

**Conservation Farming & Conservation Agriculture
Handbook for Ox Farmers in Agro-Ecological
Regions I & IIa
2007 Edition**



Conservation Farming Unit



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Conservation Farming Handbook for Ox Farmers in Agro-Ecological Regions I & IIa

FOREWORD

This Handbook is for ox farmers who farm in Agro-ecological Regions I & IIa. Farmers who follow the recommendations in this book will increase crop yields, reduce production costs and improve the fertility of their soils. They will also be in a better position to confront the threat of **climate change** and will **regenerate the environments in which they live**. The farming systems recommended are practical and can be easily understood and adopted by all serious farmers.

Farmers may belong to groups or associations to learn new ideas, grow specific crops, receive inputs or market their products. But when it comes to preparing their land, planting and tending their crops, they and their families are alone in their fields with nobody to advise them. To achieve good results, farmers must know what to do long before the arrival of the first clouds on the horizon. First and foremost, farming is about technique, doing the job properly and at the right time. After all, if farmers cannot even produce enough to feed their families, even after a perfect season like the one we experienced in 2005/6, what is the use of belonging to a group or association other than to receive food relief?

This handbook is dedicated to Gudbrand Stuve.

Peter Aagaard
CFU Lusaka, Zambia, July 2007

Our sincere appreciation to the Norwegian Government for supporting CF in Zambia since 1996.

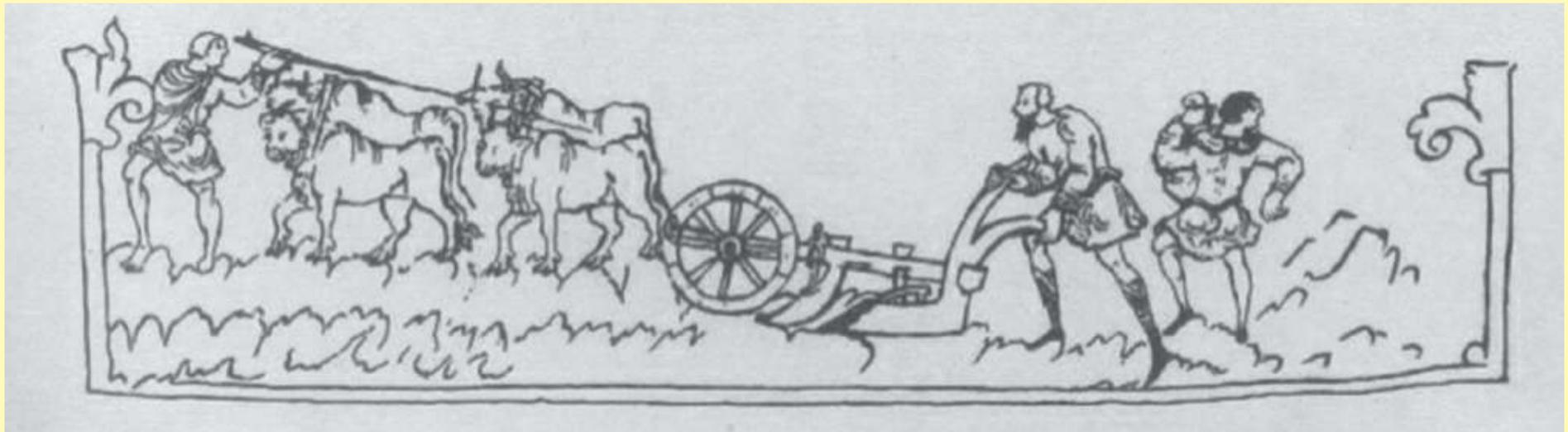


INTRODUCTION

Practically all ox farmers in Zambia plough their fields at the onset of the rains like their fathers and grandfathers before them. Even the many thousands of farmers who have lost their oxen from Corridor and other cattle diseases wait until they can hire or borrow animals from their neighbours to plough. Ploughing is a tradition so farmers accept it without question. If you asked any Zambian farmer that you found ploughing his fields why he was doing so, he would assume that you were extremely ignorant.

However, if you went to Brazil, or Argentina, or America, where over 40 million hectares of land are cropped without ploughing and asked why ploughs were not used, you would also be considered extremely ignorant.

In Zambia, the plough was introduced in about 1900 and since then its design has not changed at all. If, by performing a miracle you brought a farmer from those days back to life today, he would be confronted by all sorts of things he wouldn't recognise: modern vehicles and tractors, knapsack sprayers, fertilisers, chemicals, computers, radios, fridges and mobile phones. He would be extremely confused and nervous until suddenly recognising something from his distant past, he would smile and feel comforted – **'Ah yes, this is a plough'**.



Indeed, if you brought these **English peasants** back to life from **1005 years ago**, the only farm equipment they would recognise would also be the plough. And if you explained to these farmers that the world was in fact round and not flat, and that they would not fall off its edge at Shangombo, they would wish to reverse your miracle so they could take you back to their time and burn you at the stake for witchery! **Old conventions die hard.**



A. CONVENTIONAL FARMING OR PLOUGHING – THE PROBLEMS IT CAUSES

A.1 Burning Residues



2

These farmers, like many thousands in Zambia, are destroying a valuable resource and also wasting their time.

Traditionally, farmers rake up and burn residues at the end of the dry season, so the soil is completely bare. **Don't burn.** Residues improve rain infiltration, and protect the soils from erosion and capping during heavy rainfall. Termites and other micro-organisms incorporate residues into the soil improving its structure and fertility.



A.2 Ploughing – The Results



Notice the sheet erosion.



Notice the woman behind, seeding every 3rd furrow.

3

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, up to **1.5%** of potential 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%** of it may be washed away. Sowing seeds in the plough furrow leads to **uneven emergence** because some seeds will be planted 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.

Immediate Effects: Ploughing 18 days after the first planting rains, as 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 about 15cms below the surface (often called panning).



A.2.1 Late Planting and the Spread of Competitive Weeds

4



Hired Animals: This farmer paid **ZMK250,000** for each hectare ploughed. Because the owner of the oxen was busy himself, the job was not done until late December. The crops failed completely and all the farmer's money was wasted. Farmers who have lost their oxen to Corridor or other cattle diseases, and hire or borrow animals to plough, suffer very low yields or complete crop failure in years of low rainfall and often have to rely on food relief.



Owned Animals: This farmer ploughed with his own animals. He was still late, but less so. However, years of ploughing have encouraged the spread of Kapinga (Couch grass), which is very competitive and hard to weed out. His maize yield was very poor. Kapinga often forces farmers to abandon their land altogether.



A.2.2 Restricted Root Development, Water-logging and Water Stress



The paler line of soil above the pencil line in the photo above is a **hard pan** caused by continuous soil disturbance from ploughing. Fine soil particles precipitate immediately above the undisturbed soil, block soil pores and produce an impervious layer that impedes drainage and root development leading to **water-logging in wet seasons and crop stress in dry seasons**.



This plant's tap root has failed to penetrate the pan so the secondary roots are restricted to occupying a **small area close to the surface**.



A.2.3 Land Degradation



6

In Southern Province, and many other parts of Zambia, continuous ploughing, Maize mono-cropping and the liberal use of acidifying fertilisers have degraded the land to a state where farming is no longer possible.

10cms of top soil has been lost from this land and the infertile subsoil is exposed. This is **1000 tons** of soil lost per hectare or 100 truck loads! Even weeds can hardly grow.

Before the mid 1970s, ploughing was less damaging because farmers followed rotations that included legumes, they ploughed on the 'contour' and used less fertiliser. Government policies to encourage small-holder Maize production across the length and breadth of Zambia soon changed this, and by the 1991/2 drought an aerial survey of Southern Province revealed that **95%** of farmland was cropped to Maize!

Thousands of farmers who have destroyed their soils have migrated to other Provinces where they cut down virgin forest, mine out the natural fertility and repeat the damage that forced them to move in the first place. Those who stayed behind are far more susceptible to droughts than previously because their soils have become infertile and compacted and they rely too heavily on Maize.



A.2.4 Lower Crop Yields, Less Profit and Total Crop Failure

As the diagram below shows, farmers who plough seldom get the results that they expect even if they are reasonably skilled, have access to fertiliser, farm soils that are fairly fertile and experience good rainfall.

Causes	Losses									5.5 tons	Expectation
Partially degraded soils. Acidic, compacted, oxidised	7%	■									50% LOSS
Inaccurate application of nutrients	5%		■								
Loss of rainwater. Intermittant moisture stress	10%			■							
Planting 15 days late	15%				■						
Inaccurate seeding. Poor plant population	5%					■					
Late and discontinuous weeding	10%						■			2.8 tons	Actual



The farmer in the table above applied **400kgs** of expensive fertiliser to his Maize and should have achieved a yield of over **5 tons** per hectare, but at harvest he only achieved **2.8 tons** per hectare. His bucket was half empty because it had too many leaks. Each leak was small but together they added up to a big leak!

This photo was taken on 31st March 2006 in Magoye. The 2005/6 rainy season was one of the **best on record**. Despite this, the crop has failed because this farmer had to wait until late December before she was able hire oxen to plough her field and her soils were already degraded from years of misuse. Instead of waiting to hire oxen, this farmer and her family should have adopted **hoe CF** and dug basins starting in May or June. They would have been better off if they had hired labour rather than oxen.



B. EXPLANATION OF THE DEFINITIONS OF DIFFERENT OX FARMING METHODS

B.1 Introduction

Below we highlight the definitions (words) that are commonly used to describe different farming systems.

- **What does Tillage mean?**
Tillage is the work a farmer does to prepare the land for planting. That is all the operations undertaken to prepare a seed bed so the seeds can germinate properly.
- **What does Cultivation mean?**
The word cultivation is generally used to describe all the work that is done after planting to keep the crop free of weeds.
- **What does Conventional Tillage mean?**
For farmers who own, hire or borrow oxen, it means ploughing or ploughing and harrowing. For farmers with tractors it can mean ploughing, or discing, or rotavating, or a combination of all three depending on the crops to be grown.
- **What does Minimum Tillage mean?**
Minimum Tillage means reducing tillage operations to the minimum required to plant a crop. For ox farmers it usually means ripping out the row where the crop is to be planted and leaving the rest of the land untouched until weeding is required. To do this, the farmer may use a plough with the mouldboard removed, or a **ripper** specially designed for the job.
- **What does Conservation Tillage (CT) mean?**
Conservation Tillage farmers **preserve any remaining residues**, and rip across the prevailing slope in the **dry season** so that they are ready to plant with the first planting rains.
- **What does Conservation Farming (CF) mean?**
Conservation farmers establish their crops using CT but they also grow legumes **in rotation** with other crops that fix nitrogen, improve fertility and provide protein for the family. CF farmers diversify production to reduce risks of crop failure and hunger.



B.2 Some Examples of Different Ox Farming Tillage Systems



Conventional Tillage: Residues burned first and whole field ploughed after the first rains.



Minimum Tillage: Residues burned first and planting furrows ripped out in the dry season or more often **after the first rains** using the Magoye Ripper.



Conservation Tillage: Residues preserved, and planting furrows ripped out in the dry season using the **Magoye Ripper**.



Cultivation: A farmer cultivating his cotton to kill weeds.



C. KEY CONSERVATION FARMING PRACTICES FOR OX FARMERS WHO USE RIPPERS

- The retention of crop residues (as opposed to the widespread practice of burning).
- Restricting tillage to the precise area where the crop is to be sown, i.e. only 10-12% of the surface area of the land is tilled (disturbed) to establish crops. Ripping instead of ploughing.
- The completion of land preparation in the dry season by ripping planting furrows across the prevailing slope at 0.9 metre spacing which are deep enough (at least 15cms) to fracture underlying hard pans and to capture moisture from the early rains.
- The measured application of inorganic and organic basal fertilisers and, if needed, lime to the planting furrows before the rainy season, and the seeding of the planting furrows immediately after the first planting rains.
- The establishment of rotations that include early maturing, nitrogen fixing, legumes which occupy at least 30% of the cropped land.
- Early ripping of the areas occupied by legume crops in March/April when the soils are still moist and easier to work so that a good portion of land preparation is completed well in advance of the oncoming rainy season.

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D. THE MAIN BENEFITS OF CONSERVATION FARMING

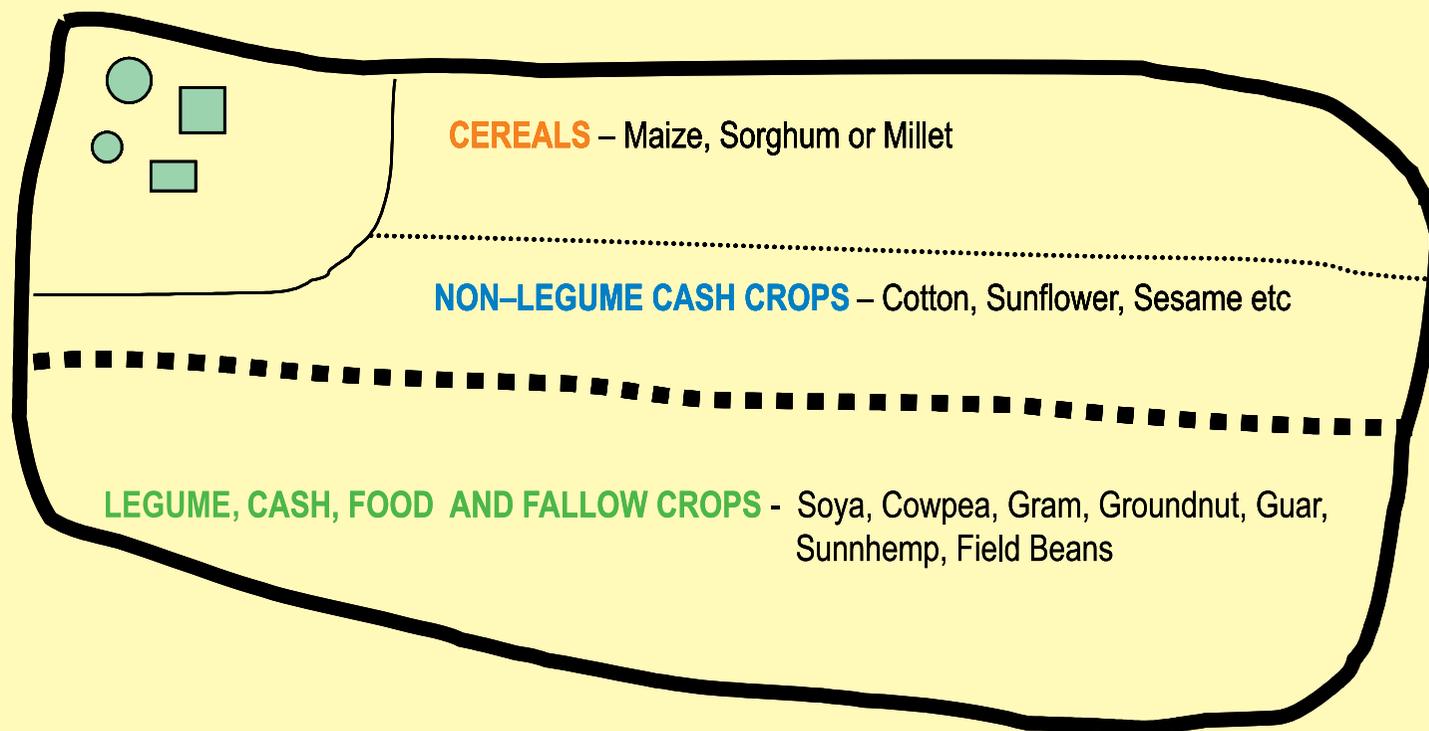
- Reduced soil erosion and better rainwater infiltration.
- Improved timeliness of land preparation.
- Farmers who rip can till at least three times the area in the same time than farmers who plough.
- Ability to calculate and plan requirements for basal inputs whether manure, fertiliser, lime or all of these.
- Ability to apply basal nutrients beneath seeds, where they are required.
- Ability to sow all seeds at the correct depth and spacing immediately after the first planting rains in a single operation.
- Rapid germination and even emergence of seeds leading to optimal plant population.
- Early rainwater harvesting in the furrow depressions.
- Fixation of atmospheric (free) nitrogen by leguminous plants for the benefit of other crops that follow in the rotation.
- Improved soil structure, soil fertility and eradication of pans enables crops to withstand seasonal droughts.
- Deeper rooting and larger root volumes for all plants increases uptake of water and nutrients from deeper layers.
- Crop diversification reduces risks of total crop failure and early maturing legumes provide a valuable source of food in the January/February hunger gap.
- Degraded soils are brought back to life enabling families to farm the same land for generations without the need to migrate.
- Exploitation of Zambia's agricultural resource base and the need for migration and tree felling are minimised.



E. ADOPTING CONSERVATION FARMING – THE MOST IMPORTANT STEPS

STEP 1 – PLANNING YOUR CONSERVATION FARMING ROTATION

Give some thought to planning your rotation and if you are a beginner **start small** so that you get it right first time. Divide your home field into approximately 2 equal sized fields. Subdivide one of the fields into 2 further equal sized fields.



2

Next year the Cereals and Non-Legume Cash Crops will be planted in the Legume field in 2 separate plots. The Legumes will be planted in the field occupied by Cereals (Maize) and Non-Legume cash crops.



STEP 1 – PLANNING YOUR CONSERVATION FARMING ROTATION

EXAMPLE OF CONSERVATION FARMING ROTATION – USING THE MAGOYE RIPPER



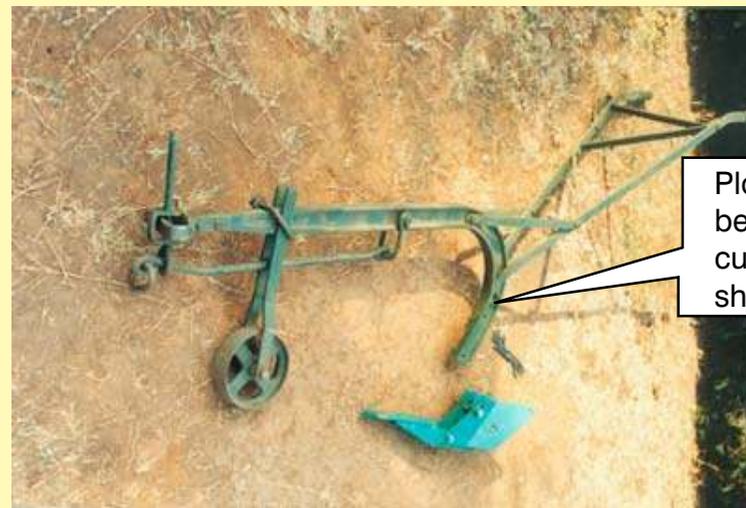
This CF farmer planted all of his **Legume field to Sunhemp** but depending on his location he could have planted it all to Soya Beans, or Cowpeas or divided it between two or three different legume crops, including Groundnuts.



STEP 2 – ATTACHING THE MAGOYE RIPPER TO YOUR PLOUGHBEAM



Remove plough or ridging body from plough beam.



Only plough beams with smoothly curved shanks are suitable for fitting the Magoye Ripper.

4



You can purchase a Magoye Ripper **with or without** detachable wings. These are used for weeding if you don't have a good cultivator.



Lay the plough beam on its back and fit the ripper tine body first.



STEP 2 – ATTACHING THE MAGOYE RIPPER TO YOUR PLOUGHBEAM

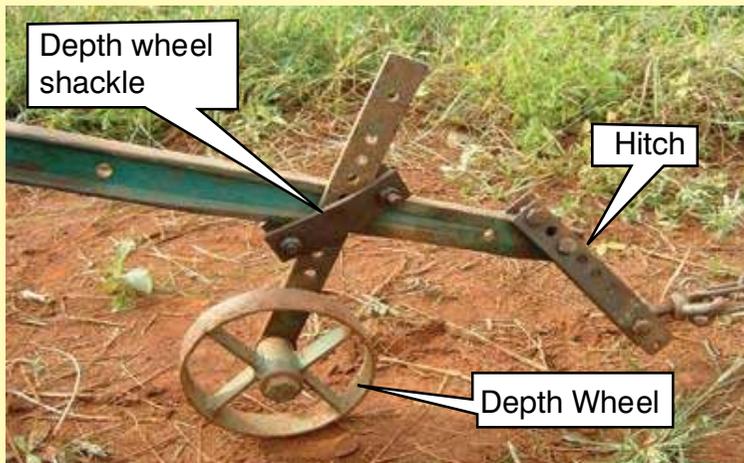


Attach the sub-wings to the ripper tine body. Always use the correct size spanner for the job!



Magoye Ripper correctly attached.

STEP 3 – CHECKING EQUIPMENT FOR EFFICIENT USE OF RIPPER



Make sure the **depth wheel** axle is not worn and the wheel rotates freely. Ensure **hitch bolts** are removable for easy adjustment. Large depth wheels are the best.



The **180cms** yoke is the right choice for **CF** ripping.

Check your yokes. Are the **necks carved** to make yokes more comfortable for the oxen? Are the skeis in good order? Does the larger yoke measure **180cms** between the centre of each neck skei?



STEP 3 – CHECKING EQUIPMENT FOR EFFICIENT USE OF RIPPER

Notice that the ring attachment in the yoke is off-set so it is in line with the angle of the chain. (The angle of draft or force).



3.5m Trek Chain

If you have to sharpen the tine with a flat file, sharpen the tine bevel at the original angle of a new tine.



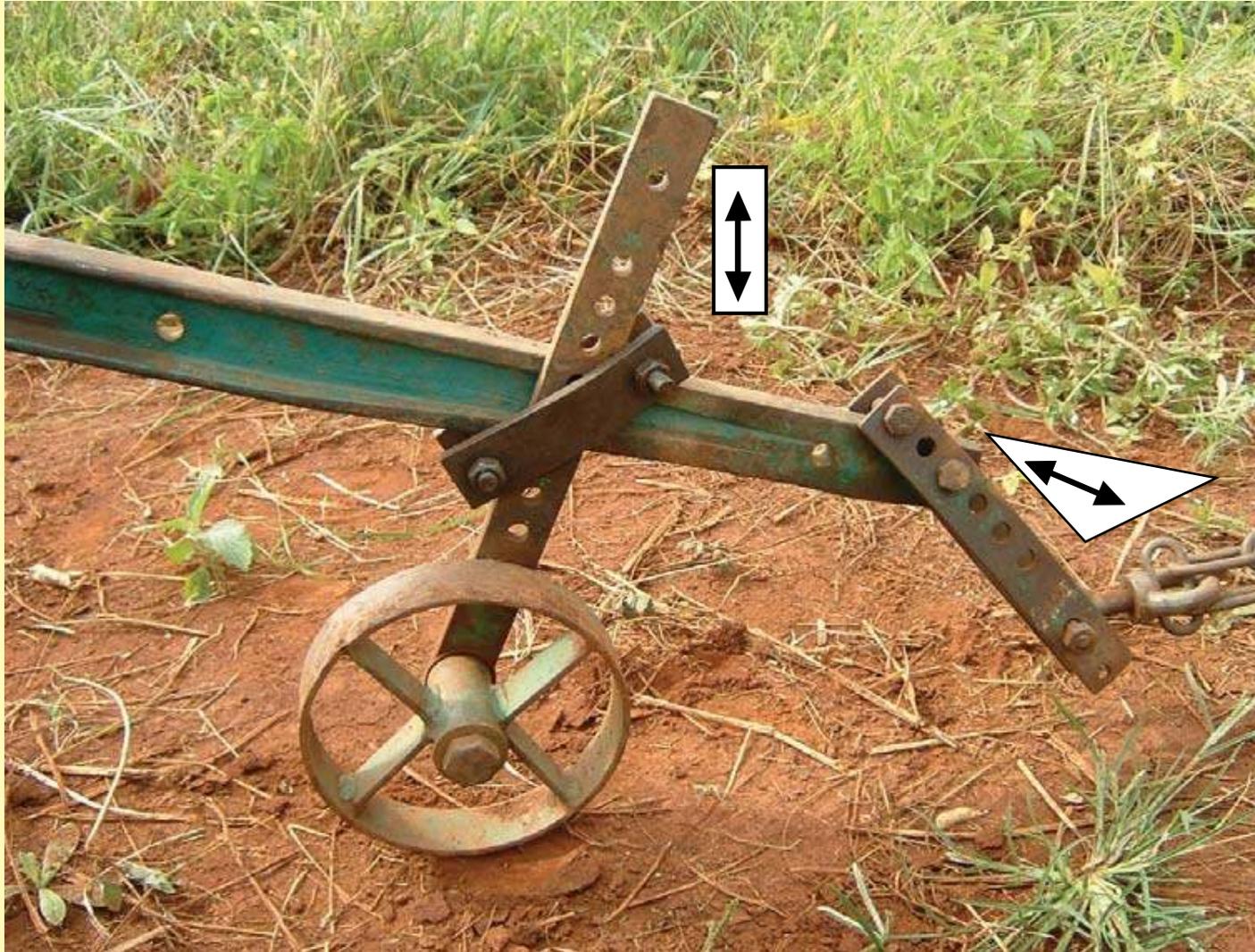
Bevel angle

Before starting, make sure that the ripper tine is **sharp** and not too worn down. If more than **5cms** of the cutting edge has worn down, undo the fastening bolts and reverse it. If the tine is made of good, hard steel, sharpening is impossible.

For correct ripping, a trek chain of 3.5 metres is required. As most trek chains are only 2.5 metres you will need to buy a second chain. Chains with **hooks** make attachment and length adjustment easier.



STEP 4 – SETTING UP THE MAGOYE RIPPER FOR CORRECT AND EFFICIENT RIPPING



Adjusting the Ripper to achieve the correct depth of about **15-20cms** while minimizing the work load for the oxen can only be achieved through **practise**. Three adjustments are available for the correct setup. **The level of the depth wheel, the angle of the chain hitch and the length of the trek chain**. Oxen vary in size and soils can be easy or hard to work so pre-fixed settings cannot be recommended.



STEP 5 – RIPPING FOR THE FIRST TIME

8



When you are adopting Conservation Farming for the first time you will have to rip in the dry season when the soils are hard. **Do not try to go deep.** Adjust the Ripper so it rips to **10cms depth only.** When the first showers come in October or early November these shallow rip lines will concentrate the rainfall and you can **rip through them again** to achieve the correct depth. Do this a day or two after the showers have gone.



DON'T do what these farmers are trying to do – deep ripping with 2 span of oxen in hard soils. Notice how the ploughman is struggling with the Ripper! Forcing is not farming.

For more information on using Magoye Rippers obtain the GART handbook ‘How to Use the Magoye Ripper’



STEP 6 – GETTING READY TO APPLY BASAL NUTRIENTS AND LIME



Accurate application of basal nutrients and lime is **more difficult** in planting furrows than in basins. A readily available measure in rural areas is the **100ml Vaseline jar**.



If, after secondary ripping, this rip line (planting furrow) is **20cms deep**, the index fingers will be touching the bottom of the furrow and the **wrist knuckle will be level with the field**.

Approximate Application Rates Using a 100ml Vaseline Jar – Practise with sand first.

Nutrient	100 kg/ha	200 kg/ha
D Compound	1 jar to 20 paces of furrow	1 jar to 10 paces of furrow
Lime	1 jar to 26 paces of furrow	1 jar to 13 paces of furrow
Urea	1 jar to 16 paces of furrow	1 jar to 8 paces of furrow
Manure	3 double handfuls for each pace of furrow is 4 scotch carts per ha	



STEP 7 – APPLYING BASAL NUTRIENTS AND LIME



Applying D Compound before the rains.



Covering D Compound



Applying D Compound and seeding in one operation after the rains have begun.

Applying D Compound, Lime or Manure accurately and quickly requires **teamwork**. Involve the family and make sure that everybody **knows what to do**. Lime and D Compound can be spread after each other into the furrow. Lime and manure can also be combined. Two people following each other will be needed. A third person following behind covers the inputs with a hoe leaving a depression of about **10cms**.

If your inputs are available it is best to complete this task with the **early showers after you have opened up the furrows again**. Planting should be done later immediately after proper planting rains when you can be sure that there is enough moisture to enable the plants to emerge. Some farmers may want to fertilise and plant in **one operation**, immediately after heavy rains.

If you have MANURE always use it, it is better than fertiliser. Do not spread it across the field, always apply it in the planting furrows.



STEP 8 – PLANTING SEEDS

Recommended Planting Dates

Cotton	Dry plant anytime after 1 st November
Maize, Sorghum, Millet	Plant immediately after heavy rains any time after 15 th November
Groundnuts, Sunflower	Plant immediately after heavy rains after cereals have been planted
Soya Beans, Cowpea, Gram, Guar	Plant immediately after heavy rains anytime before 15 th December
Red or Black Sunnhemp	Plant immediately after heavy rains anytime before 15 th December

Early planting of all crops is essential. With the exception of Cotton, always plant the day after heavy rains when you are confident that there is **already enough moisture** in the soil to **guarantee** rapid emergence of the crop.



COTTON: Sprinkle seed lightly down the row, **do not cover**.



MAIZE: Spacing is about **20cms**, or 4 to 5 seeds every pace.



STEP 8 – PLANTING SEEDS



GROUNDNUTS: Spacing is about **5cms**, or 12 to 14 seeds every pace.



SUNFLOWER: Spacing is about **5cms**, or 12 to 14 seeds every pace.

It is always worth taking great care when planting. If you have done all the preparatory work correctly and on time and then plant carelessly, you are like a person who has made a strong foundation for his house but builds his walls with mud blocks that are badly cured and collapse under the weight of the roof!



COWPEA, GRAM, GUAR: Spacing is about **7cms**, or 8 to 10 seeds for every pace.



STEP 8 – PLANTING SEEDS



RED SUNNHEMP: Sprinkle seeds lightly in furrow.



SOYA BEANS, SORGHUM: Spacing is about **5cms**, or 12 to 15 seeds for every pace.

STEP 9 – COVERING SEEDS

The best way to cover seeds is with a hoe although many ox farmers drag a branch across the furrows after planting to do this. Firming the soil down lightly with the foot will improve emergence. Remember that **Sunnhemp and Cotton should not be covered** and **Sunflower should never be planted deeper than 2cms**.



NEVER use a **Harrow** to cover seeds. The tines are too large and some seeds will be covered too deep and some will be brought to the surface.



Remember that Soya Bean seed must be treated with inoculant immediately before planting.



STEP 10 – THINNING AND GAPPING COTTON



Because fuzzy cotton seed sticks together, the seedlings emerge in **clumps with gaps in between**. Thinning and gapping is required to ensure spacing between individual plants is correct.



Thinning and gapping should be done carefully when the **seedlings are still very small** so that the roots are not disturbed. Always thin and gap **immediately after heavy rains**. After the job is done the space between individual plants should be **15 to 20cms**.



Gaps and low plant populations are a major cause of low yields in Cotton. Every space that should have been occupied by a Cotton plant is money lost. Also remember that the empty space was tilled and also has to be weeded!



STEP 10 – THINNING AND GAPPING COTTON



28

This is what you must aim for. Full stands of cleanly weeded CF Cotton. On the left established using the Magoye Ripper, and on the right using basins. These crops will yield between 1.5 and 2.0 tons of Cotton per hectare. CF is about being timely and precise.



STEP 11 – WEEDING



26

Early and repeated weeding of all crops is essential for achieving high yields. **Weeds are thieves.** They steal water, nutrients and sunlight from the crop. The first weeding when the crop is still small is best done by hoe.

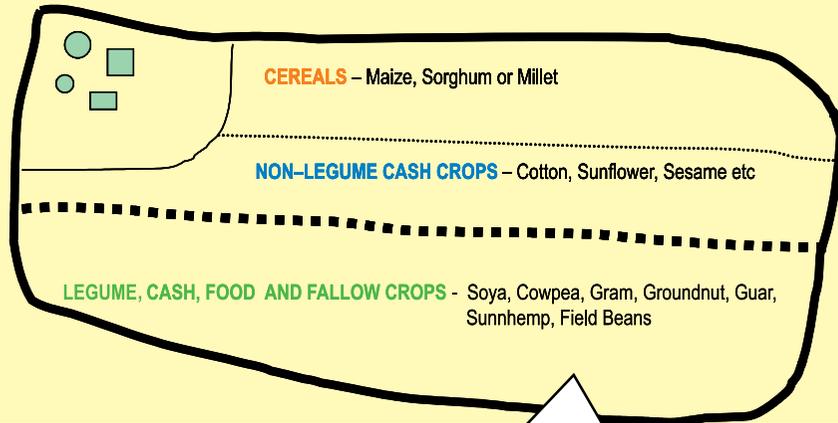


Farmers often abandon weeding when their crops mature. **This is a mistake** because each of these weeds will produce over 1000 seeds that will germinate in the following year!

← Experienced ox farmers advise that this is the best cultivator to use for weeding, with 1 duck foot tine at the back and 2 spoon tines in front.



STEP 12 – USING CF ROTATIONS FOR SUCCESSFUL EARLY RIPPING AND TIMELY PLANTING



If you planted any, or a combination of these legumes, you can now rip in March or April when the soil is still moist and easy to work . It is also easy to rip rows where Groundnuts have been harvested.



Ripping through **Sunnhemp** in late March.



Ripping through harvested **Cowpea** in late March.



Same field as above in early May showing Sunnhemp cut and windrowed between rip lines.



STEP 12 – USING CF ROTATIONS FOR SUCCESSFUL EARLY RIPPING AND TIMELY PLANTING



Ripping between mature **Soya Beans** in mid April. The Soya Beans can be harvested after ripping!



Before ripping through Soya Beans make sure that the crop is mature. The leaves should be **yellow and falling off** the plants and the youngest pods should have **full ripe seeds**. Don't wait too long or the pods may shatter.

Timing of ripping in standing legumes will depend on the planting date of the crop to be ripped and the length of the rains. Use your judgement. The soils should be quite hard but still moist underneath. The area you have ripped is **where you will plant your cereals and non legume cash crops next year**. All you have to do when the first showers come in October or November is to open up the furrows again, a quick and easy task for you and your oxen.



F. CONVINCING FARMERS TO ADOPT CONSERVATION FARMING

Farmers are generally stubborn people and prefer to continue following traditional methods. **The best people to convince farmers to adopt CF are farmers who have already done so.** The results will speak for themselves. Skilled conventional farmers with well trained oxen should always be the first choice to persuade. **Arrange field days on well managed adopters' farms and let the adopter do the talking!** Compare the results with conventional farming!



22nd January 2006, Mwachisompola – Ploughing.



22nd January 2006, Mwachisompola – CF Ripping with Rotation.

These farms are less than 1 kilometre apart. In 2005/6 the rainfall was almost perfect.



F. CONVINCING FARMERS TO ADOPT CONSERVATION FARMING

CLIMATE CHANGE – CF FARMERS ALWAYS DO BETTER, BUT PARTICULARLY IN A DROUGHT YEAR



16th March 2005, Mwachisompola – Ploughing. Yield of all crops was zero.



26th January 2005, Mwachisompola – CF Ripping with Rotation. Maize yield 7.0 tons/ha. Cotton Yield 2.4 tons/ha.

Rainfall Mwachisompola 2004/5 – A Drought Year

Month	Oct	Nov	Dec	Jan	Feb	March	Total
Rain days	3	5	13	16	6	3	46
Rain mm	15.0	94.0	304.0	245.0	71.0	31.0	760.0
Mean	22.0	79.0	177.0	212.0	163.0	157.0	810.0

Feb rain 57% below normal.
March rain 80% below normal.

The CF farmer wasn't affected by the drought!



G. CF ZERO TILLAGE WITH THE OX DRAWN FITARELLI PLANTER

Zero Tillage

A CF planting method where seeds are mechanically drilled directly into the soil in one pass without any preliminary tillage. Special tractor and ox drawn drills are required to do this. The Fitarelli animal drawn drill was designed in Brazil for this purpose and is used extensively by thousands of farmers.



The Fitarelli drill is an ideal tool for **more advanced farmers** who plant large areas. It is also ideal for **contract planting**. It can easily be drawn by 1 span of oxen and injects and covers basal fertiliser and seed in one pass.



Notice the dead weeds that were treated with **Roundup after planting but before the crop emerged** and which act as an 'in situ' mulch binding the soil and protecting it from erosion.

If you want to know where to purchase the Fitarelli and learn how to use it properly, contact the CFU.



H. 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	2002	2003	2004	2005	2006	2007
Urea	285	315	385	455	530	600
D Compound	295	315	390	400	510	600

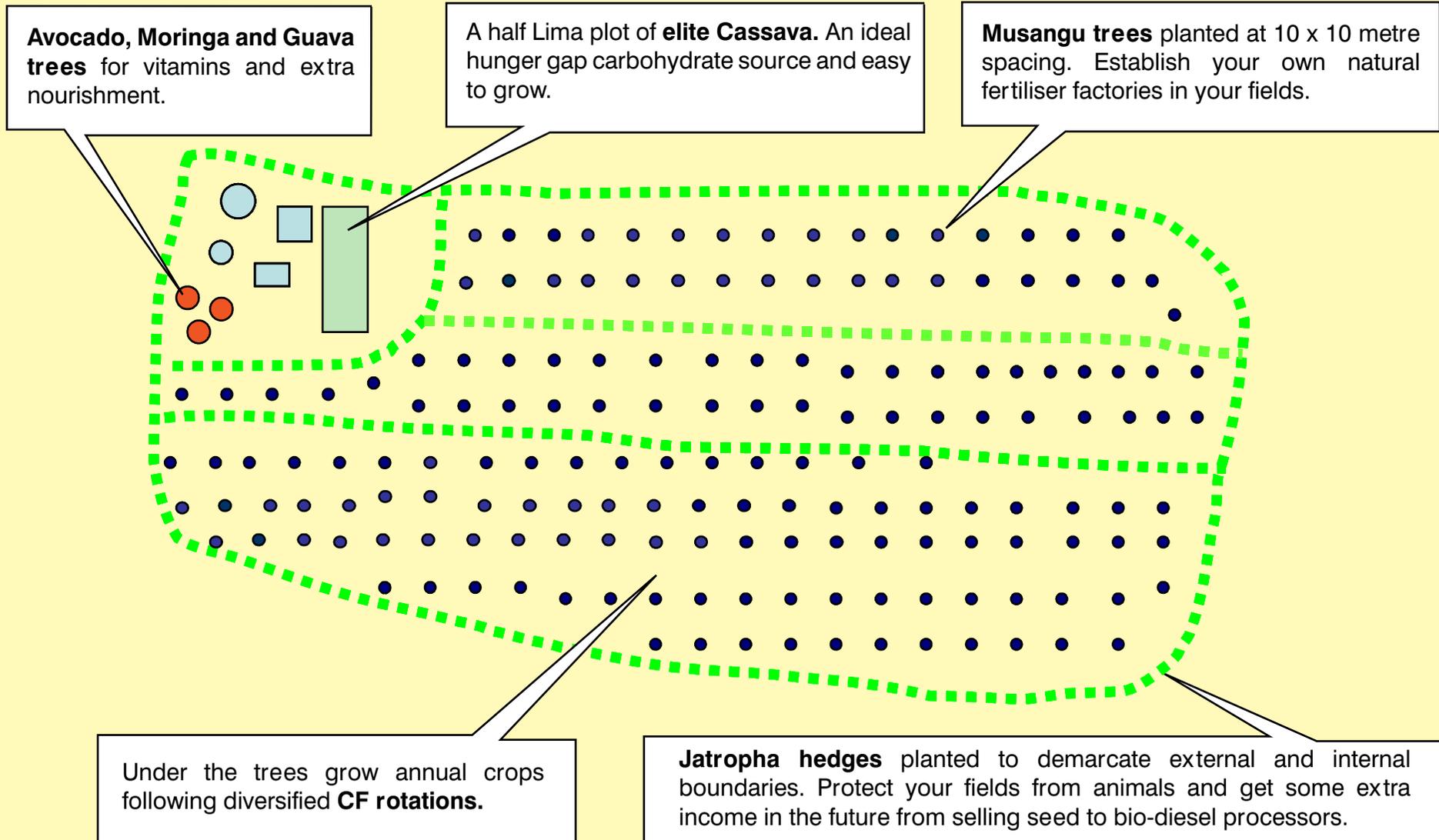
Urea and D Compound prices have more than doubled in just five years.

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

- Be prepared for the threat of Climate Change.
- 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.
- Become a real farmer and husband your land rather than exploiting it.



H. FROM CONSERVATION FARMING TO CONSERVATION AGRICULTURE



H.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.

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 P₂O₅, 183kg CaO, 39kg MgO, 19kg K₂O, and 20kg S**. This is equivalent to **300kg of complete fertiliser and 250kg of Lime** worth at least \$165 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.



H.2 Cassava: An excellent food security standby crop



Advantages of Cassava:

- Minimal cash input.
- Highly drought tolerant and grows well 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

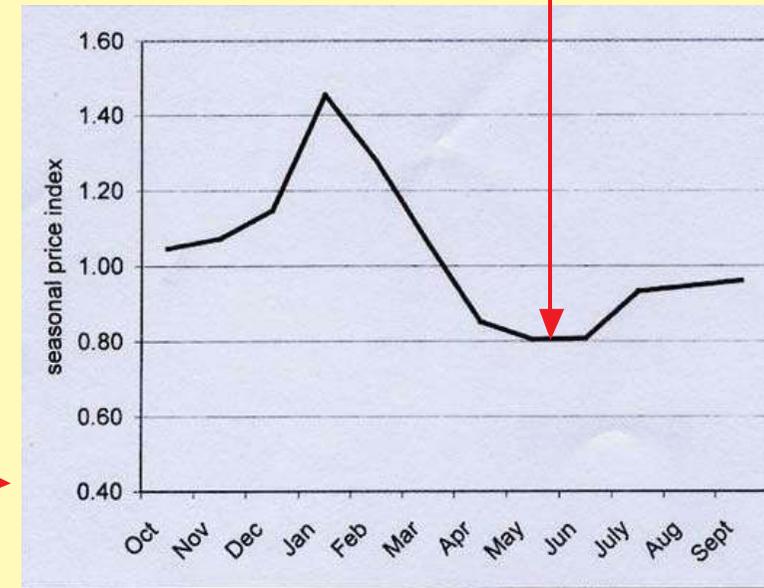
Planting Date	Harvest Date – Yield Tons/ha		
	12 months	15 months	24 months
December	10	22	33
January	8	17	26

Source: AIS Cassava trials – Barratt et al. 2005

36

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.

Most farmers have to sell Maize when price is lowest.



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. Top the young seedling at 30cms tall to encourage branching.

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 meantime, 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.



I. LOOKING AFTER OXEN

I.1 Basic Health Care

Oxen are your tractors. Just like tractors they need proper care and regular maintenance.



A well fed and matched pair of oxen ready for work.



Annual inoculation against diseases is essential.

Oxen Health Care Calendar

Ticks	Drench oxen with acaricide using a knapsack once a week in the rains and once a fortnight in the dry season. Apply tick grease regularly underneath and around tail and remove any ticks.
Botulism & Anthrax	Combination injection once a year.
Black Leg	Injection once a year.
Corridor Disease	This once in a life time injection must be administered before animals are 6 months old.
De-worming	De-worm your oxen three times a year.

Demand advice and assistance from you local veterinary officer. That is what he is paid for.



I.2 Feeding Your Oxen



Velvet Bean



Red Sunnhemp



Perennial Pigeon Pea

- **Good Crops for Making Hay and Keeping Oxen Well Fed Throughout the Year:**

Velvet Bean, Red Sunnhemp, Perennial Pigeon Pea, Dolichos Lab-Lab, and traditional (spreading) Cowpeas, all provide excellent fodder for livestock, either eaten fresh or preserved as hay. There are other choices as well.

- **Conserve and Feed Haulms after Threshing Crops:**

Groundnut and erect (determinate) Cowpea haulms left after threshing out pods and seed make ideal fodder for oxen.

Velvet Beans, Lab-Lab and Pigeon Peas can be grown within a CF Rotation but are **not suitable for early ripping**. Velvet beans get **twined around the Ripper** and clog it up and the Pigeon pea shown above is a perennial.



I.2 Feeding Your Oxen



Preparing Sunnhemp Hay.



Dry Cowpea Haulms after threshing.

Making Hay with Legumes

Because the leaves of Sunnhemp and Velvet Beans **shatter easily when drying**, it is best to cut dry grass, spread it on the ground and then cut fresh material and place it in a layer over the grass to dry. When the legumes have dried, wrap the grass around the hay and store for feeding to your oxen when there is less grass left in the fields, so that the animals are well fed and strong for haulage and for cultivation at the beginning of the rains.



1.2 Feeding Your Oxen - Examples of basic daily rations, 300 - 400kg animals

When oxen are busy:

10kg Hay or 40kg Grazed Grass + 2kg Maize Bran or Cotton Cake or Sunflower Cake + 1kg Molasses + 1 handful salt + Mineral Lick

When oxen are not busy:

10kg Hay or 40kg Grazed Grass + 2kg Maize Bran + 1 handful salt

1.3 Watering

Water is a very important requirement. Oxen lose water all the time through urine, faeces, sweating and respiration. Animals should be watered 3 times a day after supplementary feeding. During the rains, 20 to 40 litres for each oxen, and in the dry season 30 to 60 litres for each oxen.

1.4 Work and Rest

Draft oxen should be allowed to graze for 4 to 6 hours each day. Oxen should not be worked more than 6 hours a day. Work in the cooler hours before 10hrs and after 15hrs. Allow animals 15 minutes rest under the shade of a tree after every 45 minutes of working.

1.5 Kraal Management

Keep kraals dry to prevent foot rot by removing dung every day. Make sure there are no harmful objects in the kraal like plastic bags, broken bottles or sharp stones. Heap manure under a tree to reduce leeching of nutrients during the rains. Remember it is the best fertiliser for growing crops.

To learn much more about looking after your oxen get the 'Oxen Manual' published by GART



J. CF Photo Gallery



2

Hoe CF land preparation underway and it's only May!



An attractive CF scene in Mwachisompola.



Are your Groundnuts and Maize like this?



CF in Kapiri brings a big smile!



J. Conservation Farming Photo Gallery



John Mweemba's field - a CF hoe & ox expert.



Collins Mwiinga got ox CF right first time.



86 year old Jessie with dependant orphans. No food relief needed, even in 2005!



Soloman Mudala - CF pioneer. Excellent crops for 9 years.



J. Conservation Farming Photo Gallery



Guar at Golden Valley. A promising legume cash & food crop for drier regions.



Cowpea under-sown to maize at Golden Valley. Weed suppression and a bit of extra protein.



Young Musangu over CF at GART. From CF to CA. Get ready for the future now!



Standing Red Sunnhemp already ripped. There's always a better way to get the job done.



K. 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.

The GART Yearbook, published by GART

How to Use the Magoye Ripper – GART

Oxen Manual – GART

CF Handbook for Hoe Farmers in Agro-Ecological Regions I & IIa – CFU

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

CF Handbook for Ox Farmers in Agro-Ecological Regions I & IIa – CFU

CF Laminated Technical Guides for Farmers, 8 Different CF and CA subjects – CFU

The Farmers Gazette – Monthly Magazine

The Zambian Farmer – Monthly Magazine



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