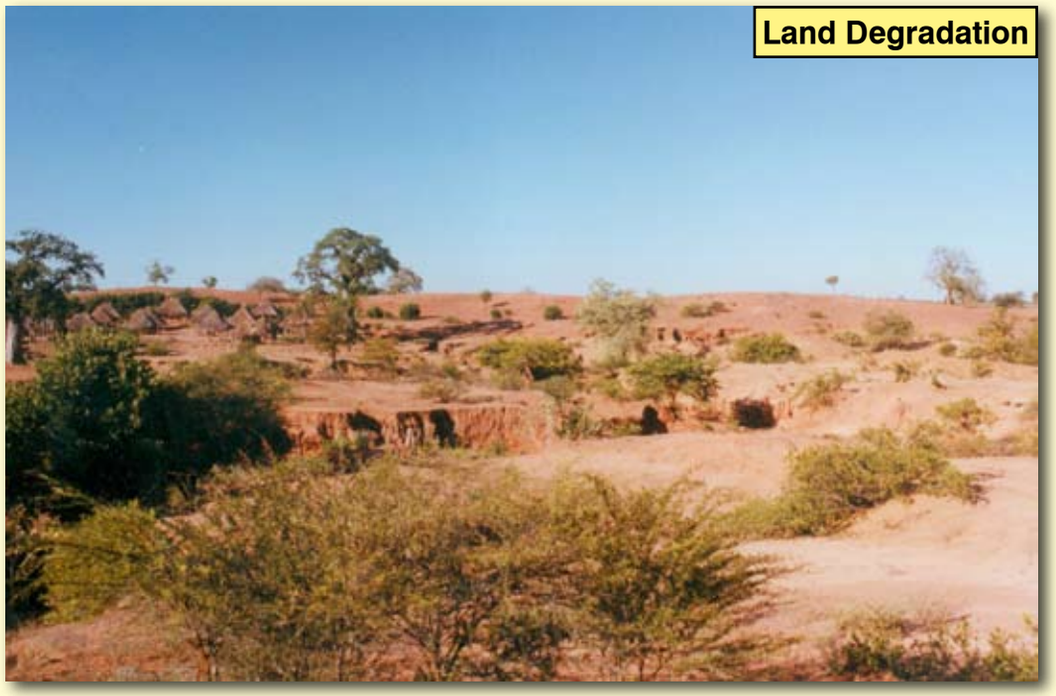
Low Crop Yields

Crop yields in Zambia are very low and food insecurity is a widespread problem despite the fact that the country has a small population, is blessed with good soils and has abundant farmland.

Food Insecurity

These farmers, who grow Maize and Cotton, ran out of Maize in mid-February. They had to abandon weeding their own Cotton crops and weed their neighbours' fields in exchange for Maize. Food insecurity arising from low yields of food crops undermines cash cropping and agribusiness.

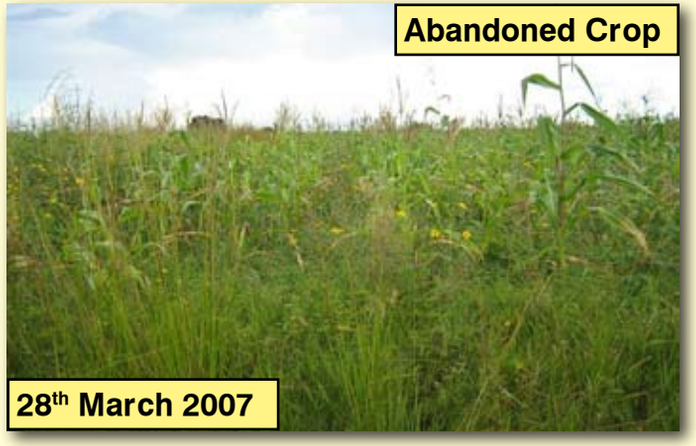




Land clearing in Southern Province: This farmer is felling woodland to make way for farming because he has exhausted the soils on his own farm. In time this soil will also become infertile unless he changes the way he farms.

Land degradation and deforestation is increasing in Zambia. Conventional farming methods that rely on mining out the fertility provided by nature are a primary cause. When the soils become exhausted, farmers look for virgin land where they can chop down the trees and start the destructive cycle all over again. This is one reason why so many farmers migrated from Southern Province. It also explains why Zambia now has the 2nd highest deforestation per capita in the world. Notice the enormous gullies in the picture **on the right**.

There are many thousands of hectares of land like this in Zambia, abandoned because the top soil has gone and the land can no longer produce a crop. Re-growth of vegetation will be slow because there is no soil to which seeds can anchor their roots. This land will take at least 30 years to regenerate to its former condition. Luckily this farmer can move to another piece of land but in time this will also be destroyed. In neighbouring countries where population pressures are higher, farmers cannot move.



Maureen like many thousands of farmers **hired oxen** to plough, which cost her **ZMK 300,000.** The owner was busy himself so she only managed to plant on **28th December.** The first opportunity to plant occurred on **19th November.** Already she has lost **59%** of her potential yield! Later she abandoned her crop and all the money she had invested in ploughing and hired labour for weeding **was wasted**. If instead of hiring oxen, Maureen had hired labour to dig CF basins in the dry season she could have planted with the first rains and would have been successful.

Conventional farming methods WASTE: soil, moisture, the farmer's time and energy, expensive inputs and money. Conventional farming methods destroy the land upon which farmers depend, and increase food insecurity and poverty.

C. Words Used to Describe Different Tillage & Farming Systems

C.1 Introduction

Before we explain the basic steps involved in Conservation Tillage and Conservation Farming we must understand the terms that are commonly used.

C.2 What Does Tillage Mean?

Tillage is all the work that a farmer does to prepare his land for planting. That is, all the operations undertaken to prepare a seed bed so the seeds can germinate properly. The word cultivation is usually used to describe all the work that is done after planting to keep the crop free from weeds.

C.3 What is Conventional Tillage?

When we say Conventional Tillage, we are describing 3 tillage methods that are commonly used by farmers in regions I and II in Zambia in order to prepare their land for planting. These 3 methods of Conventional Tillage are as follows:

- **Soil Inversion (digging or ploughing)**
  The soil on the entire surface area of the field to be planted is disturbed. This could include one or all of the following operations: digging by hoe; ploughing; discing and harrowing.

- **Ridging**
  A hoe is used to ridge up the soil. This is usually done in October or November by splitting the previous season's ridges to form new ones in the old furrow. It may also be done after the rains have started, either using a hoe or ox ridgers. Ridges should always follow the contour, but seldom do.

- **Minimum Tillage**
  Minimum Tillage (MT) means reducing tillage operations to the minimum required to plant a crop. For hoe and ox farmers it usually involves scratching or ripping out the row where the crop is to be planted and leaving the rest of the land untouched until weeding is required. Alternatively, hoe farmers may just dig holes where the seed will be sown.

C.4 What is Conservation Tillage?

Conservation Tillage refers to a number of practices that in combination conserve soil, moisture, fertiliser, seeds, energy, time and money. With Conservation Tillage (CT), Minimum Tillage is used to plant the crop but other simple techniques are also applied, which:

- Protect the soil from the damaging effects of rain splash;
- Reduce run off and keep more of the rain on the fields, this is called **rain harvesting**;
- Make the best use of costly fertiliser and seeds; and
- Allow farmers to finish land preparation well before the rains come so they are ready in good time.

C.5 What is Conservation Farming?

Conservation farmers use Conservation Tillage methods to establish their crops but they also grow legumes in rotation with their other crops. Legumes, depending on the varieties grown, fix Nitrogen, improve fertility, break soil pans and are an excellent source of protein for the family. Conservation farmers recognise the value of trees and live in harmony with the land rather than destroying it.

C.6 Adoption Definitions

It is sometimes difficult to decide whether a farmer is a true adopter of CT or Conservation Farming (CF). The definitions below describe 3 levels of adoption, from partial adoption through to full adoption of CF. These definitions are non-negotiable because they describe practices that are the very foundation of hoe CF.

Definition	Non-negotiables
Improved Reduced Tillage (IRT)	• Correctly spaced permanent planting basins established before the rains; • Early planting of all crops; and • Early weeding.
Conservation Tillage (CT)	• No burning of residues; • Correctly spaced permanent planting basins established before the rains; • Early planting of all crops; and • Early weeding.
Conservation Farming (CF)	• No burning of residues; • Correctly spaced permanent planting basins established before the rains; • Early planting of all crops; • Early weeding; and • Rotation with a minimum of 30% legumes in the system.

D. The Main Benefits of Conservation Farming

CF involves adopting a number of husbandry practices that together comprise a complete farming system. If these practices are followed correctly, a number of important benefits arise:

- Farmers can plant a larger area because they are not moving or turning over the soil before they plant. This saves money and time. For example, conventional ploughing or ridging 1 hectare of land to 10cms depth involves turning over or moving 1,000 tons of soil.
- Farmers can begin to prepare their land as soon as they have harvested. This allows for early planting at the onset of the rains, which is critical for success. Early land preparation and rapid planting also permit early weeding.
- Labour requirement for land preparation is spread over several months rather than being done at once. It is therefore more suitable for women.
- Fertilisers and seeds are increasingly costly. Accurate placement of fertilisers and seed reduces wastage and allows optimal use by the crop.
- Retaining residues reduces soil and water loss, improves infiltration, reduces soil temperatures and, in time, improves soil fertility. Conservation Farming minimises crop loss in drought years and improves food security.
- Planting holes or 'basins' concentrate early rainfall around the seeds, accelerating emergence and improving crop stands.
- Because seeds are planted in the same place each year, residual fertiliser from cereal crops can be taken up efficiently by subsequent crops. Deep rooting crops can be used in rotation to break pans by making root channels which weaker rooting crops can follow;
- Because the inter-row is never ploughed, weed populations will decline over time as long as weeds are not allowed to seed.
- Rotations with legumes reduce the requirement for artificial fertilisers. Pigeon peas and other legumes also have strong roots that break plough pans and aerate the soil. Pigeon peas also recycle phosphorous from deeper layers and make it available to shallower rooted crops that follow in rotation. Early maturing varieties of Cowpea and Gram provide a high protein source in February when food is generally scarce.
- Handhoe CF does not entail the need for purchasing any additional capital equipment by the smallholder. It is also easy to understand and apply.

Getting good results in farming is about doing critical tasks on time and in the proper way.
CF provides a system that enables farmers to be timely, accurate and efficient.

E. Basic Conservation Farming Steps for Hoe Farmers

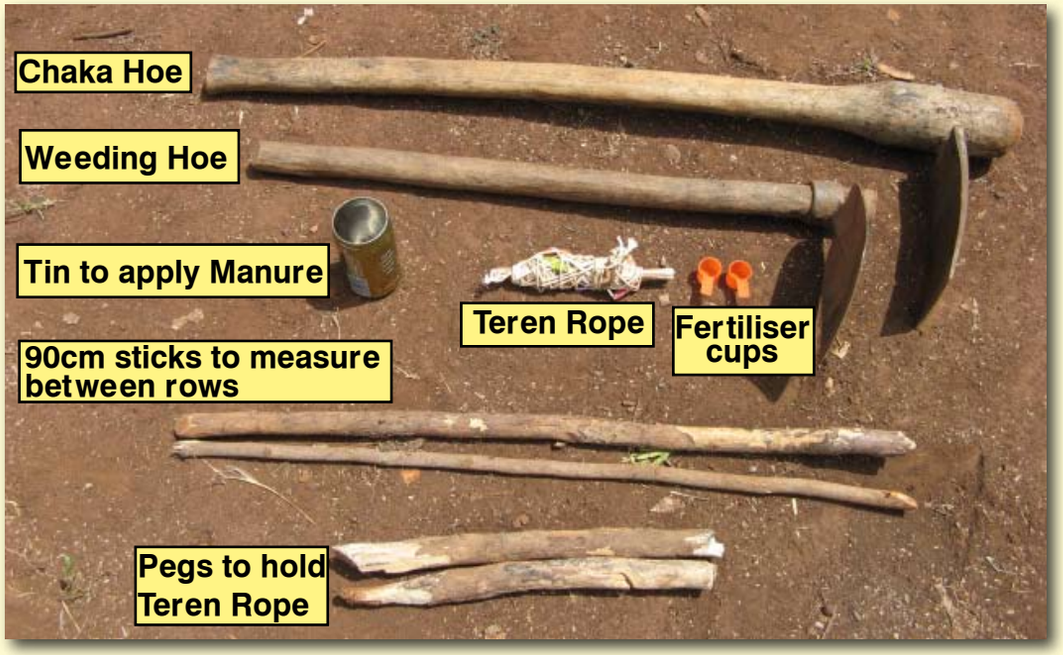
In the following Sections, we show the basic husbandry steps that hoe farmers must adopt to convert to Conservation Farming to establish and maintain their crops.

Step 1: Keep Residues

Do **not** burn crop residues from the last harvest. Leave them where they are. A minimum of 30% ground cover is recommended. The more residues left on the land the better. Residues reduce sheet erosion and capping, allow the rain to soak into the soil and, when they are harvested by termites, add valuable organic matter to the soil.

Many farmers believe that leaving residues on the ground attracts termites that will later attack their crop. The opposite is true. Burning residues leaves no food for the termites so they attack the crop instead. Termites are everywhere and need to eat too!

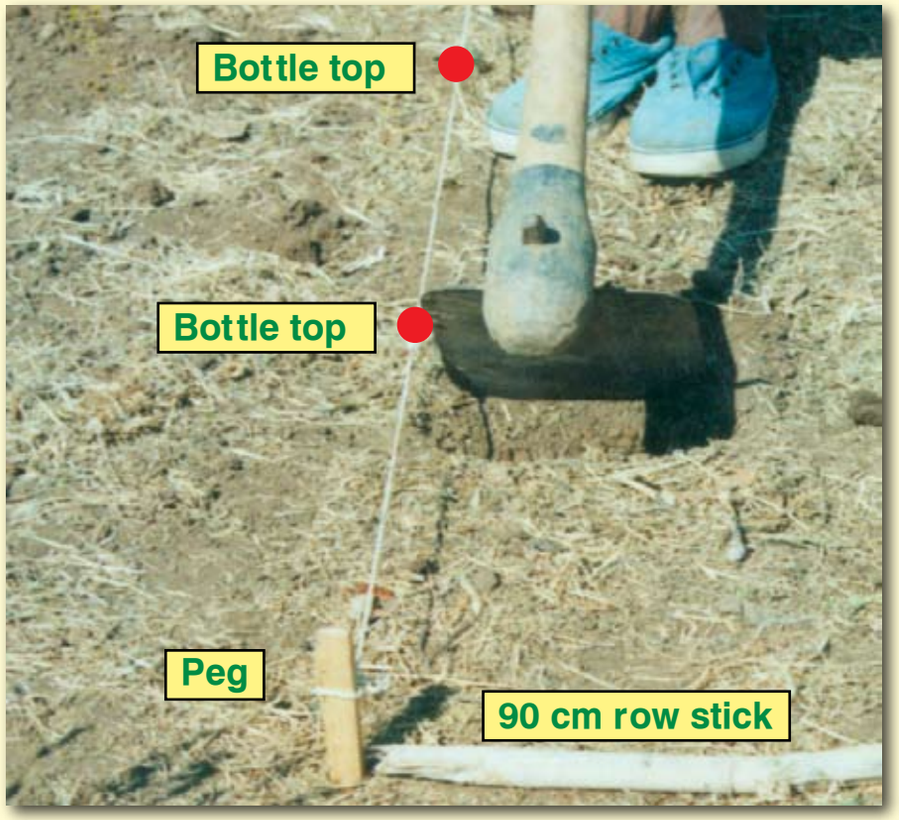
Step 2: Get Prepared Early



To prepare their land, hoe farmers will need the following: Teren Rope; strong hoes, 2 x 90cm row sticks; 2 pegs to hold the rope when it is stretched across the field; fertiliser cups and a Coca-Cola tin. If the soil is hard, the Chaka hoe is recommended as ordinary weeding hoes will break and are not suited to digging. The Chaka hoe, with an extra strong and long blade **(photo on the right)** is available from rural outlets. Contact CFU staff for your nearest retailer, and keep your eyes open for new and improved CF equipment.

The Teren Rope is an essential tool for the Conservation Farmer because it ensures accurate spacing of the basins. **CF is about precision.** The Teren Rope consists of a rope or string with bottle tops squeezed onto it at 70cm centres. It is used to mark out where to dig the planting basins for the correct spacing.

Step 3: Marking Out the Permanent Planting Basins



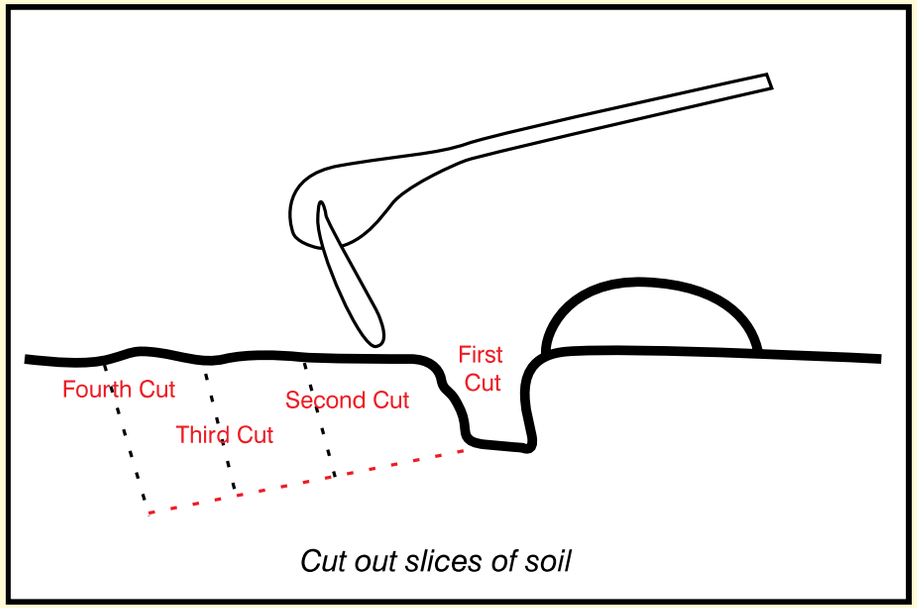
As long as farmers return to the same position each year, digging of basins becomes easier. Research has shown that by Year 4 labour requirement for digging reduces by 35 to 40%.

The Teren Rope is used to mark out where to dig the planting basins. These are spaced at 70cms along the row and the rows are 90cms apart. There will be 15,850 basins per hectare. Stretch the rope **across** the prevailing slope using the 2 pegs to anchor it. Keep it well clear of the ground so it remains straight in spite of trash and clods brought up during the digging of the basins. The position of the bottle tops **(red dots in the picture)** marks the edge of the elongated basins. The basins are not round but rectangular in shape (see pages 18 and 19). Use the 90cm sticks to get the correct spacing when you move the Teren Rope to the next row.

It is worth marking out accurately in the first year because the basins will be **permanent.** This is another important and unique aspect of Handhoe CF. Each year the basins are re-dug in exactly the same place as the year before.

Step 4: Digging the Basins

The basins should be dug well before the onset of the rains. CF means doing work in advance, so you are ready rather than being overwhelmed when the rains come. Making the basins when the rains have already started means you have missed one of the main benefits of CF.



Cut out slices of soil

When digging a basin, swing the Chaka hoe like an axe using the weight of the hoe blade to penetrate the soil. This is why the Chaka hoe must have a long handle. Cut out slices of soil **working forwards**. When you have finished a basin, **move backwards** to the next mark and start digging the next basin. Following this simple method will save you days of work.

If you save 10 seconds digging each basin, you will save 7 days of work digging 1 hectare of basins.

Step 5: Make Basins the Correct Size

The basin should be 20cms deep, 30cms long and the same width as the blade of the hoe. If you place your outstretched hand down the hole, the top of the basin should be level with the bone on your wrist. This depth will ensure that any **hoe or plough pans are broken**. The basin needs to be 30cms long so that the seeds of different crops can be spread along the basin. When the plants emerge they will not be overcrowded.

Digging basins in compacted soils is a hard task. Farmers who dig large round basins like the ones on the left are wasting their time. Each of these basins took the old lady who dug them 1.5 minutes to complete, while the correct one took her 45 seconds. Over 15,850 basins (one hectare), the lady could have **saved herself 197 hours (or 33 days) of extra work**.

Small things can make big differences. CF is about attention to detail.

Step 6: Start Land Preparation Early and Work Steadily

Situmbeko April 2007

Mumbwa May 2004

Farmers should be advised to start land preparation as soon as the harvest is over. The best way is for the adults in the family to work for **about 3 hours each morning**. 3 adults can dig about 500 basins in 3 hours. In this way, **1 hectare can be completed in 4 weeks**.

This photo was taken on 24th May 2002 in Monze. There are no men in this household. Land preparation is already finished well before the planting rains expected in mid November. Despite the poor rainfall experienced in 2002/3 this family did not go hungry.

Idea:
Don't hire oxen to plough, hire labour to dig basins before the rains

Step 7: Applying Basal Fertilisers, Manure and Lime

Properly dug and precisely spaced basins allow farmers to be extremely accurate in the application of fertiliser and seeds. Guesswork is no longer necessary and the inputs can be placed exactly where they are needed. Wastage is minimised.

Applying Manure

Kraal manure is a valuable resource that farmers often fail to take full advantage of. With CF, manure is scattered across the bottom of the basin. **2 full Coca-Cola tins, or 1 double handful, per basin** is recommended. This is the same as 4 tons (or 4 scotch carts) per hectare. Farmers who spread manure across the field and then plough it in, waste most of it.

Applying Fertiliser & Lime

The Number 8 fertiliser cup is recommended for the application of fertiliser and lime.

The fertiliser should be scattered in the bottom of the hole. One No.8 cup per basin gives 125kgs per hectare of “D” Compound and 100kg of Urea.

Lime can be applied at the same time as basal dressing. 2 cups of lime per basin gives 350kgs per hectare.

Manure, basal fertiliser and lime can be applied as early as August and should always be applied to the bottom of the basin and not used as a side dressing after the crop has emerged.

Applying Fertiliser Easily and Back-filling Basins

To apply inputs easily, tie the ends of the same side of a fertiliser sack together and sling it over your shoulder. Fill it with 10 to 15kgs of fertiliser or manure. Using the cup or Coca-Cola tin, toss the fertiliser into each basin from hip height so that it spreads out.

After the inputs have been applied in the basins, they should be covered with soil using a hoe. This is called **back-filling**. A shallow depression, **about the depth of a matchbox**, should still remain after this is done.

Step 8: Deciding When to Plant

This depends on the season and is one of the most difficult decisions farmers have to make. A major advantage of CF is that when heavy rains fall, all the farmers have to do is plant because they are ready. Most conventional farmers have to combine land preparation and sowing. This complicates and delays the job.

The main objective is to achieve rapid, even and complete emergence of the crop. To achieve these results, timing is critical.

Always plant seed **immediately after heavy rain.** Never plant several days after rain when the soil is already beginning to dry up.

When the rain stops, continue planting for only 48 hours, then stop planting until the next good shower.

When you plant there must be enough moisture to germinate the seed **so the whole crop emerges at the same time.** If you are relying on a further shower of rain to achieve emergence, you could fail.

Make sure your family knows how to plant different seeds so they can help you to finish the job quickly. Planting should always be **completed in 1 day** if possible.

Guide to Planting Dates – Agro-regions I & II

Crop	Dates	Note
Cotton	Dry plant any time after 8th November or immediately after heavy rains	This is the ***only*** crop where we recommend dry planting.
Maize	Plant immediately after first heavy rain that falls after 15th November	Do ***not*** advise small-scale farmers to plant before 15th November even if heavy rain has fallen. It is too risky.
Groundnuts	Plant after the first heavy rain that falls after 15th November	
Sorghum	Plant immediately after heavy rain between 1st and 15th December	
Millet	As above: 1st to 15th December	
Sunflower	As above: 1st to 15th December	
Soya Beans	As above: 1st to 15th December	
Cowpeas	As above: 1st to 15th December	A small area planted at the same time as maize will provide early, high quality food.
Green Gram	As above: 1st to 15th December	
Pigeon Peas	As above: 1st to 15th December	

Step 9: Sowing Crop Seeds

It is very important to sow crop seeds correctly. If seeds are not sown properly the effort put into land preparation will be wasted. The part of the **matchbox** seen in each of the following photographs shows the correct planting **depth** for each type of seed. After covering seeds, the soil should be compacted lightly to ensure good contact between seed and soil so that the seed can absorb water quickly.

Check Back-filling is Correct

Before sowing, check the level of soil in each basin. The hollow in the centre of each basin should be about the depth of a matchbox, or 5cms. Rainfall may have caused the soil to slump down so more may need to be added.

Sowing Maize

4 seeds are sown along the basin and covered with 5cms of soil. This is a full matchbox depth. Clods should be broken so the soil makes good contact with the seed. The aim is to have a stand of 57,000 plants per hectare (90% germination).

Sowing Sorghum

10-12 seeds are sown along the basin and covered with 2.5cms of soil. The aim is a stand of 100,000 plants per hectare.

Sowing Pearl Millet

Sow a small pinch of seed at each end of the basin and cover with 1cm of soil. Millet seeds are small so they must not be planted deep.

Sowing Soya Beans

Sow 10 to 12 seeds along each basin and cover with 2cms of soil. Do not plant too few seeds as this will reduce the yield. The aim is to have a vigorous stand of 125-150,000 plants per hectare.

Sowing Cotton

Before sowing cotton seed, all the soil should be moved back into the basin so it is **level with the ground**. Plant **a pinch of 6-8 fuzzy, or 2-3 delinted cotton seeds** at each end of the filled hole. The seed should be pushed into the soil but should remain visible. After thinning to 4 plants per basin, the aim is to have a stand of 63,000 plants per hectare.

Remember that Soya Bean seed needs to be treated with innoculum immediately before sowing. Follow instructions provided carefully.

Sowing Green Gram

Sow 7 to 8 seeds along each basin and cover with 1 to 1.5cms of soil. Gram is best suited to the drier areas. It should never be grown in the Copperbelt or the North.

Sowing Cowpea

Sow 7 to 8 seeds along each basin and cover with 2cms of soil.

Sowing Groundnuts

Sow 8 to 10 seeds along the basin and cover with 3cms of soil. If you are planting Groundnuts, it is better if the basins are made a bit longer, i.e. 40cms, to avoid overcrowding.

Only 'bunching type' Groundnuts, such as Natal Common, MGV4, MGV5, Chipego and Makulu Red should be grown in basins. Spreading types, like Chalimbana, must be grown on box ridges to allow for easy harvesting.

Sowing Sunflower

Sow 2 to 3 seeds at each end of the basin. Sunflower seeds should not be planted deeper than 2cms. Sunflowers will not emerge if planted too deep.

Reminder:

Always plant immediately after heavy rain.

Soil must be wet enough to enable the crop to emerge.

It is better to plant a few extra seeds than too few.

Step 10: Thinning & Supplying

Cotton is the only crop where **thinning** may be necessary. If the emergence of the crop is poor, **supplying is also necessary**. Sowing of supply seeds should be done as soon as possible and before the existing plants are matchbox height (5cms tall). Only sow into a very moist seedbed.

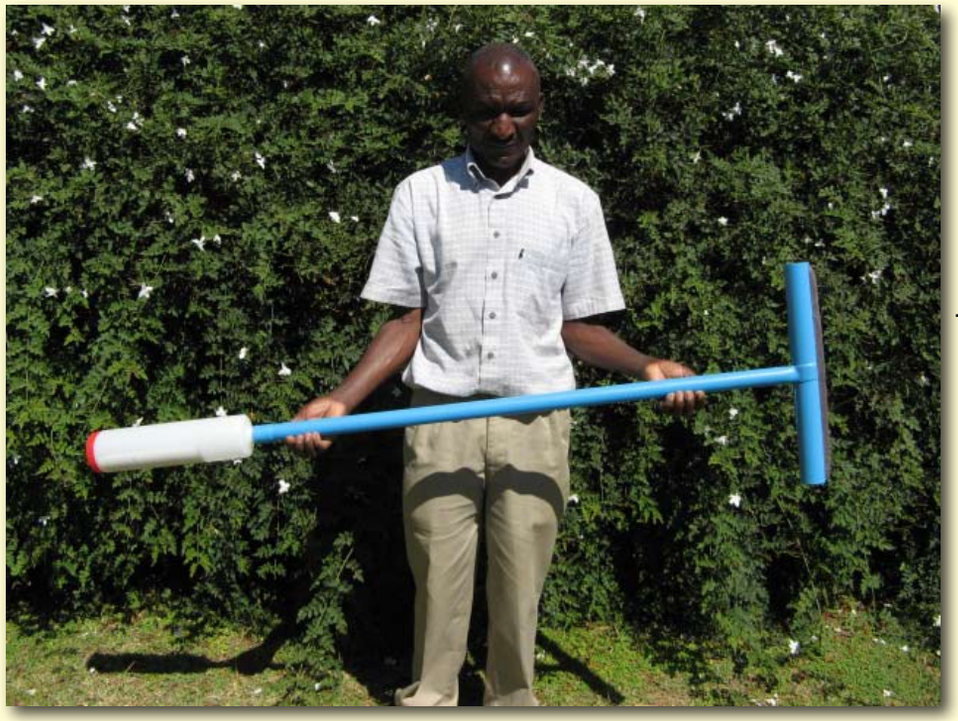
Cotton seedlings should be **thinned** out before they are 5cms tall leaving 2 strong seedlings at each end of the basin. This is 4 seedlings per basin or 63,000 seedlings per hectare.

Step 11: Weeding

Early and continuous weeding is a critical element of CF. If weeds are not allowed to seed, the population of weed seeds in the soil will gradually decline. Farmers often stop weeding after the crop has matured believing the weeds can no longer do any harm. This is a serious mistake because each weed will shed thousands of seeds which will germinate the following year and for many years thereafter.

At GART in Chisamba, where CF has been practised since 1997, the labour requirement for weeding had **reduced by 50%** by 2001, because weeds have not been allowed to seed. The soil is never ploughed so the number of weed seeds in the top-soil has declined.

Farmers seldom pay enough attention to weeding and are not aware of the damage that weeds do to crops by competing for water, nutrients and light. Weeds should never be allowed to grow beyond **5-6cms**. One person can weed 1 hectare of weeds this size in **8-10 days**. If the weeds are 15cms high, (as in the photograph above) the same job will take **20-25 days** and the crop will suffer severely.



Weeding is a major problem for small-scale farmers, particularly vulnerable households. Each year, farmers spend over 60 million days weeding in Zambia. Ask CFU staff about controlling weeds using a **knapsack sprayer** with **herbicides**. For controlling patches of late weeds, the **new and stronger Zamwipe (shown above)** is a simple and light hand-held applicator that is used with glyphosphate (Roundup).

The Zamwipe is ideal for eradicating patches of **Kapinga**

Step: 12 Getting the Tools and Training You Need to Do CF

The CFU is working with retailers in rural areas to make sure that the tools you need to convert to CF can be found in your locality. Contact CFU staff or CFU Farmer Coordinators to obtain the necessary information.

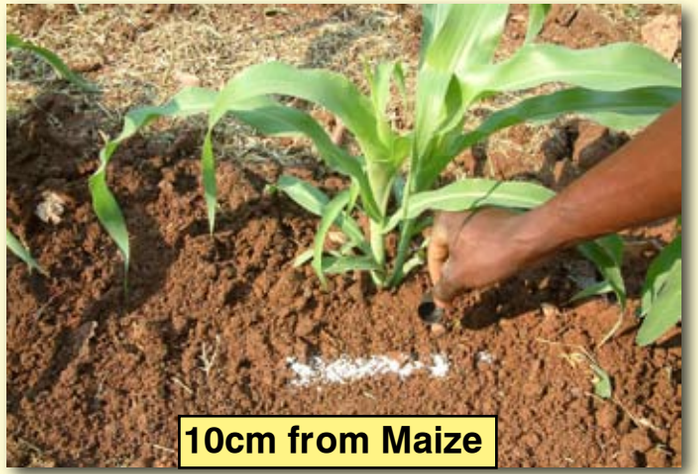
The CFU has offices in Chipata, Lusaka, Golden Valley Chisamba, Monze and Mumbwa.

Ask CFU staff or ZNFU District staff about our regular training schedules so that you can attend these and obtain practical training from CFU Field Officers and Farmer Coordinators.

Our job is to train you. Find us and use us.

Step 13: Top Dressing of Maize

On medium to heavy soils, Maize should be top dressed once when it is **knee high**. It is best to use 2 people to do this job. The soil should be **moist**. The first person scratches a small furrow beside each Maize stand (basin), with a stick. The second person applies the fertiliser in the furrow with a **No. 8 cup** and covers lightly with soil.



If the soil is **very sandy**, the top dressing should be **split**. The first dressing is applied at **knee height** (normally 6 weeks after planting), and the second dressing about 3 weeks later when the Maize is **waist height.**

Step 14: Topping Maize

Once Maize is physiologically mature, it is a good idea to top the stalks just above the cobs and drop the tops into the rows. This will speed up drying and reduce lodging from termites and wind.

Termites will consume the toppings rather than attack the crop.

Fertiliser and Lime Application Rates

CF is a farming system that enables farmers to get the best results from whatever resources they can muster, big or small, more or less. The principles of CF apply to all farmers, whether they use a hoe, use oxen, or use a 300 horsepower articulated tractor! CF is not about agronomy; i.e. which varieties of crops are best suited to different rainfall patterns or soils, how much fertiliser should be applied to these crops etc. However, as we are often asked these questions, here are some very basic guidelines on fertilisation.

Fertiliser

Crop	Basal		Top Dressing	
	D Compound Kgs/ha	No. 8 Cups/Basin	Urea Kgs/ha	No. 8 Cups/Basin
Maize				
Target yield 3.5 – 4.5 tons/ha	125	1	200	2
Target yield 5.0 – 6.5 tons/ha	250	2	300	3
Sunflower				
Target yield 1.0 – 1.5 tons/ha	125	1		
Target yield 2.0 – 2.5 tons/ha	250	2		
Soya Beans				
Target yield 1.0 – 1.3 tons/ha	125	1		
Target yield 1.5 – 2.0 tons/ha	250	2		
Groundnuts				
Target yield 1.0 – 1.3 tons/ha	125	1		
Target yield 1.5 – 2.0 tons/ha	250	2		

Lime

All farmers should be advised to apply lime to their **legume** crops at a rate of **1.5 No.8 cups per basin. This is 300 kgs/ha.** The cost of lime, which is only 12% that of fertiliser, increases legume yields substantially and provides very attractive returns.

Farmers should not wait until their soils become acid before applying lime. Lime should be applied as a routine measure to keep soils neutral. Good agricultural lime should be very fine. Uniturtle produces this type of lime.

Lime can be applied in combination with basal fertiliser or manure.

F. Rotations and CF

F.1 Introduction

Rotations are an essential part of CF. We all talk about the importance of rotations and using legumes, but despite the development of improved varieties of Cowpea, Green Gram, Pigeon pea, Groundnut and Soya Beans, legumes still occupy less than 10% of smallholder crops in any one season. Either seed is unavailable or there is no market. The regional and international demand for soya bean and groundnut is large but for other legumes it is small. Local demand, particularly in urban areas, must be developed. Legumes provide an excellent source of protein and can be prepared in many different ways, including bean fritters which would provide a more nutritious alternative 'fast food' to green Maize. In West Africa, legumes are produced and consumed locally in very large quantities.

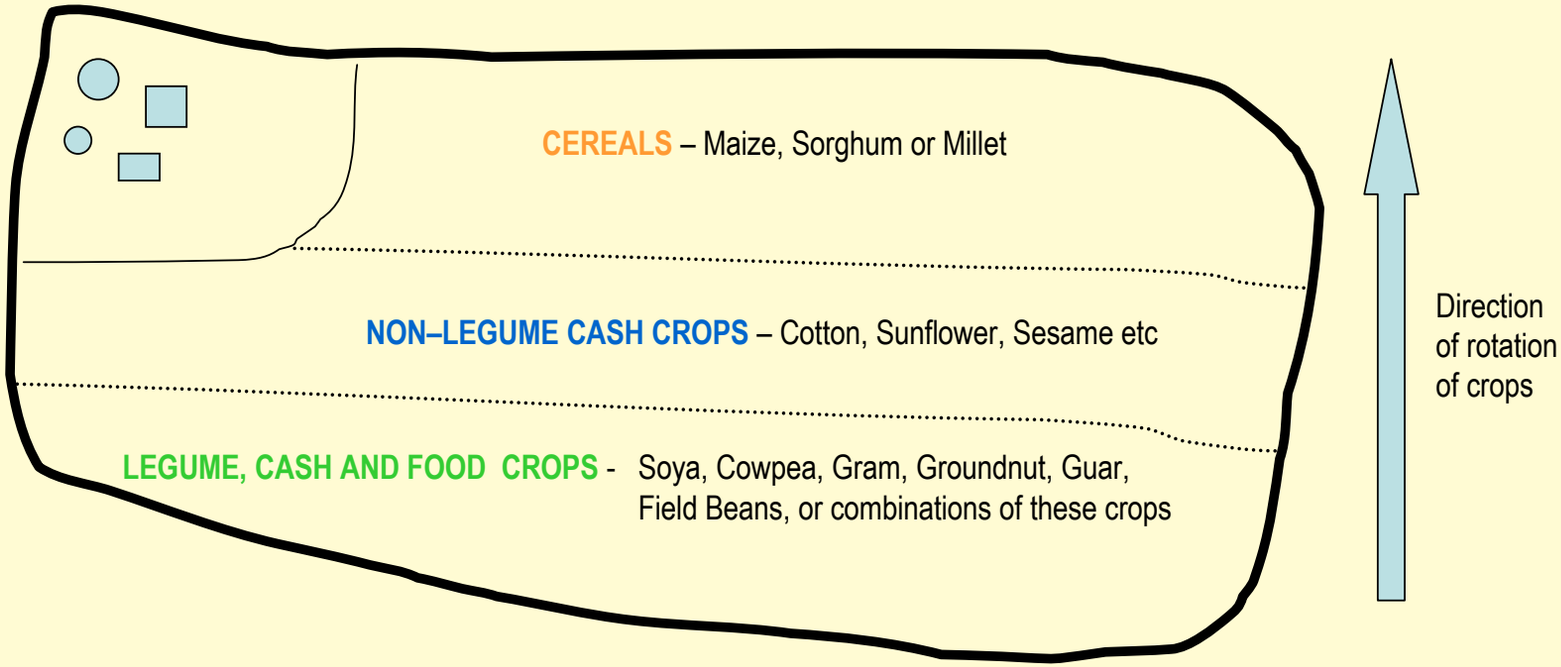
F.2 Strip Crop Rotations

Strip crop rotations are where each crop occupies at least **4 rows** or more. The crop combinations will depend upon the location and whether the farmer grows cotton. It is no use recommending Cowpeas and dwarf Pigeon peas to farmers if they do not have a Knapsack or ULV sprayer. Both these crops are susceptible to aphids and pod borers. Gram, Groundnuts and Soya Beans are less susceptible. If the farmer grows Cowpeas, a minimum of 2 applications of synthetic pyrethroid will be required, the first at flower initiation and the second 3 weeks after this. Farmers without sprayers will not achieve good seed yields. The contribution of legumes through improving soil fertility, household food security and nutrition cannot be over emphasised. CF farmers should have at least **30% of their cropped area planted to legumes** each season.

Flowering and early podding stage is when Cowpeas are usually attacked by pests.

F3 Planning Your Conservation Farming Rotation

Give some thought to planning your rotation and if you are a beginner start small so you get it right first time. Divide your home field into approximately 3 equal sized fields as shown in the diagram below.



Next year:

- the Cereals will be planted in the field occupied in the diagram by the Legume, Cash and Food Crops
- the Non-Legume Cash Crops will be planted in the Cereals field
- the Legumes will be planted in the field occupied by Non-Legume cash crops

Following year:

- the Cereals will be planted in the field occupied in the diagram by the Non-Legume Cash Crops
- the Non-Legume Cash Crops will be planted in the Legumes, Cash and Food Crops field
- the Legumes will be planted in the field occupied by Cereals

In the **fourth year**, the position of the crops returns to that shown in the diagram above and the cycle begins again

A good stand of Lutembwe Cowpeas in a CF rotation with Maize. Because Cowpeas are susceptible to aphid and pod boring maruca, they are more suited to cotton farmers who have sprayers. Cowpea and Gram are very drought resistant and will produce a crop even when Maize has failed.

Two Course Rotations

An excellent crop of CF planted Green Gram alongside Maize. Gram is less susceptible to pests than Cowpea. If gram, or improved Cowpeas, are planted before 7th December, the first crop can be harvested in mid-February and a second crop can be planted that will produce relish and some extra seed.

Typical Three Course Rotations

G. Intercropping and CF (Often Called Cover-Cropping)

1 Row Maize + 1 Row Cowpea

Cowpeas are sown immediately the Maize is sown or after the first **early** weeding about 10 -12 days after the Maize is sown. The Cowpeas **smother weeds, reduce labour for weeding**, **fix Nitrogen and provide some early protein**. Cowpea yields will, however, be relatively low at 250-500kg/ha due to competition from the Maize. Maize yield is not affected. The following year the rows are switched.

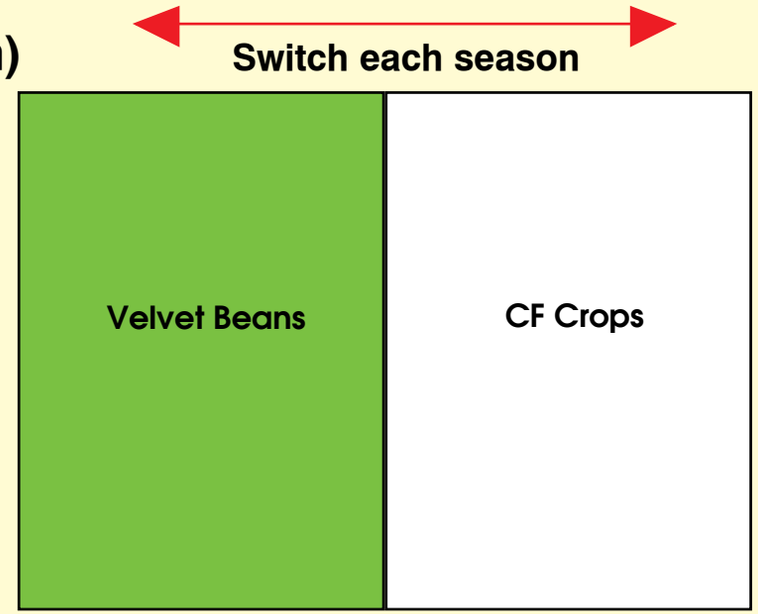
Cowpea Under-Sown to Full Maize Stand

Cowpeas are sown under a **full** Maize stand about 10 days after sowing Maize. Labour for weeding is **reduced** but the Cowpea yield is low due to severe competition from the Maize. This option is best suited to situations where **land is a limiting factor** – very small farms.

If Cowpea is sown later than 2 weeks after the Maize, the Cowpea will be overshadowed by the Maize and produce very little. Research shows that Cowpeas can fix over **50kgs of Nitrogen/ha**.

Intercropping is uncommon in Zambia except in Agro-ecological Region III where Maize is often intercropped haphazardly with beans. In other Regions farmers will fill gaps in the Maize with Pumpkins, Okra and patches of indeterminate Cowpeas. Intercropping is a good choice for women who farm their own gardens

H. Fallow Cropping and CF (Low Fertiliser Input System)



Where hoe farmers have spare land they are **not utilising,** Velvet Bean *(Mucuna pruriens)* is the best fallow crop choice. Velvet beans are extremely vigorous and smother weeds very effectively. Velvet beans also fix **over 100kgs** of Nitrogen/ha for successive crops. This is very valuable.

Planting Velvet Beans: Plant as soon as possible before weeds establish. Dig small holes at approximately 90cms x 70cms spacing after some rain. **Sow 3 seeds** in each hole and cover with **5cms** of soil. Seed rate is **50 to 60kgs/ha**. **Planting can be done very quickly and easily.**

I. The Importance of Early Planting – The Nitrogen Flush

The importance of **early planting** of all crops cannot be over emphasised. CF farmers who have completed land preparation in the dry season but fail to plant immediately after the first planting rains have missed out on one of the most important benefits of CF.

This Maize plant grew from a seed left in the soil after the previous harvest. It has not received any fertiliser but **look at the cobs!** This happened because the plant emerged with the first rains and benefited from Nitrogen released by soil microbes. **This is called the Nitrogen Flush.**

The things we ignore are often the most obvious! In this case, it is nature's message.

What CF farmers should do if availability of fertiliser is delayed.

If the distribution of fertiliser is delayed, the farmer should not wait, he should plant his own Maize with the first planting rains (even if it is recycled Maize), top dress it with D Compound immediately it is available and then use his Urea for later top dressing. **(Refer back to Step 13 – Top Dressing Maize).**

EXAMPLE: THE COST OF LATE PLANTING MAIZE – FARMERS EXPECTED YIELD 4 TONS/HA.

Fertiliser costs **ZMK 120,000/bag**. The farmer applies for his subsidised fertiliser which comes 15 days after the first planting rains. **He only pays ZMK 60,000/bag for 8 bags so he is happy because he has saved ZMK 480,000.** But because he planted 15 days late he lost 22.5% of his Maize yield or 900kgs, which is worth **ZMK 684,000**.

J. Some Common Mistakes and Misunderstandings About CT/CF

J.1 Minimum Tillage Means More Weeds

People who make this claim have not studied smallholder tillage systems. Farmers who have lost their oxen and have converted to handhoe Minimum Tillage will complain about the extra work required to weed. This is because they no longer have oxen and have to do the weeding by hoe. Ox farmers who have converted to CF using the Magoye Ripper do not have a problem because they can still weed using cultivators. The argument cannot be applied to handhoe farmers either because, with the exception of Eastern Province, MT is the system over 90% of farmers have always used, so no comparison can be made. Weeds are a problem, but **for everyone**, no matter what practice is followed.

J.2 Planting Without Back-Filling

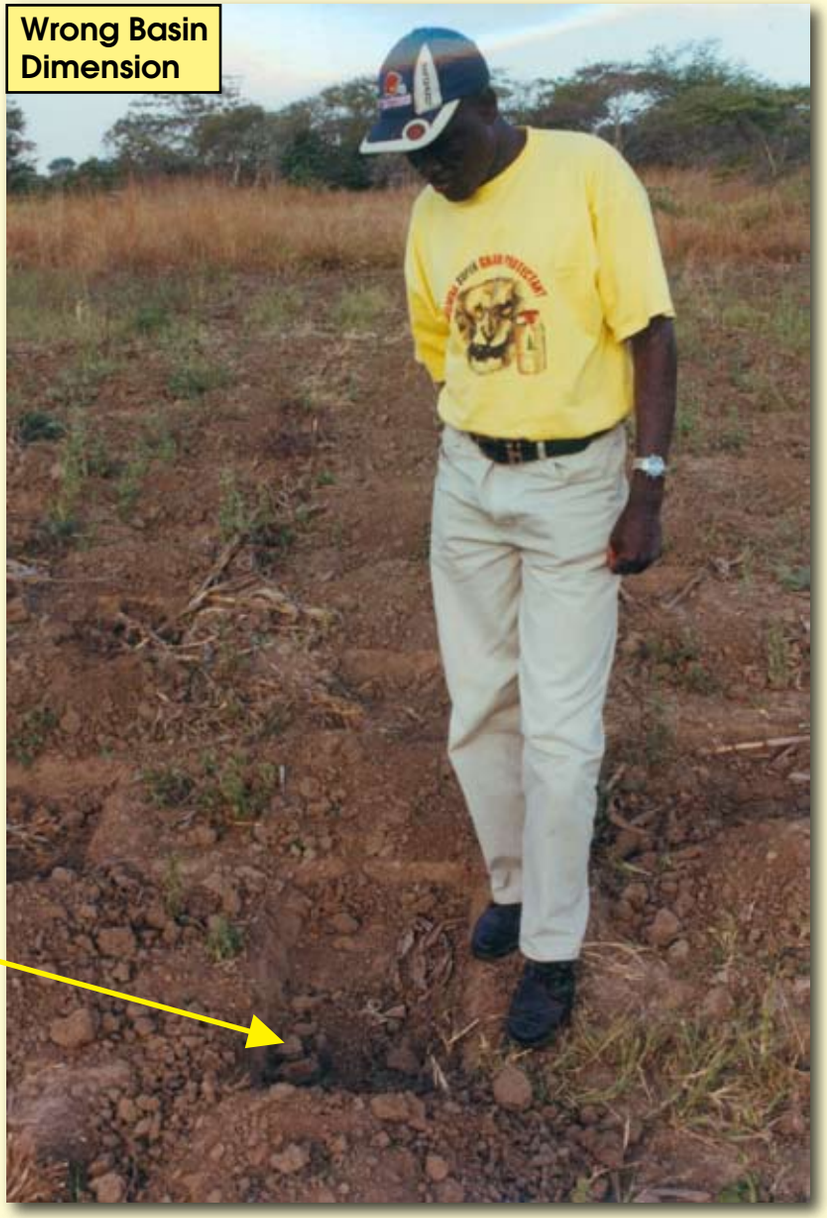
Back-filling the planting basins before sowing is **essentia**l, otherwise poor emergence and water logging will occur when rainfall is continuous. Cotton is particularly susceptible.

J.3 Pot-Holes

Pot-holes are not the same as planting basins or planting holes. Pot-holes are dug in the inter-row after the rains have started. Their purpose is to capture extra rainfall.

Maize was planted close to the bottom of the basin without back-filling. After heavy rain, water is left standing around the seedlings. The farmer has been badly advised by field staff and his crop will suffer.

If field staff do not know what they are doing, they should keep away from farmers. Farmers should not be expected to pay for the consequences of bad advice.



J.4 Digging Basins the Wrong Size and at the Wrong Spacing

Field staff from a well known NGO advised this farmer to dig huge shallow basins. The basins are too shallow to break any plough pans and they took the farmer twice as long to dig. The spacing is also far too wide because a Teren rope has not been used. The farmer's time and energy has been wasted and the results will be poor. This NGO should get it right!

J.5 Minimum Tillage and Conservation Tillage

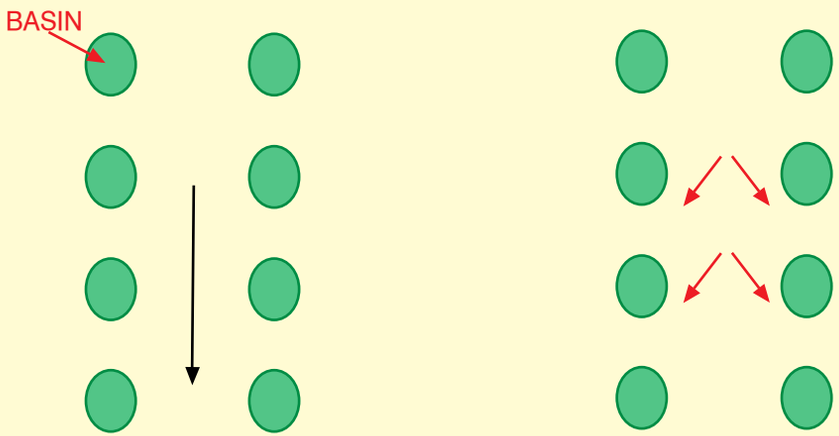

Scratching Planting Lines After the Rains Have Begun

Minimum Tillage is a method of planting that has been practised for centuries in Zambia. Farmers burn off residues wait for the rains, then dig planting holes. Cereals are planted first, then gaps are filled with Cowpeas, Beans, Pumpkins and Okra. Minimum Tillage is easy to do, saves labour and lets farmers plant quickly with the first rains. However these are the only benefits. The soil between the holes will be hard and bare and precious rainfall will run off taking top soil with it. **Minimum Tillage is not Conservation Tillage.**

Scratching lines with the edge of a hoe as seen in the **photo on the left** or dragging a hoe to scratch planting lines after the rains have come as the children are doing in the **photo on the right** are relatively new variants adopted by farmers with the introduction of Cotton.

J.6 Adapting CF to Wet Seasons and Dry Seasons

In dry seasons, farmers should weed straight down the inter-rows. In very wet seasons farmers should weed towards the crop rows to make sure the basins are not hollow.



Dry season weeding action:
Hoe down the inter-row.

Wet season weeding action:
Hoe towards the crop rows to make small ridges.

Remember to always work backwards when weeding to prevent "transplanting" the weeds by walking on them and pushing them back into the soil.

J.7 Digging Basins Down the Slope

The farmer in the photograph has kept residues and dug good basins at the correct spacing. Unfortunately, the field staff has forgotten to advise her to dig the basins **across the slope**. This is a fundamental mistake as the rains will wash the soil down the slope. This is not CF.

Basins should be dug across <u>not</u> down the slope

J.8 The Need for Continuous Weeding

The need for continuous weeding even after the crop is physiologically mature, or in the case of early maturing legumes, even after the crop is harvested, is the most difficult concept to get across to farmers. In Central Africa, the Harvest Festival starts as soon as the crops are off the ground and thanksgiving often doesn't finish until November, when the first rains threaten. This is a pity because more productive farming requires steady work throughout the year. Marathon festivals that last from June until October are not recommended if you want to adopt CF!

These late weeds have already shed thousands of seeds and will make extra work for the farmer next year. CF farmers who have weeded continuously have noticed a substantial decline in their weeding requirement by year 3.

For crops like Sunflower and legumes that are sown during the first fortnight of December, the first weeding may have to be done before planting.

K. From Conservation Farming to Conservation Agriculture

Farmers must prepare themselves for a rapidly changing world. They must be ready to face new challenges and be in a position to take advantage of new opportunities.

According to most experts, the days of cheap oil are over. Increasing oil prices have a knock on effect and increase the cost of most goods and services. For farmers, the cost of transport, fertilisers, seeds and equipment have risen steeply in recent years. Nowadays only the most efficient CF farmers can make a profit growing Maize and few farmers can afford to purchase the fertiliser required to grow it.

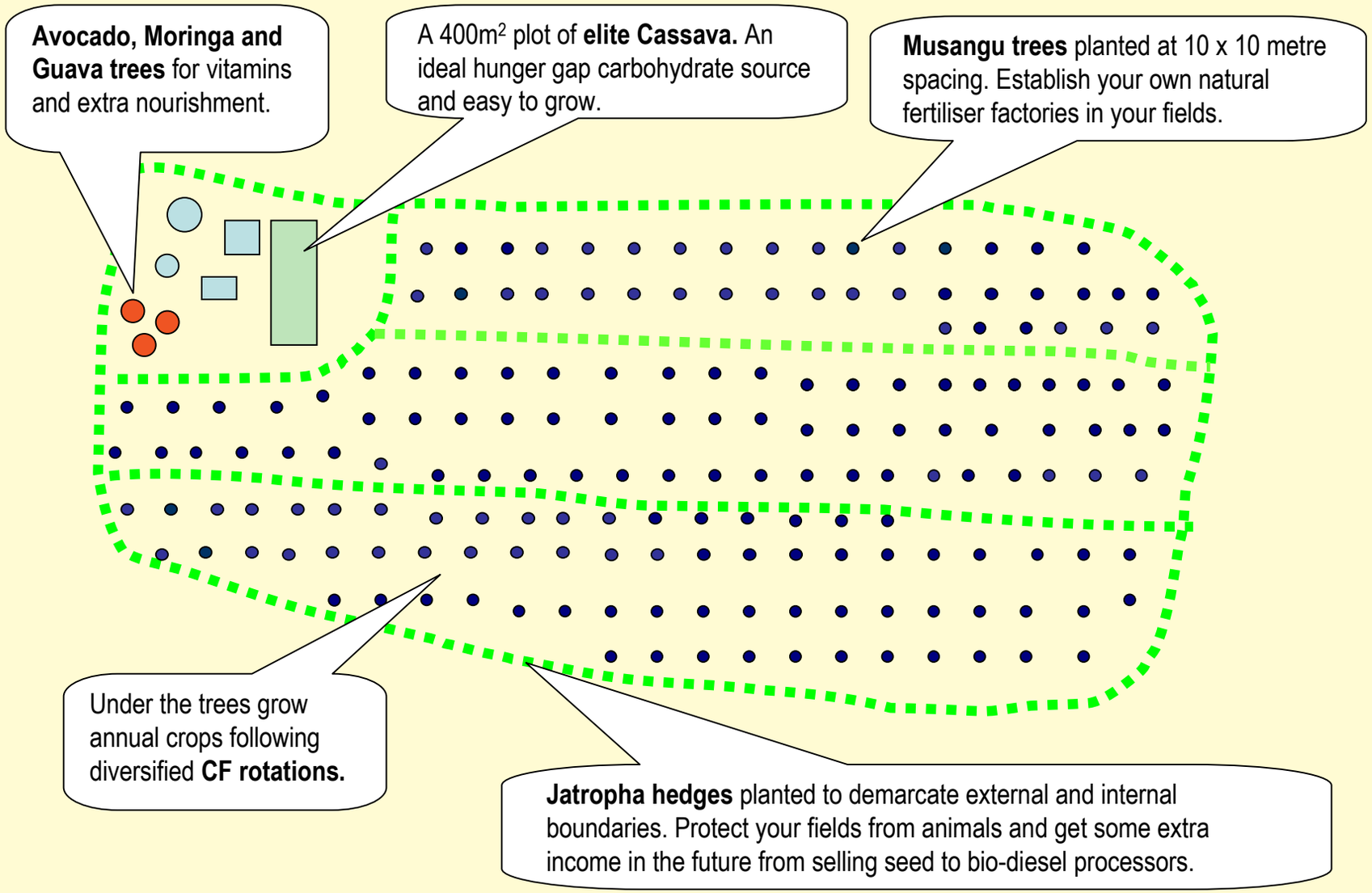
Fertiliser Price Trends US$ Per Ton Lusaka

Year	2001	2002	2003	2004	2005	2006	2007
Urea	295	285	315	385	**455**	**530**	**600**
D Compound	295	295	315	390	**400**	**510**	**600**

If you are already a Conservation Farmer now is the time to graduate to Conservation Agriculture, in order to:

- Insulate your family from hunger by growing annual and perennial crops;
- Liberate yourself from excessive reliance on costly fertilisers;
- Protect your most important asset – your land;
- Harness the power of nature to improve your soils and the environment in which you live; and
- Become a real farmer and husband your land rather than exploiting it.

From Conservation Farming to Conservation Agriculture



K.1 Musangu – *Faidherbia albida:*
Minimise reliance on bag fertiliser, reduce costs and increase soil fertility

Notice how much greener the young maize is under the Musangu canopy which can reach over 20 metres in diameter.

7 year old Musangu trees established over CF fields at Golden Valley Agricultural Research Trust.

Musangu is a **very deep rooting**, indigenous, leguminous tree that has the unique property of shedding its leaves during the rains. The extraordinary benefits of this tree have been known for many years and in many countries in West Africa it is an offence to cut it down and traditional leaders encourage farmers to plant it. In Malawi, research shows that mature trees support **increased Maize yields of 250% without the addition of any fertiliser**. Similar yield increases for Millet and Sorghum, and increases in cereal **grain protein,** are reported from many countries.

Through leaf and pod fall, nitrogen fixation and association with soil micro-organisms, fertility accumulation under the canopy is reported as follows: **75kg N, 27kg P_20_5, 183kg CaO, 39kg MgO, 19kg K_2O, and 20kg S**. This is equivalent to **300kg of complete fertiliser and 250kg of Lime** worth at least $330 today and provides the recommended nutrient requirement for a **4 ton Maize crop!**

Obtain CFU's ***Information Leaflet 1 – How to Plant and Look After Musangu*** for more information.

K.2 Cassava: An excellent food security standby crop

Advantages of Cassava

- Minimal Cash input.
- Highly **drought tolerant** and grows better on poor soils.
- Low and flexible labour requirement.
- Stored in ground and harvested as needed.
- Produces substantial staple food in hunger periods.
- A perennial crop easily propagated on the farm.
- Growing potential as a cash crop.

New varieties mature much earlier, out yield traditional varieties threefold, and are pest and disease resistant.

The so called **Lean Season between September and May** is a very difficult time for many families. November to February is particularly difficult because it is the busiest time of the year for farmers and food stocks are at their lowest. Money has to be found to buy uniforms and school books for children. Farmers are often forced to abandon their own fields and work for neighbours in exchange for food, make charcoal, trade on the roadside or borrow money locally at exorbitant interest rates.

When the **Maize harvest** comes they are no better off as they have to **sell their crop when prices are at their lowest** to pay off accumulated debts or purchase much needed items.

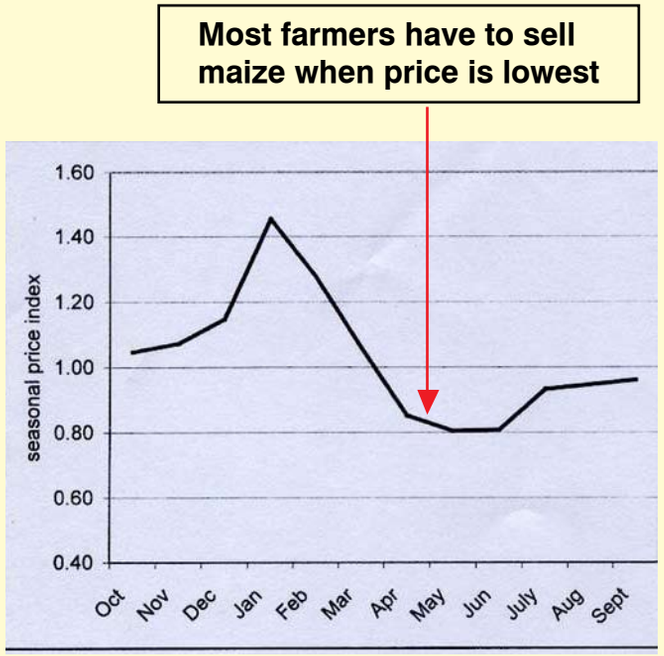
The table below illustrates the potential of the **new** Cassava varieties. Even when harvested at 12 months, the crop provides the calorific equivalent of a 3.3 ton Maize crop, well above the national average yield.

Performance of Mweru Sweet Cassava Variety

Planting Date	Harvest Date – Yield Tons/ha		
	12 months	15 months	24 months
December	10	22	33
January	8	17	26

Source AIS Cassava trials – Barratt et al. 2005

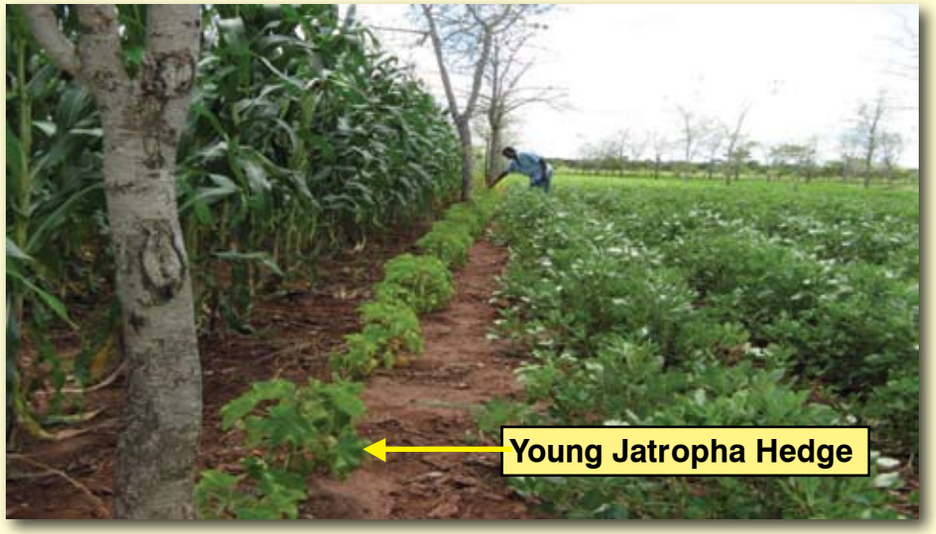
Farmers who grow Cassava as a food reserve have the opportunity to store their Maize and sell it when the price is higher because they are food secure.



The conclusion arrived at by researchers from trials undertaken in Central Region and case studies of experienced growers, is that a typical family of 5 would only have to harvest about 200-300 square metres of mature Cassava each year to ensure lean season staple food supply.

Obtain CFU's ***Information Leaflet 3 – How to Plant Cassava Gardens for Food Security*** for more information.

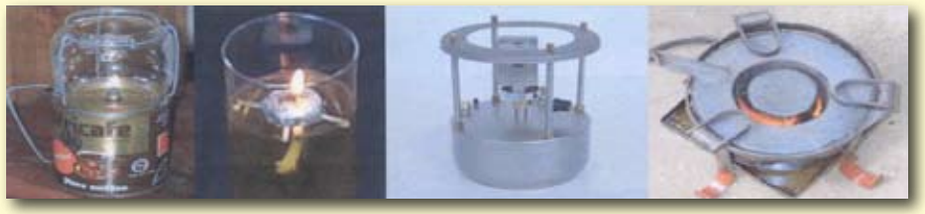
K.3 Jatropha - *Jatropha curacas:* An ideal live fence to protect fields



Jatropha is easy to establish from seed or cuttings. The plants are **not browsed by livestock** and when planted close together at 0.25m to 0.3m spacing **make an impenetrable hedge** around fields.

After crushing, the remaining cake is rich in NPK and, as an organic fertiliser, has the equivalent nutrient value of chicken manure. It must not be fed to livestock as it is poisonous.

Seed contains 30% flammable bio-oil. Do not eat!



The crude oil from the seed burns without emitting smoke and can be used in **easily modified lamps and stoves.**

Because of escalating mineral oil prices, Jatropha has a promising future as a source of bio-diesel which is made by trans-esterification of the crude oil. In the mean time, farmers should plant it **as a protective hedge so it does not occupy productive land**. This way they will, in the near future, be in a position to supply seed to bio-diesel processors with little or no risk to themselves.

Obtain CFU's ***Information Leaflet 2 – How to Plant and Look After Jatropha Hedges*** for more information.

L. Conservation Farming – The Results

Farmers who adopt CF will experience immediate, medium and long term benefits. Crop yields will double in the first year. In seasons of poor rainfall, the farmer will still get a reasonable harvest. In the medium term, the fertility of the soil will improve, weed populations will decline, and the farmer will be able to make more money from cash crops, such as Cotton, Soya Beans, Groundnuts and Sunflower.

Because CF increases yields so dramatically, farmers can reduce the area they crop, and cope with weeding and other critical tasks on time. CF enables farmers to intensify their production. CF benefits the environment because the same land can be farmed for generations. CF farmers do not have to migrate and cut down virgin forests because they have exhausted the land. CF does not rely on destructively exploiting nature.

Results of independent trials show that in Zambia, CF alone increases **Maize yields by at least 75% and cotton yields by 60%**. It has equally dramatic results on practically all annual rain-fed crops. **The immediate benefits arise from:**

Early planting, more accurate placement of seed and fertilisers, rainwater harvesting, rapid and even crop emergence, early and continuous weeding, nitrogen fixation and improvements in soil fertility.

M. CF, CA and Climate Change

Throughout the world these days there is much concern about the threat of **CLIMATE CHANGE**. CF and CA provide farmers with practical solutions to minimise the effects of erratic rainfall and droughts.

The two photos above show the benefits of CF in a drought year. They were taken in Monze West on **22nd January 2003**. Rainfall at this time was **40% below average**. Southern Province was classified as a disaster area and the WFP food relief programme was in full swing. This CF farmer is a widow who does all the work with her two children aged 12 and 15 years. **She produced excellent crops**.

2004/5 was declared a drought year and food relief was distributed in many areas by WFP and NGOs.

Rainfall Chibombo District 2004/5 Season

Month	Oct	Nov	Dec	Jan	Feb	March	Total
2004/5 Rain (mm)	15.0	94.0	304.0	245.0	71.0	31.0	760.0
Average Rain (mm)	22.0	79.0	177.0	212.0	163.0	157.0	810.0

February Rainfall: **57%** below normal. **March Rainfall**: **80%** below normal

Chibombo District Conventional Farming

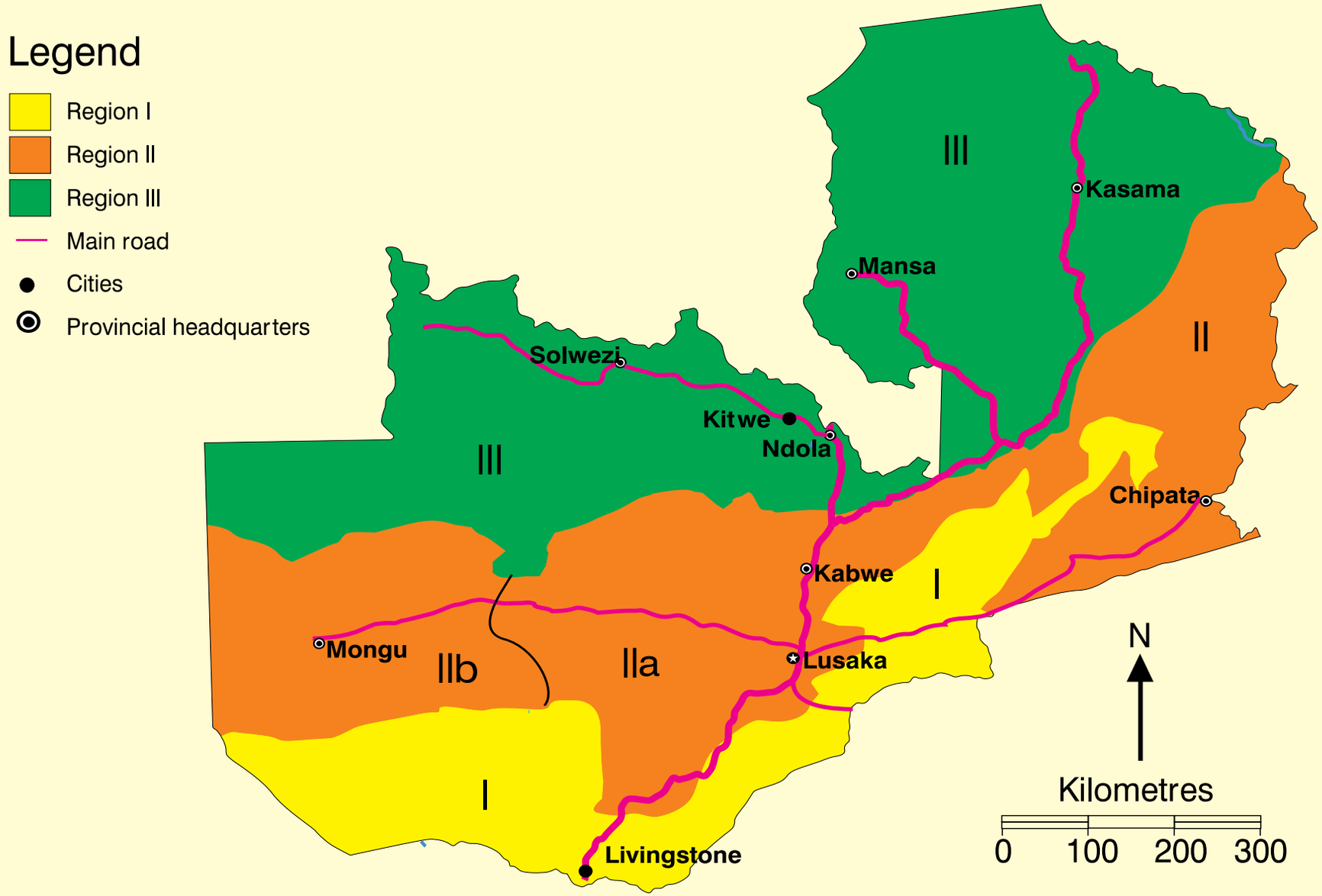
16th March 2005 – Yield Zero. Another food relief candidate?

Chibombo District Conservation Farming

January 25th 2005 - CF Hoe Farmer. Excellent Crops

In drier years, CF farmers benefit from earlier planting, rainwater harvesting, more fertile soils and better management

N. Zambia's Main Agro-Ecological Regions



Zambia

Latitude

10° to 18° South

Region I

Luangwa and Zambezi Rift Valley areas, comprising 14% of the land area. Mainly difficult solonitzic soils and unpredictable rainfall, <800mm, with recurrent droughts and floods. Summer (rainy season) temperatures can exceed 38°C.

Region II (Zone IIa)

The Central and Eastern plateaus of Zambia, comprising 28% of the land area. Contains the most fertile soils in the country. Rainfall ranges from 800 - 1,000mm with summer temperatures ranging from 20 - 33°C.

Region II (Zone IIb)

The semi-arid plains of Western province, comprising 12% of the land area. Sandy and alluvial soils. Rainfall >800mm.

Region III

The northern parts of Zambia, comprising 46% of the land area. Acid leached soils of relatively low fertility predominate. Rainfall is above 1,200mm, with summer temperatures ranging from 18 - 30°C and extended cloudy periods.

Conservation Farming practices can benefit many farmers, well beyond the boundaries of Zambia

O. Improving Your Knowledge

Keep abreast of new ideas and methods by reading more about what is happening in the farming world. Below are some useful publications. Look out for new ones as well.

CF Handbook for Ox Farmers in Agro-Region I & IIa - CFU

CF Handbook for Hoe Farmers in Agro-Region I & IIa - CFU

CF Handbook for Hoe Farmers in Agro-Region III - CFU

CF Laminated Technical Guides for Farmers, 10 different CF & CA subjects – CFU

The GART Yearbook – GART

How to use the Magoye Ripper – GART

The Farmers Gazette – Monthly Magazine

The Zambian Farmer - Monthly Magazine

ISBN 978 - 9982 - 52 - 0003

NEW HORIZON FRINTING FRESS

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