Farming for the Future

A Guide to Conservation Agriculture in Zimbabwe

"You will be like a well-watered garden."
Isaiah 58:11

Acknowledgements

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A Guide to Conservation Agriculture in Zimbabwe

Zimbabwe Conservation Agriculture Task Force

FOREWORD

This manual is designed to support extension workers, trainers and implementers to promote sound Conservation Agriculture practices throughout Zimbabwe.

Over the last decade, food security and income for many small holder farmers in sub-Saharan Africa have declined significantly. At the same time the focus of many governments and donors has moved away from agriculture, sidelining agricultural activities and reducing their support. Due to recent drastic increases in food and input prices, once again agriculture is becoming a priority.

Conservation agriculture can significantly boost production, and improve the food security and livelihoods of farming households.

Farmers' low yields on the continent are due to a multitude of reasons, including: declining investments in agriculture, unreliable rainfall, low and unattractive producer prices, poor extension support, poorly developed input supply markets, shortages and high prices of key inputs, declining soil fertility and insecure land tenure.

Communal farming in Zimbabwe is characterised by low and inadequate soil, land and crop management techniques. In many cases land preparation is of a low standard, planting is often delayed and crops are not well managed.

Conservation agriculture is an appropriate technology that can address some of the underlying crop management problems facing farming in the sub region. When practised to a high standard it can significantly boost production, and improve the food security and livelihoods of farming households.

The last few seasons have seen the introduction of conservation agriculture to small holder farmers in Zimbabwe. In many cases yields have been remarkable with farmers practising conservation agriculture able to double or sometimes triple yields compared to those farmers not practising conservation agriculture.

FOREWORD

Conservation agriculture is particularly beneficial for many farmers who do not have access to animal or mechanical tillage, since it enables them to carry out all their operations on time and precisely, increasing productivity and yields

The main focus of conservation agriculture has been on high management levels and good extension work, optimising all resources through best land and field practices.

Conservation agriculture offers an opportunity for all farmers in all regions of Zimbabwe to improve yields and income, food security and livelihoods, through optimising land use based on timely land preparations and improved crop management. Conservation agriculture has proved particularly beneficial for many small holder farmers who do not have access to animal or mechanical tillage, since it enables them to carry out all their operations on time and precisely, increasing productivity and yield potential.

This manual is the result of a collaborative effort by the many individuals and institutions represented on the Zimbabwe Conservation Agriculture Task Force. It distils the experiences and expertise gained over past seasons and presents current best practice in conservation agriculture. We hope that the manual will be distributed widely and used by the many extension staff throughout Zimbabwe to guide farmers in implementing conservation agriculture. We also believe it will be useful to practitioners in other southern African countries. We thank all those who have contributed to the conceptualisation, writing and production of the manual.

Finally, it is our hope that in the coming years, conservation agriculture will bring increased food security and prosperity to many more households and communities in Zimbabwe.

Joseph Gondo

Acting Director of Field Services, AGRITEX

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Introduction

Conservation agriculture is an approach to farming which can sustainably increase yields from cereal, legume and cash crops. The various practices that make up this approach follow key principles based on the conservation of soil, water, nutrients and farm power. Since 2004, Zimbabwe has been the focus of numerous initiatives promoting conservation agriculture which have involved over 45,000 farmers supported by the government agricultural extension service, AGRITEX, as well as various non-governmental organisations (NGOs). The principles have been successfully implemented on both small scale and large scale farms, including irrigated plots.

> *This manual is not intended to cover the subject of conservation agriculture comprehensively but to provide an overview of the principles and practices.*

This guide draws together good practice in the field of conservation agriculture, the latest understanding of what works in conservation agriculture and why, and how best to communicate that learning to farmers in Zimbabwe. As well as referring to recent achievements and experiments, the content is based on experiences from many years of implementation and draws on a variety of perspectives held by those working in conservation agriculture. As such, it is a work in progress, and feedback from readers and users of this first edition will be used to inform future editions of the manual and other materials supporting conservation agriculture.

About this manual

This manual is primarily for agricultural extension field officers. It is not intended to cover the subject of conservation agriculture comprehensively but to provide an overview of the principles and practices. The language has been kept simple.

The first section of this manual introduces conservation agriculture in the context of trends in sub-Saharan and especially Zimbabwean agricultural production and practices. It presents the origins of conservation agriculture and its relevance for addressing constraints faced by farmers. The key principles, practices and benefits are described and explained, based on field experience from implementation in Zimbabwe.

Section 2 contains information and advice on how to promote conservation agriculture among farmers in Zimbabwe. This section highlights approaches to working with farmers, and training methods that have been tested with farmers. It discusses challenges in implementing conservation agriculture and makes suggestions for how to sustain this approach over the longer term.

The third section provides a step by step practical 'how to' guide for extension officers to implementing conservation agriculture interspersed with discussion points and training tips for field-based training.

Section 4 contains conservation agriculture implementation calendars, an overview of conservation agriculture packages recommended by natural region, and guidelines for paired plot demonstrations. It also includes recommended further reading, website links and details of organisations involved in promotion and implementation of conservation agriculture in Zimbabwe and the region.

1. INTRODUCING CONSERVATION AGRICULTURE

1.1 What is Conservation Agriculture?

Amai Makondora, a widow in Gokwe district, tells her story:

"This is the second year after my husband passed away. He loved beer and women. If I were younger I would have left him when he fell ill but I felt pity for him and nursed him till his death. Before his death, he sold the four cattle we had and left two calves. I never got any cent from the cattle sales.

"Conservation farming requires hard working so that you get a better harvest. I no longer rely on other people for my basic needs like food."

When I ran away and went home I was sent back to my husband's place and told to work hard so that I could produce enough for the family and myself. I would sell matches to other villagers and do piecework like weeding and picking groundnuts in order to get money to meet all the household expenses like grinding mill. After picking 60 bags of groundnuts I would be given a single bucket of unshelled groundnuts in payment. I also worked for money to buy other basics like salt. Since I do not have cattle to use as draught power I used to pay three chickens for others to plough my field. This was done late and resulted in my having low yields. Weeding other people's plots left me with inadequate time to tend my own plot.

When I started conservation farming in the 2006-7 season, I planted early because when it rained I had already made planting basins and had seeds. I did not need to plough. Because of early planting and putting manure exactly on the plant stations I managed to harvest three 50kg bags of groundnuts, two 50kg bags of macia (sorghum) and one 50kg bag of maize. When people asked me to weed and harvest their plots I refused because I was working on my own field. I even refused to pick groundnuts from other people's plots because I had my own.

Conservation farming requires hard working so that you get a better harvest. I no longer rely on other people for my basic needs like food. I am now able to do my own things and this leaves me with enough time to plan for my family. In the coming season I want to increase my plot size under sorghum. If everything goes well I would like to be the food basket for my community."

Conservation agriculture means ways of farming that conserve natural resources of soil and water resulting in improved and sustainable production. Conservation agriculture techniques can be adopted by farmers with resources such as animals and implements as well as by those farmers who have no draught power or equipment. In Zimbabwe less than 40% of farmers have access to draught power.

FAO defines conservation agriculture as: *'a way of farming that conserves, improves and makes more efficient use of natural resources through integrated management of the available resources combined with external inputs'.*

In Zimbabwe the narrower term 'conservation farming' is often used to describe the specific practice of using planting basins and soil cover.

1.2 Principles of conservation agriculture

Conservation agriculture takes advantage of natural ecological processes to conserve moisture, enhance soil fertility and improve soil structure. It reduces soil erosion and the presence of diseases and pests. These benefits are achieved through the application of six key principles.

Key Principles - in brief

- Minimum soil disturbance
- Mulching and minimal burning of crop residues
- Mixing and rotating crops
- Timely implementation
- Precise operations; and
- Efficient use of inputs

Minimum soil disturbance

A key principle is to move the soil as little as possible. Only disturb the soil where the seed and fertility amendments such as fertilizer and manure are to be placed. Minimum soil disturbance has numerous benefits, and overcomes many of the disadvantages of ploughing.

Soil is formed in layers. If we disturb these layers by ploughing or turning the soil, we damage the structure of the soil, which makes it harder for rainwater to infiltrate into the soil, as natural drainage pathways are disrupted. It also makes the soil susceptible to erosion. Ploughing destroys organic matter in the soil. Soil organic matter is acted upon by micro organisms to form humus – a stable compound which stores nutrients and water in the soil. Soils with poor organic matter content are less capable of storing nutrients and become less fertile. Soils with high organic matter content can store nutrients and water for longer.

Minimum tillage:

- reduces destruction of the soil structure;
- does not expose soil to wind and water erosion;
- improves infiltration rates;
- slows the rate at which organic matter is mineralized and oxidized, so organic matter build-up occurs;
- causes little disruption to the organisms that live in the soil, improving the soil structure and mineralization of the organic matter;
- compared to whole-scale ploughing, minimum tillage saves time, energy and money because less land is tilled;
- reduces soil compaction because the crop plant roots are left undisturbed. The root systems prevent soil from slumping under its own weight.

Mulching and minimal burning of crop residues

Mulching means the spreading of crop residues (stover), dry grass and leaves, and other dead plant material on the field. It is a fundamental principle of conservation agriculture and is probably the biggest difference from conventional practice. In the past agriculturists encouraged 'clean' fields – free of crop residues or other organic materials. They thought that organic materials caused poor germination, contained pests and diseases and interfered with operations like planting and weeding.

Traditionally crop residues are burned after harvesting or animals allowed to freely graze in the fields. Conservation agriculture promotes the proper management of crop residues where they are placed carefully between rows during land preparation in the dry season.

Mulching has the following benefits when properly managed:

- helps reduce direct raindrop impact and so reduces soil erosion;
- helps water to seep into the soil, reducing runoff;
- reduces evaporation and so conserves moisture for the crop;
- inhibits weeds from emerging;
- in the long term, the organic residues improve organic matter content and soil nutrient status;
- provides a beneficial environment for soil organisms, such as worms and millipedes, that are important for biological tillage;
- moderates soil temperatures.

However, there are challenges to promoting the use of crop residues for mulching when farmers convert from conventional approaches to conservation agriculture.

Farmers already have other uses for crop residues, such as feeding livestock, and these may compete with mulching. Another challenge is keeping livestock off the fields when they are covered in stover.

Some of the traditional uses of stover in mixed crop-livestock systems.
Photo above: stover removed and stored for feeding livestock during the dry season.
Photo below: stover is left for in-situ grazing.

Also, the quantity of crop residues produced may not be enough to meet all the needs of the farmer. But it is worth remembering that, as crop yields increase under

conservation agriculture techniques, so too will the amount of crop residues. Crop residues are not the only mulch available: farmers can harvest grass, leaves and kitchen compost to place on the soil as a blanket. Some other ideas for tackling these challenges are presented in Section 3.

Mixing and rotating crops

Intercropping and crop rotation has been promoted in Zimbabwe since the early 1970s and it is not a new concept to farmers! Mixing different crops in one field echoes processes found in nature and can maximize plant nutrient use by synergy between different crops. Conservation agriculture encourages profitable and agronomically efficient rotations: usually cereal and legumes or cash crops. Taken together, these practices have the following advantages:

- replenishing soil fertility: intercropping with nitrogen-fixing legumes adds 'top-dressing fertilizer' to the soil;
- enabling crops to use the nutrients in the soil more effectively: intercropping different crops with different feeding zones which do not compete for nutrients may help prevent a hard pan forming;
- helping to control weeds, diseases and pests by breaking their life cycles through the introduction of a new crop;
- reducing the risk of total crop failure in cases of drought and disease outbreaks.

Farmers in Zimbabwe rarely practice rotation for a number of reasons. Shortages of legume seed restrict planting. Legumes are normally grown for local consumption only, so if production is increased then additional output markets will be needed. Farmers often give priority to growing cereal crops because cover crops compete for moisture. This last reason is a problem that conservation agriculture helps to overcome and thus helps intercropping to become a viable practice for farmers in semi-arid areas.

Intercropping maize with cowpeas provides cover, reducing soil erosion and ensuring a better nutrient balance through nitrogen-fixing.

Timely implementation

A key principle of conservation agriculture is the need for timely implementation.

This means:

- preparing the land in good time before the rains start;
- planting soon after an effective rainfall event;
- weeding at appropriate times and intervals, during the winter usually two to three weeks after emergence, then at six weeks, and finally at the end of the rains;
- doing effective pest and disease control before either spread too widely.

Where conservation agriculture has not produced the expected results, it is often due to a lack of timeliness of operations. Practitioners of conservation agriculture have learned not to cut corners in the early part of the season as this will cause more work and lower yields later on. Table 1.1 below is a guide to when operations should be carried out. A detailed calendar of activities is provided in Section 4.

Table 1.1 Conservation Agriculture Calendar (see also Section 4)	
What operation?	**When?**
Winter weeding	May - July
Land Preparation (digging basins, ripping, digging furrows)	July - October
Application of basal fertility amendments (manure, compost, lime, compound fertilizer)	July - October
Planting	October - November
First weeding	As soon as weeds appear
Second weeding	December - January, just before or after topdressing
Third or final weeding	March-April, at end of rains
Application of topdress fertilizer	December - January
Post-harvest management	June - July

Precise operations led to this good crop of sorghum.

Precise operations

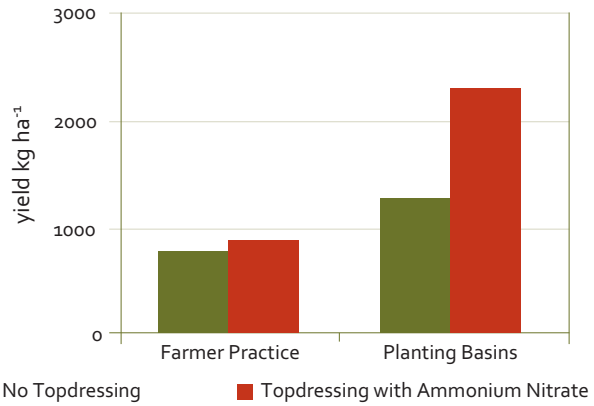
Low standards of implementation management are one of the main causes of the poor yield performance in Sub-Saharan Africa. Conservation agriculture is effective when it is conducted as a full package with attention to detail. As noted above a major part of good management is timeliness of all operations. Precise measurements of row and plant spacing, evenness of depth and size of planting basins and covering of seed are also important. Planting should be done on the same lines each season (as long as they have been done correctly the first time). A key benefit is that compaction of the soil by feet, hooves and wheels will then only occur in the inter-row spaces and not over the crop lines. Residual fertility builds up in the rows and the crop roots of each consecutive crop provide organic matter. They create channels for other roots to follow and

for water infiltration, and hold the soil in place preventing it from collapsing and causing compaction. With high standards of management and precision in operations, the benefits of conservation agriculture can accumulate and increase over successive years.

Efficient use of inputs

In general, the use of farming techniques such as reduced tillage, maintenance of soil surface cover and use of cereal/legume rotations and associations resembles processes that occur under natural ecosystems. These principles differentiate conservation agriculture techniques from conventional ones. However, there are some similarities in the two approaches: for example, the use of manure, compost or inorganic fertilizer is equally important for obtaining higher yields in conservation agriculture. In fact, planting basins perform best when topdressing fertilizer is used: yielding a crop that is 70% greater than when no topdressing is used (see Figure 1.1 below).

Figure 1.1 The impact of topdressing fertilizer on maize grain yield responses to basin tillage and conventional spring ploughing



Data from Masvingo and Chivi Districts for the 2005-2006 harvest.

The difference is ***how*** you use the soil amendments in conservation agriculture compared to conventional systems.

- In conventional systems manure or compost is spread in the field before planting, whilst in conservation agriculture approaches they are placed near the planting station where they are needed. (See Section 3 for details).
- Basal and top dressing fertilizer are also placed close to the planting station/plant ensuring that these resources are used efficiently.
- In conservation agriculture, better responses to nitrogen application are realised with basins even during drought years. Usually with farmer practice, good returns with nitrogen application are only evident in average to above average rainfall season.

Due to this precise application of soil amendments there is little wastage because only the crops, and not the surrounding soil and weeds, benefit. This gives higher yields and huge savings on costly inputs. For example farmers require 10-40 tonnes of manure per hectare in conventional systems. A lot of labour is needed to collect, apply and spread this manure, and a large number of animals are needed to provide the manure. For the same hectare put under conservation agriculture techniques, a farmer will need significantly less - usually a minimum of 1.6 tonnes.

The same can be said of basal and top dressing fertilizer: Conventional systems require 200-350 kilograms of basal per hectare compared to 80 kilograms per hectare in conservation agriculture.

Similarly 100-150 kilograms per hectare top dressing is required for conventional farming compared to 80 kilograms per hectare in conservation agriculture.

TIP: Conservation agriculture does require soil fertility amendments. The amounts mentioned before are minimum amounts! You can find out in your own area maximum amounts of manure, compound D and N you should recommend to your farmers. See Section 4 for details of a simple demonstration to assess different levels of fertilizer applications on crop performance.

Inputs are not confined only to soil amendments. Inputs include time, energy, draught power (if available); all of these can be used more effectively under conservation agriculture. This is because the operations are limited to the planting stations, and mulching can help prevent weed emergence. Timeliness of planting and weeding avoids the additional effort that will be needed if weeding is left until later in the season and the weeds get out of control. Lower manure requirements mean less time and effort is spent collecting manure. Also, since land preparation can start soon after harvesting up until the rains start, labour inputs can be spread out more evenly over the year.

1.3 Why practice conservation agriculture?

Farming in Zimbabwe and throughout much of sub-Saharan Africa faces a double challenge: to increase production while simultaneously preserving natural resources. This is not an easy task, but is key to fighting hunger and poverty in the region. Many of today's pressing problems for rural people are related to poor management of land and water resources. In many areas the land is insufficient to sustain growing human and livestock populations. Poor land management practices play a part: lands once used for grazing are being cultivated and the remaining grazing lands overexploited, resulting in loss of local plants, soil erosion and the formation of gullies.

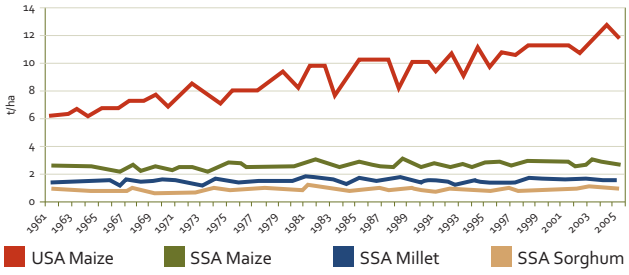
Key Principles of Conservation Agriculture

- Minimum soil disturbance: digging planting basins or making rip lines instead of ploughing.
- Mulching: covering the soil with stover or other dry organic material, not burning crop residue, and controlling grazing.
- Mix and rotate crops: combining different crops in one field and varying the crops that are planted in successive years.
- Timely implementation: carrying out all operations at the best time of the year (preparation, planting, manuring and fertilisation, controlling weeds and pests).
- Precise operations: paying attention to detail and doing all tasks carefully and completely.
- Efficient use of inputs: not wasting any resources including labour, time, seeds, stover, manure, fertilizer and water.

Gully erosion

Cereal yield levels in sub-Saharan Africa (SSA) have been declining over the last 30 years, while yield levels in other parts of the world have been increasing steadily. This is largely a result of low management standards, inadequate input availability and poor extension support, combined with unattractive producer prices and increasingly unreliable rainfall patterns. Figure 1.2 shows the stagnation of cereal yields in sub-Saharan Africa compared to the United States of America.

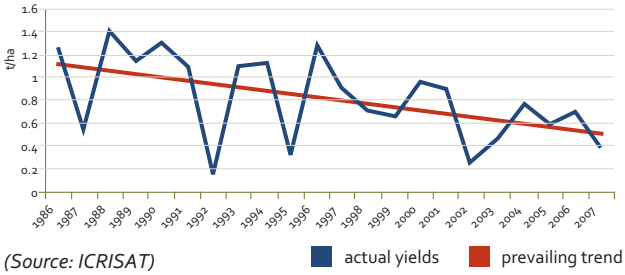
Figure 1.2 Long-term cereal yield for Sub-Saharan Africa and the USA



(Source: FAOSTAT

SSA maize yield data includes large scale commercial farmers, yields for small scale farmers are much lower.

Figure 1.3 Average communal maize yield in Zimbabwe 1986 - 2007



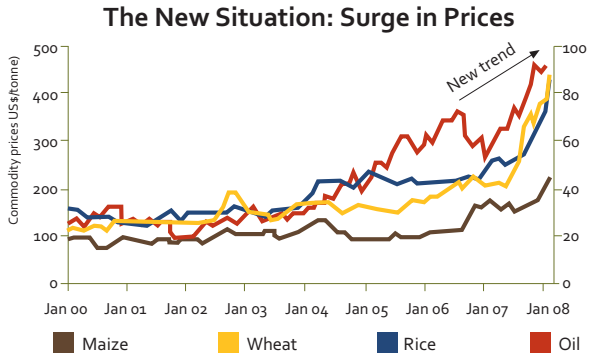
(Source: ICRISAT)

Average communal cereal yields in Zimbabwe have been declining sharply over the last 20 years (see Figure 1.3), due both to the problems cited previously, and to very low public and private investment in agriculture. Farmers faced with this situation usually try to expand cropping areas to compensate for poor yields, sometimes growing crops inappropriate to the area. However, this stretches their already limited resources (including labour, implementation management ability, fertilizer and draught power) further and leads to greater land degradation. In turn soil degradation decreases average yields even more.

Poor soil, lack of water and many mouths to feed.

The recent increase in food and oil prices worldwide presents an additional constraint to household food security in Zimbabwe, as the direct and indirect (transportation etc.) costs of inputs and imported foodstuffs rise (see Figure 1.4). In 2007 the international food price index rose by nearly 40%, compared with 9% the year before, and in the first three months of 2008 prices increased further, by about 50%.

Figure 1.4 Food and oil price index 2000 - 2008



(Source: IFPRI, 2008 from FAO, 2008 and IMF, 2008)

Why Food Prices Increase

Three factors are key to driving this global increase in prices:

- increased demand for food due to high income growth
- high energy prices
- misguided policies, including ambitious biofuel promotion policies and neglecting investment to increase agricultural productivity.

To address these issues there is a need for a rapid investment in agricultural growth, particularly in agricultural science and technology and for market access, at a national and global scale, to address the long-term problem of boosting supply. Rural investments have been sorely neglected in recent decades, and now is the time to reverse this trend. In addition comprehensive social protection and food and nutrition initiatives are needed to meet the short- and long-term needs of the poor, both urban and rural. Ultimately rising food prices can potentially offer opportunities for producers if they are in a position to respond to market signals.

1.4 Problems with conventional farming

Conventional land preparation methods along with removal or burning of crop residues, poor rangeland management and inadequate crop rotations have contributed to a worsening situation in Zimbabwe. In conventional agriculture, soil tillage is considered one of the most important operations for creating a favourable soil tilth, preparing a seedbed and controlling weeds. However, mechanical implements destroy the soil structure by breaking down the aggregate size and currently conventional tillage methods are a major cause of soil loss and desertification in many developing countries. Erosion as a result of tillage can lead to soil losses exceeding 10 tonnes per hectare annually from sandy soils in southern Zimbabwe. Soil erosion accelerated by wind and water is responsible for 40% of land degradation worldwide.

The most widely practised method of land preparation in Zimbabwe is ploughing using an animal-drawn mouldboard plough.

The advantages of ploughing are that it:

- helps to bury weeds;
- helps to mix soil with fertilizers and manure;
- helps in the short term to control pest and diseases by burying them under the soil.

The disadvantages of ploughing are that it:

- delays planting as farmers have to wait for the rains before they plough, hence planting is usually late;
- can form plough pans especially when done to shallow depths (less than 23cm). These are hard layers that prevent good root growth and reduce crop yields;
- leaves bare soil, at risk of erosion, and which forms crusts that stop rainwater from soaking in;
- breaks down soil structure making it easier for soil to be washed away;
- requires draught power which is often difficult and expensive to access;
- may destroy healthy pathogens and predators in the soil;
- destroys the root anchorage in the soil. This anchorage stabilises the soil, reducing lateral movement and preventing wet soil profile from slumping under its own weight;
- buries weed seeds at different levels allowing them to germinate in subsequent seasons when they are brought up again during later ploughing;
- moves and spreads runner grasses and weeds throughout the field;
- buries any protective crop residue mulch covers;
- destroys many of the beneficial aerobic and anaerobic micro-organisms through inversion;
- increases soil surface evaporation.

To counter these disadvantages, agricultural stakeholders started advocating for the use of conservation agriculture practices by smallholder and large scale farmers. Conservation agriculture includes a range of farming practices that try to minimize soil and water losses, stabilise or increase crop yields, reduce the impact of drought, enhance soil fertility and improve farm productivity.

1.5 Conservation agriculture in nature

To a large extent, conservation agriculture imitates processes that occur naturally. By going back to basic principles, conservation agriculture provides a farming system which is in closer harmony with nature, such as:

Zero tillage: in the wild, soil structure is maintained and compaction is avoided due to the supportive network of plant roots which remain undisturbed. Seeds germinate and flourish naturally where they fall on the soil, without significant external disturbance. Clearly it is not essential to plough the earth for propagation to occur. In its natural undisturbed state the soil contains oxygen, micro-organisms, humus, worms and other soil fauna which help roots to form and seedlings to emerge.

Soil cover: in the wild, a layer of fallen leaves, dead grass and other organic matter falls and accumulates naturally on the earth's surface. This covering protects the soil from run-off and erosion by cushioning the impact of raindrops and allowing the water to infiltrate the soil. In addition it reduces evaporation and permits more efficient use of any rain that falls. The natural blanket prevents the sun from scorching the earth's crust, protects seedlings from heat and cold, keeping them moist until they emerge. It provides natural recycling for humus and micro-organisms.

Intercropping and plant/animal interaction: Rarely, if ever, in nature does mono-cropping occur. Natural cultivation is the result of the interaction between a variety of plants and animals; some plants provide shade or protect

other plants from pests and diseases whilst others act to improve soil fertility. Animals, birds and insects also help to spread seeds, break down dead plant and animal material into food for plants to feed on and, in the case of bees, pollinate plants to produce fruit.

1.6 Benefits of conservation agriculture

Table 1.2 shows that conservation agriculture package outperforms conventional farmer practice in terms of yield achieved, profitability, production costs and productivity (returns to labour) under any rainfall conditions and even when fertilizer is applied in conventional practice. It is also evident that these benefits accumulate over time since there are significantly greater improvements in the second year of implementation.

Conservation agriculture has multiple benefits for farmers, for their households and communities, and for the environment. Some of these gains will become obvious during the first season of implementing conservation agriculture, while others take time to materialise. In some cases three to seven years may be needed for all the benefits to be achieved. Farmers can get the maximum benefits if they apply the key principles outlined above and properly manage implementation, with support from extension staff.

Table 1.2 Sensitivity analysis for conservation agriculture package versus conventional farming practices under high, normal, and low rainfall situations in Zimbabwe

		Conservation agriculture practice		Conventional farmer practice	
		First year	Second + year	No fertilizer	With fertilizer
High rainfall					
Maize grain	kg/ha	2000.00	2650.00	678.00	1120.00
Gross margin	US$/ha	654.18	866.84	196.64	357.16
Cost per kg	US$/kg	0.07	0.07	0.15	0.12
Returns to labour	US$/day	6.25	7.03	3.30	4.94
Normal rainfall					
Maize grain	kg/ha	1750.00	2200.00	560.00	728.00
Gross margin	US$/ha	529.42	697.17	152.77	191.06
Cost per kg	US$/kg	0.10	0.08	0.17	0.18
Returns to labour	US$/day	5.47	6.27	3.00	3.28
Low rainfall					
Maize grain	kg/ha	1520.00	1780.00	368.00	400.00
Gross margin	US$/ha	473.36	535.35	70.60	48.19
Cost per kg	US$/kg	0.09	0.10	0.25	0.32
Returns to labour	US$/day	5.22	5.26	1.90	1.50

(Source: ICRISAT, survey data collected in April 2007)

Short term benefits (1-4 years)

Conserves water

Conservation agriculture conserves water in a number of ways by using it more efficiently than most conventional practices. It allows farmers to plant early with the first effective rains. It allows households without draught power to plant as soon as the first effective rains come because land preparation is done during the dry season. This means that such households do not have to delay planting while waiting to hire draught animals or tractors, which may only become available several weeks into the season. With the cropping period in most semi-arid regions being relatively short, the timing of field operations is critical. Early planting allows crops to make the best use of soil moisture.

Mrs Sengezile Ncube, a conservation agriculture farmer from Matabeleland South, said this:

"This method of farming has increased my yields compared to the past years when I always planted late as I had to wait for draught power from my neighbours. In most cases they would prepare my plot very late into the season, leading to low crop yields."

"Lokhu kulima kungenzele ngcono kakhulu ngoba kweminye iminyaka ngiyake ngithwale nzima ngidinga izifuyo kubo makhelwane njalo baphuze ukuzongilimela, lonyaka ngivunile sibili".

"Uku kurima kwakandibatsira chaizvo nokuti pane mimwe mwaka ndinombotambudzika ndichitsvaka zvipfuyo zvokurimisa ndozvodziwana nguba yapera zvichizvondiwanisa goho shoma".

In conservation agriculture, reduced tillage and mulch cover result in less surface run-off and higher water infiltration than is the case with conventional tillage. In addition, the basins, furrows and rip lines collect run-off and this water becomes available to the crops. Mulching further assists moisture conservation by shading the soil surface and so reduces evaporation.

Conservation agriculture also outperforms conventional practices in high rainfall areas and during years when the rains are good. This is borne out by over two decades of observations for very wet seasons, both in large and small-scale sectors and is endorsed by recent trials to compare farmer and conservation practice - see Table 1.2 overleaf.

Saves on inputs

Conservation agriculture uses inputs more efficiently both because it uses less of them, and because of the way they are used,these smaller applications actually result in higher yields. In the case of labour inputs, whilst the amount of labour required may not change it can be spread out over the season. Also, since conservation agriculture gives greater yields, a smaller area can be cultivated for the same yield. Precision application of inputs such as manure and inorganic fertilizers ensures that there is no wastage since they are spot placed where the crop needs them. Traditionally, communal farmers broadcast manure before ploughing it in resulting in more manure being used in a given area.

A Fact from the Field

In a survey conducted among smallholder farmers who had been implementing the planting basins technology for one season, 75% of the farmers identified saving of nutrients through precise application as the major benefit of planting basins.

Better establishment and crop growth

The high level of management in conservation agriculture, which ensures timely planting, fertilization, weeding and effective crop protection results in better crop establishment compared to conventional farming practices. Increased water harvesting in conservation agriculture plots helps crops survive mid-season dry spells that are a recurrent feature of semi-arid areas.

The maize on the left was grown on planting basins. The shorter maize on the right was cultivated using conventional farmer practice.

Higher yields

Yields are higher in conservation agriculture than in conventional farming due to early planting, more efficient use of rainfall, a better crop stand and precise application of soil fertility amendments. This is the case in years of drought and of good rainfall. Most farmers acknowledge they obtain higher yields with conservation agriculture.

Mrs Tariro Manyiwa of Masvingo compared her conservation agriculture and conventional plots in 2005 - 2006.

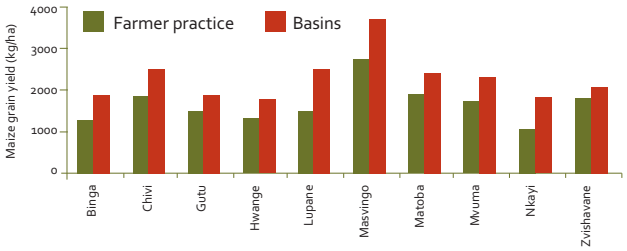
"Kurima kwemakomba kwakabudisa goho rakawanda kupinda dzimwe ndima dzakaenzana nayo. Uye hakuna kundidyira mari yakawanda senge pandakarima nemombe."

"Ukulima ngamagodi kwangitholisa isvuno esinengi ukwedlula indima elinywe ngenkomo elinganayo njalo akungidlealanga mali enengi njengalapho okulinywe ngenkomo."

"Where I used manual planting I got better results than the other places. It didn't even cost me as much as when I used draught power."

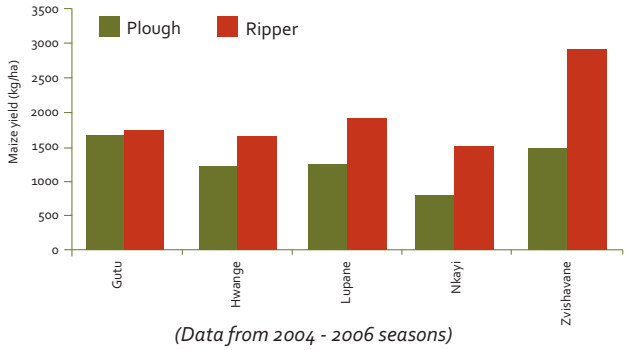
Yields obtained from conservation agriculture were scientifically compared with yields from conventional practice for two consecutive seasons from 2004 to 2006 in 10 southern and western districts of Zimbabwe. See Figures 1.5 and 1.6 below.

Figure 1.5 Maize yields as produced through planting basins and farmer practice



(Data from 2004 - 2006 seasons)

Figure 1.6 Maize yields resulting from conventional spring ploughing and reduced tillage using a ripper tine



(Data from 2004 - 2006 seasons)

Improves nutrition available to households
Conservation agriculture, if practised correctly, has the potential to improve food security and nutritional status for farming households. Firstly, higher yields will provide more food for the family to eat directly, and any surplus can be sold and the cash used to buy other dietary requirements. Secondly, by establishing the practice of intercropping or rotating with legumes, households benefit from a mixed diet.

Lowers costs, increases profit and returns to labour
Recent enterprise budget analysis for planting basins and farmer practice in Masvingo showed that costs per tonne of maize are around three to four times lower for conservation agriculture compared to conventional farming. Returns to labour increased five-fold for farmers using planting basins for the first time. This is the case even though conservation agriculture usually requires more labour than farmer practice as well as the application of basal fertilizer and top dressing which farmer practice normally excludes.

Long-term benefits (beyond 4 years)

Improves soil fertility
Conservation agriculture principles such as applying soil cover, combining cereal-legume associations and applying organic and inorganic fertilizers help build soil fertility.

The effects of poor weed control: A planting basin plot that has been poorly weeded will not achieve optimum crop growth.

Soil cover results in organic matter build up, which increases the population and activity of macro and micro soil organisms. This results in more humus formation as soil micro-organisms break down the organic matter, yielding a dark coloured soil. Inclusion of fertility amendments and legumes replenish soil nutrients, and macro-organisms such as worms and termites burrow into the soil, improving its structure, enabling good root formation and drainage.

Stabilises yields
Conservation agriculture systems achieve high yield levels with fewer fluctuations than conventional ploughing, even in poor seasons. Conservation agriculture therefore contributes to food security at household and national level. Crop rotations and crop mixes produce a range of crops. They reduce the risk of ruin if one crop fails, and provide a more diverse diet.

Reduces weeds
Reduced tillage disturbs the soil less and so brings fewer buried weed seeds to the surface where they can germinate. Weed seeds and or weed seedlings on the soil surface are suppressed by the presence of mulch. Timely weeding results in fewer weed seeds being deposited on and in the soil. See photos below.

Mulching between basins: Fewer weeds because of mulch effects.

In addition, rotating crops prevents certain types of weeds from multiplying. During the course of the season, timely weeding ensures weeds are destroyed before they can produce any seeds. In this way, the seed bank is reduced and fewer weeds appear in subsequent seasons.

Conserves soil moisture
The build up of organic matter and improvement of soil structure leads to better water infiltration into the soil through pores and cracks. This increases the amount of moisture for the crops.

Reduces soil erosion
By continuously improving the management of soil and water resources, erosion and desertification of farm land is reduced, the water table rises and there is less river siltation. In Natural Region II where water conservation is less important, the prevention of soil erosion is an important benefit of conservation agriculture.

Reduces production costs
Relatively inexpensive equipment is needed for reduced tillage options and the wear and tear on equipment decreases too because the area tilled is smaller than in conventional ploughing. Less energy (whether human labour or draught power) is used in tilling the land. Over time weeding requires less time as weeds are reduced in number each year. And as noted above smaller quantities of basal and top dressing are required.

The accumulated benefits of conservation agriculture show great potential for hunger and poverty alleviation in natural regions III-V.

1.7 Implementing conservation agriculture in Zimbabwe

Farming land in Zimbabwe is divided into five distinct agro-ecological zones, also known as Natural Regions I-V (see map overleaf), with varying climatic conditions, soil types, and social and economic features. Conservation agriculture practices have been implemented successfully in zones II, III, IV and V. A number of organisations promoting conservation agriculture operate mainly in the semi-arid zones III and IV where over 80% of smallholder farming land is located. However proponents of conservation agriculture have demonstrated over many years that it is also highly effective in Zone II, and in addition recommendation packages have been developed for Zone V. Thus it potentially has widespread application, with variations, throughout much of the country.

Map of Zimbabwe showing Natural Regions I-V

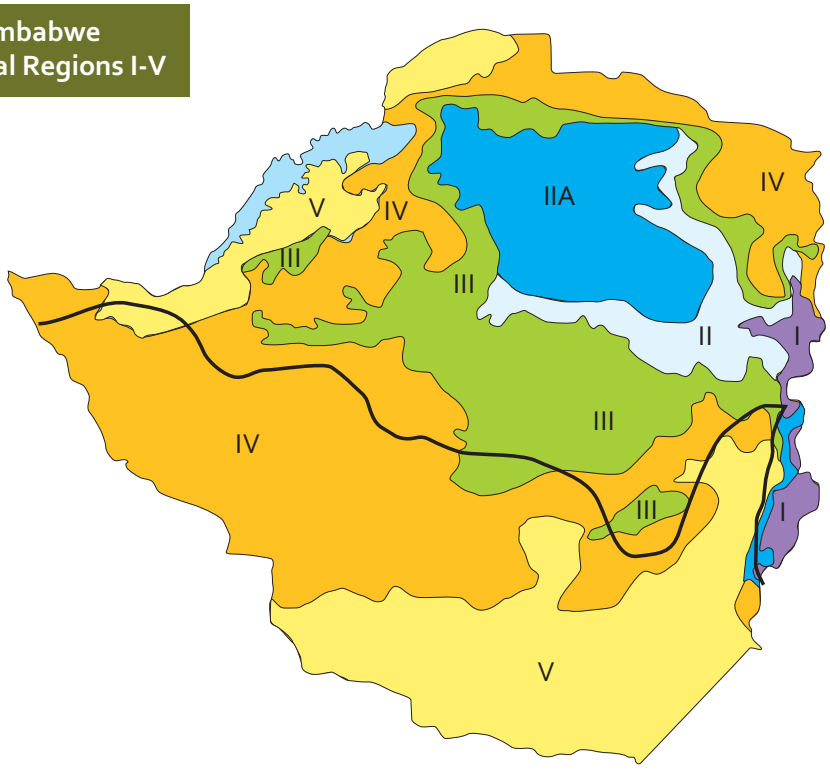


Table 1.3 Physical characteristics of Natural Regions I-V in Zimbabwe

Natural Region	Soil type	Average annual rainfall (mm)	Rainy season	Number of growing days
I	Red clay	1000+	Rain in all months of the year, relatively low temperatures	170-200
II	Sandy loams	750-1,000	Rainfall confined to summer: October/November to March/April	120-170
III	Sandy, acidic	650-800	Relatively high temperatures and infrequent, heavy falls of rain, and low fertility subject to seasonal droughts and severe mid-season dry spells	60-120
IV	Sandy, acidic	450-650	Rainfall subject to frequent seasonal droughts and severe dry spells during the rainy season	60-120
V	Sandy, infertile	>450	Very erratic rainfall. Northern low veldt may have more rain but the topography and soils are poor	>70-135

(Source: adapted from Moyo, 2000; Vincent and Thomas, 1960)

Agro-ecological zones III-V are characterized by soils that are commonly sandy in texture, acidic with low fertility and require careful management if desired productivity levels are to be achieved on a sustainable basis. The available supply of crop nutrients in these soils is reducing over time because farmers do not replenish the fertility of the soil with fertility amendments. Less than 5% of farmers use some form of inorganic fertilizer each season.

These areas are characterized by low erratic rainfall of up to 650mm per annum and periodic droughts. The crop-growing period is short, ranging from 60 to 120 days, so early planting is critical to achieving yields. Current extension methods encourage households to plant their cereal crops as close as possible to the first effective rains. But since fewer than 40% of households in Zimbabwe have access to draught animal power, most farmers rarely plant on time.

Temperatures are high with all months having a high mean monthly temperature greater than 18°C, with daily mean temperature greater than 20°C during the growing period. The high temperatures increase transpiration and evaporation rates, and this in combination with seasonality of rainfall makes the areas vulnerable to prolonged droughts. Evapo-transpiration exceeds rainfall in the most arid parts (zone V) of the country throughout the year, and in zones III and IV during part of the year.

Land use in agro-ecological zones III-V is given over to subsistence crop production and extensive livestock production. The two enterprises are dependent on each other: the livestock enterprise providing draught and manure, as inputs to crop production and residues from the crop are an important feed resource for ruminant livestock. The land tenure system is communal with controlled grazing of livestock restricted to the cropping season. Production depends mainly on family labour, which has been depleted in many households due to HIV/AIDS and migration.

In addition, farmers in these agro-ecological zones have unreliable markets for inputs and products. Seed and fertilizer are rarely available at the right time of year in local shops, and they tend to be too expensive for the smallholder farmer. These constraints, combined with erratic rainfall and infertile soils, have meant that the households rarely achieve food security, with maize yields of less than one tonne per hectare being the norm. As a result, these agro-ecological zones have the highest incidence of poverty in Zimbabwe.

Consequently the accumulated benefits of conservation agriculture show great potential for hunger and poverty alleviation in zones III-V. The dramatic improvement in crop performance that is possible with conservation agriculture could eventually help overturn the destructive practice of communal grazing. This process will also be of benefit in Natural Region II.

1.8 Options for conservation agriculture

Both hand-powered tillage and animal powered options exist. Hand-powered options include the planting basin and the furrow. Farmers with draught power can make use of a ripper tine. More complicated direct planting techniques are beyond the scope of this manual.

Planting basins – all crops

The central component of the basin tillage package is the planting basin. Seeds are planted not along the usual furrow but in small basins – these are small pits that can be dug with hand hoes without having to plough the whole field. They are a modification of the traditional pit systems once common in southern Africa. The technology is highly appropriate in Zimbabwe where a majority of farmers

struggle to plant their fields on time because they lack draught animals. Planting basins are prepared across the slope of a field along the contour, between July and October. They enable the farmer to plant the crop after the first effective rains when the basins have captured rainwater and drained naturally. Seeds are placed in each basin at the appropriate seeding rate and covered with clod-free soil. The advantage of using basins is that they enhance the capture of water from the first rains of the wet season and enable precision application of both organic and inorganic fertilizer as it is applied directly into the pit and not broadcast. Any available soil fertility amendments such as lime, basal fertilizer and manure are placed in the planting basin before planting. More details on the planting basins option are available in Section 3.

Mulch carpet

Shallow planting furrows – small grains and legumes

These are created using a hand hoe and again you do not have to plough the field. Land preparation is done before the onset of the rainy season, between July and October. The furrows are 5 - 10cm wide and approximately 2 - 5cm deep. Fertility amendments are dribbled along the furrow. This option is suitable for small grains and legumes, which are traditionally dribbled along plough furrows and then thinned to appropriate spacings.

Animal-powered options

Farmers with any level of resources can use the planting basins and the shallow planting furrows. Farmers with timely access to draught power and a mouldboard plough may choose to use ripping.

Sorghum cultivated on furrows in Buhera

Ripping is a reduced tillage method using a ripper tine attached to a mould board plough beam. A locally available ploughshare can also be used to open up a rip line. This is an option for farmers interested in animal-powered conservation agriculture. The rip lines are opened at a row spacing of 75 or 90cm and should be aligned along the contour. Available soil fertility amendments can then be added to each rip line before planting.

Ripper tine attached to plough beam

Rip lines opened by ripper tine

1.9 Conservation agriculture and other farming approaches

Conservation agriculture should be combined with other farming approaches to improve soil and water management, increase yields, diversify sources of income, and enhance food security. Some of these approaches are described below.

Soil and water conservation

This term covers a range of techniques that have been developed to mitigate the impact of drought, erosion, erratic rainfall patterns and over-grazing. Whilst the conservation agriculture approaches described in this manual mostly apply to cropping areas, soil and water conservation methods are used throughout a catchment area. These methods include gully reclamation through building stone check dams and planting live hedges or strips of sisal, banana and vetiver grass to reduce speed of run-off and increase water infiltration.

Communities need to work together to improve conservation works on individual fields and contours, in communal grazing lands, in the waterways and along footpaths to reclaim gullies and rills. Contour works include dead level or graded contour pegging, digging of infiltration pits to collect run off and planting of vetiver hedges. In the long term, for conservation agriculture to be sustainably effective, catchment areas need to be protected through broader soil and water conservation measures. More information can be obtained from your local AGRITEX office.

Water and soil conservation: deadlevel contour with infiltration pit

Integrated pest management

Conservation agriculture does not specify recommendations for pest control because pest types and control methods are so diverse. However it can be combined with Integrated Pest Management (IPM), an approach which uses information on the life cycles of pests and their interaction with the environment, and applies available pest control methods. It is intended to be economical and pose the least possible risk to people, property, and the environment. IPM takes advantage of all appropriate pest management options including, but not limited to, the careful use of pesticides. In practicing IPM, a four-step approach can be used (see box below).

Integrated Pest Management: a step by step approach

1. **Setting action thresholds:** deciding the point at which pest populations or environmental conditions indicate that pest control action must be taken.
2. **Monitoring and identifying pests:** not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that the correct pesticide is used and only when really needed.
3. **Prevention:** the first line of pest control is to use cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock, which are effective and cost-efficient and present little or no risk to people or the environment.
4. **Control:** once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

IPM is introduced through farmer field schools (FFS), an experiential learning approach which combines adult education with individual and group capacity-building. In Zimbabwe organisations promoting conservation agriculture have also adopted FFS principles and methods.

Agro-forestry

> *This is designed to provide tree and other crop products and at the same time protect, conserve, diversify and sustain vital economic, environmental, human and natural resources.*

Agro-forestry is another approach that builds on processes that occur naturally and can be combined with conservation agriculture. It means the growing of both trees and agricultural or horticultural crops on the same piece of land. This is designed to provide tree and other crop products and at the same time protect, conserve, diversify and sustain vital economic, environmental, human and natural resources. Agro-forestry differs from traditional forestry and agriculture by its focus on the interactions among components rather than just on the individual components themselves.

Research over the past 20 years has confirmed that agro-forestry can be more biologically productive, more profitable, and more sustainable than forestry or agricultural monocultures. Traditional agro-forestry practices in Zimbabwe include planting of fruit trees in fields and on homesteads; others that have been introduced include multi-purpose windbreaks, riverbank buffer strips, contour plantings for erosion control, and fertility plantings of nitrogen-fixing trees. Rotation of grain crops with leguminous shrubs can help eradicate Striga weed. Systems designed to improve fodder production can work in synergy with conservation agriculture to address the challenge of competing claims on crop residues.

Multipurpose trees such as the Moringa, also known as the 'miracle tree', can be integrated into conservation agriculture and its benefits multiplied: when planted with other crops, it adds nutrients to the soil and so increases the crop yield. The pods, leaves, flowers and seeds are all edible; the oil from the seeds can be used for cooking, soap manufacture and as fuel for lamps. The Moringa tree grows rapidly, even in poor soils, sometimes flowering and producing fruit within a year of planting. The plant can be used to prepare natural medicines to treat skin infections and as a nutritional supplement for people living with HIV and AIDS. Furthermore, the trees can be grown as live fences and windbreaks; they can supply firewood on an ongoing basis through coppicing; and the leftover leaves and seeds can be used as animal fodder and fertilizer. More information can be obtained from your local AGRITEX office or from ICRAF (www.worldagroforestry.org).

2. PROMOTING CONSERVATION AGRICULTURE AMONG FARMERS

2.1 Working with farmers

Community entry

Implementing conservation agriculture involves more than simply training farmers in new technologies or practices. A change in attitude has to take place regarding what they believe to be the 'correct' way to farm. This is true not only of farmers but also among extension providers, researchers and policy-makers because the key principles of minimum tillage, soil cover and implementation management challenge the way Zimbabweans have farmed for many decades.

At a local level, the whole community and existing structures need to be involved in conservation agriculture extension programmes. As an extension officer, you may already be very familiar with the communities with whom you plan to promote conservation agriculture and have years of experience in working with rural communities. Or you may have recently arrived in a new area. Whatever your situation some key steps should be taken:

1. Firstly identify recognised channels for communication and consultation: these are individuals, groups and organisations that should be involved from within the ward or area you are targeting. They will include the Rural District Council, local authorities, and traditional leaders, farmer groups, community leaders, local institutions such as schools and churches, other agricultural stakeholders including AGRITEX and NGOs, and input suppliers. You should always seek permission from the District Administrator for conducting activities. Once sensitised, these influential stakeholders can help to raise awareness of the intervention and also assist in mobilising the farming communities to support the whole idea of conservation agriculture.

2. Then call a community meeting or work with some selected farmers and stakeholders to learn about the social, economic and biophysical characteristics of the environment in which they are operating. Find out what complementary approaches have been promoted in the area such as agro-forestry, soil and water conservation, integrated pest management, and improved harvesting, storage and management of crop residues for livestock.

3. With this wider context in mind, work with farmers to determine those production constraints they face that can be addressed through the adoption of conservation agriculture. Use your skills and expertise in participatory approaches to facilitate the community in identifying production problems, the causes of these problems, and strategies for addressing these problems.

If farmers learn how conservation agriculture can solve some of their cropping problems they are more likely to be willing to participate. Describe the benefits, principles and practices of conservation agriculture. Show the advantages of conservation agriculture through demonstration plots and have lead famers from other areas relate their experiences. Even if your organisation is targeting specific groups in the community, such as vulnerable households, make sure you introduce conservation agriculture to all farmers in your operational area at these introductory meetings. If you exclude some social groups at this early stage it may hold back adoption by the wider community later.

How often have you heard the following statement said by villagers as you work in a community?

"A, ini handisi muchirongwa, takahwa kuti ndechavarombo."

"A, mina angikho ehlelweni, sezwa kuthiwa ngolwabayanga."

"I am not part of this programme because I heard that it is meant for the poor."

Conservation agriculture is for all farmers who would like to increase farm productivity and profitability whilst preserving the environment for future generations. Keep the door open to all farmers all the time!

Extension approaches

There are three basic methodologies used by organisations working with conservation agriculture in Zimbabwe:

- Extension Agent System: Trained extension staff (NGO or AGRITEX) work directly with groups or clusters of farmers and support them in the implementation of conservation agriculture interventions on their own fields.
- Lead Farmer System: Trained extension agents work with lead farmers in a community, and, in turn, these farmers work with farmer groups. The 'lead farmer' should have been practicing conservation agriculture successfully for at least two seasons.
- Combined Extension Agent and Lead Farmer System: Some organisations begin working with clusters/groups and from these select the lead farmers who will in the future lead groups.

You should discuss with the community how you are going to organize the farmers for implementation. Find out about existing farmer groups, as these are usually useful entry points for interventions. Or it may be preferable for the community to select participating households. Selected farms should be close enough so that farmers can visit each other easily and you can visit each of their plots. Some conservation agriculture schemes may target specific social groups among the farmers. Find out if any groups have been formed using the same criteria as your own. If they exist, start with them before forming new groups altogether. Where no suitable groups exist, part of your task will be mobilising and supporting group formation.

Facilitate the selection of one of the participating households as a central site where you will conduct the farmer training. This may be the site where you may want to implement all components (minimum tillage, mulching, effective weed control, crop rotation) of conservation agriculture, even if it means that your organisation provides all inputs initially, except labour. It serves as an effective demonstration to all the farmers on the concepts and practices of conservation agriculture.

Farmers generally learn more from other farmers and often make good extension workers. They tend to believe and trust each others' experiences more than messages brought by outsiders. It also helps to make your conservation agriculture programme more sustainable if you move towards an extension model that does not rely only on extension workers to demonstrate good practice and facilitate learning. Once you have been implementing conservation agriculture for two years or more in your area, you can select lead farmers from the group of participating farmers. They should have proven results and be dynamic, hard-working, and committed individuals who are trusted by other farmers. Ideally you should have a mixture of young, old, men and women, with varying levels of resources, so that their experiences are relevant to a range of households in the community.

A completely new programme, introducing conservation agriculture concepts for the first time into a community should not contemplate the use of a Lead Farmer System. Whichever system you choose, make sure all stakeholders are clear on how the implementation will proceed.

2.2 Challenges to working with farmers

Gender issues

Conservation agriculture may affect men and women in different ways which will affect their willingness and ability to adopt and implement the practice. In Zimbabwe, as in many other African countries, men and women have different roles and responsibilities. In the conventional agricultural domain, men tend to plough whilst women plant, weed and harvest. This means that conservation agriculture may increase the amount of work for women and for children who contribute to these tasks as well as helping to keep animals and birds away from fields. But since men often keep most of the money earned from selling cereal or cash crops like maize and cotton, women may not benefit from the proceeds of their additional work. So they may be less willing to adopt conservation agriculture unless your extension programme encourages a fairer distribution of agricultural tasks between men and women.

Conversely, the elimination of ploughing may make it easier for widows and female-headed households to adopt conservation agriculture. Traditional gender roles are breaking down due to the impact of AIDS and migration on households. It is important to make sure that conservation agriculture serves to mitigate and not to exacerbate these problems. The gender dimension of conservation agriculture, and in particular conservation farming, has been highlighted by the participation of many widowed women who have lost their husbands to AIDS.

Here are some ways of helping men and women adopt conservation agriculture:

- Understand the roles and views of men and women. Consider holding separate meetings or trainings for women if they are not specifically targeted by your programme. Hold them at convenient times of the day. Don't forget to include children too: they can play a big role. But again, make sure they aren't overburdened as a result.
- Anticipate the impacts of conservation agriculture on men and women -- including those not involved in the programme -- who might do piecework for other farmers. Encourage a flexible attitude towards roles among men and women, and involve traditional leaders in influencing men to help with some of the work women traditionally do. Focus on improved food security and family welfare as ultimate goals of conservation agriculture.
- Provide information in an appropriate way. Encourage children to help parents to read materials and record their costs and yields.
- Help link people, including women's groups, to input supplies and markets. In some cases you may want to deliberately target women with inputs.
- Assist women to be a driving force in conservation agriculture by using women as lead farmers.
- Support the establishment of conservation agriculture committees in which women take a leading role as chairpersons.
- Remember to include other vulnerable groups, such as the elderly and disabled. They too can play a role and have successfully implemented conservation agriculture in Zimbabwe.

Maria Musona is a 45 year old widow with four dependants. She was able to nearly double her harvest using conservation agriculture methods – by planting early she increased her yield from five 50kg bags to eight 50kg bags and the cobs were bigger too. She is now able to feed her family with the food she grows.

She attributed this benefit to three key factors: firstly her crops were not affected by the dry spells as the basins conserved whatever rain fell. Secondly, she did not waste manure because she applied it directly to each planting station. Thirdly, her crops were not affected by witch weed because they matured early. She plans to expand the area under maize because she knows she can improve her yields with conservation agriculture even in poor seasons. She wants to experiment with pumpkins, water melons and cucumbers too.

HIV and AIDS

HIV and AIDS have had a devastating effect on farming communities in Zimbabwe over the past 20 years. Many of the most productive members of families have died or fallen ill, leaving the children and the elderly who would normally depend on these adults to take responsibility for farming and their sick relatives. This double burden starts a cycle of food insecurity and loss of income.

Much time may be spent by women, girl children and the elderly looking after the sick, which they would normally spend on farming activities. As a result these household members can only cultivate smaller plots and grow a smaller range of crops. They may not be able afford to plough, so they plant late and fail to buy inputs and to weed their fields. Their harvest is small so their diet is poor and they go hungry, so they become even less productive and fall ill more often. Unable to grow enough to feed themselves, and beset by medical bills and funeral expenses, desperate families are forced to sell what they have. They sell farm implements, draught animals and land to raise money, and they may move to an urban area or another country. They have less to invest in their farms. Relatives of the deceased may seize the family's property, leaving widows and orphans destitute. The survivors – orphans, the elderly, and women – may lack the right skills to use equipment, so it falls into disrepair. They may find it particularly difficult to get credit or extension advice. Many communities have traditional ways of supporting vulnerable people. But these customs may be stretched to breaking point by the large numbers of illnesses and deaths.

Conservation agriculture can help overcome some of these problems:

- Labour for land preparation can be spread out over time.
- Improved household food security can be achieved through increased yields.
- Improved nutrition through diversification of crops including intercrops and cover crops high in protein and vitamins.
- Including legumes in rotations brings in flexibility in utilisation, ranging from green mature pods or fresh groundnuts to processed products such as peanut butter. Peanut butter can increase the palatability and nutritional value of various foods including boiled snacks, bread, relish and porridge.
- Increased household income through sales of surplus can help pay for extra labour should it be needed.
- Once started, conservation agriculture becomes less labour intensive, allowing the sick the elderly, the disabled and children to practice it without having to worry about sources or means of labour.

As extension officers you can:

- Provide extension support to households affected by HIV and AIDS.
- Assist such households to identify suitable crops to grow and provide nutrition advice.
- Encourage farmers to pool their labour and exchange ideas.
- Encourage farmers to work in groups so that group members help out a member when he/she is unable to work in the fields because of illness.
- Establish linkages with home-based care programmes and encourage or allow the participation of care-givers by deliberately targeting them regardless of their socio-economic status. Increased yields in community or individual gardens arising from the practice of conservation agriculture will permit any surplus to be given to orphans and the sick in home-based care programmes.
- Deliberately target people with disability and engage them right from the outset. Conservation agriculture can be adopted by people with all forms of disability.

Barriers to implementing conservation agriculture

Conservation agriculture may not always be readily adopted by farmers because it conflicts with conventional farming practices. Some barriers to promoting and implementing conservation agriculture arise from deep-rooted socio-cultural beliefs, and the downgrading of indigenous farming methods over past decades. Some examples are given below

- Ploughing: for many years farmers in Zimbabwe have been taught that ploughing is essential for crop production because it makes the soil soft and enables roots to penetrate easily, when in fact the opposite is true.
- Clearing or burning stubble: farmers like to burn crop residues and weeds in fields after cattle have grazed it or use fire to manage pastureland. These practices have in the past been promoted by extension officers.
- Clean fields: this barrier of burning is reinforced by the notions that a 'good farmer' has a clean field and that organic matter should be ploughed into the soil. In fact mulch on the soil surface allows more rain to infiltrate and promotes fertility better.
- Growing maize: because this is the staple crop in Zimbabwe many people prioritise growing maize over any other crop even when conditions are not well suited to it and other more drought resistant crops such as sorghum or millet may provide better yields.
- Communal grazing: this is a long established practice throughout Zimbabwe and many farmers believe it to be socially unacceptable to not permit communal grazing of their fields.
- Jealousy: sometimes farmers who experiment with new practices and do better than others are the object of resentment and accusations. This may make it unappealing for farmers to change their methods and to take risks.
- Land ownership and tenure: this is an economic and political issue as well as a cultural and social one. If land is owned communally (or by the state), individual farmers may have little incentive to improve it.

- Access to credit and financial constraints: traditional approaches to farming emphasise external inputs, and this remains a concern for many farmers, even though the success of conservation agriculture relies more on positive attitudes, knowledge and precise management than inputs. Neither farmers on communal lands nor resettled farmers have collateral in the form of secure tenure so their ability to access credit for inputs is constrained.
- Labour constraints: in the first year of conservation agriculture land preparation and weeding are labour-intensive tasks and heavy work for those who are physically weak. The year round requirement for labour may also give rise to the perception that conservation agriculture is labour intensive.
- Farmer management capacity: conservation agriculture emphasises high levels of precision and timeliness which may be new to farmers and give the impression that conservation agriculture is burdensome to implement.
- Ingrained habits and attitudes: current approaches appear to target older farmers who may find it harder than the young to adopt new practices. As the sayings go 'old habits die hard' and 'it is difficult to teach an old dog new tricks'.
- Lack of institutional support: conservation agriculture is not yet fully integrated into the curriculum of most tertiary institutions responsible for training extension staff.
- Lack of self-confidence: vulnerable groups sometimes feel that their situation is hopeless, and that they may not be able to escape poverty and hunger.
- Suspicion of the extension agent and his/her motives.

Ways to overcome barriers

- Spend time listening to the local community, listening to their opinions on agricultural production and their challenges and barriers to conservation agriculture. Ask them if they have any answers to the problems they have listed. Help them envision the benefits of conservation agriculture, and ask them what they are prepared to do to support this - this encourages ownership and support for the project.
- Discuss the problems caused by ploughing, and the benefits of basins, early planting, timely weeding and mulching.
- Jointly explore solutions to satisfy animal feed requirements.
- Establish high quality demonstration plots to show farmers the higher returns that can be achieved with a small amount of labour and inputs.
- Encourage farmers to experiment with different, more suitable crops.
- Encourage exchange visits between farmers.
- Encourage farmer groups and communities to find ways to prevent cattle over-grazing stubble or eating crops, to pool labour and to support vulnerable households.
- Use participatory extension approaches which empower communities to identify and develop solutions to their own problems, especially to determine, over a number of years, optimal variations on the conservation agriculture packages in their context.
- Introduce conservation agriculture to the younger generation, especially in schools. Advocate for it to become part of the school syllabus. Agriculture is a subject at both primary and secondary schools in Zimbabwe. The practice can then be transferred home when parents have been sensitized to the approach.

- Link conservation agriculture to other interventions such as the establishment of water points in community gardens, especially in times of drought.
- Facilitate in-service training and demonstrations to ensure new extension staff are conversant with conservation agriculture principles and practice.
- Lobby higher education institutions to include conservation agriculture into their curriculum.

2.3 Monitoring and sustaining conservation agriculture

If any sustainable impacts are to be realized, conservation agriculture implementation by farmers should continue well after your intervention and training finishes. Experience in Zimbabwe suggests that farmers need significant support and supervision in at least the first two years of implementing conservation agriculture. This is largely due to the high management standards with which farmers are not familiar. Evidence also shows that initially adoption can be variable with some techniques less implemented than others: farmers may be unable or unwilling to practice key elements such as mulching and winter weeding, and incorporating legumes in crop rotation for reasons explored elsewhere in this manual. Gradually reducing levels of support will be needed over a number of years.

It is estimated that at least 500,000 farmers throughout the country could potentially benefit from conservation agriculture: this would require a ten-fold increase in numbers currently implementing these practices. Since the extension effort required is intensive in early years there will need to be an intensification of the training and support given to extension officers. Thus conservation agriculture should be integrated into your institution's routine work if possible. By undertaking some or all of the following steps you can help ensure sustainable implementation of conservation agriculture by farmers.

If you are an AGRITEX field officer:

- Discuss with your supervisor and make sure that the conservation agriculture programme is part of your key result areas for the year. It should not be viewed as a separate programme but an integral part of your 'usual' extension work.
- Incorporate conservation agriculture into your conventional master farmer training as soon as you have sufficient capacity in your area.
- Empower the farmers with respect to the technology and their organisation. In addition to training lead farmers in conservation agriculture, you may need to train them in establishing and sustaining farmer groups.
- Explore the possibility of establishing and strengthening community-school linkages. School children are the farmers of the future: introduce them to conservation agriculture concepts and practices at an early age. This may include setting up a demonstration at the school. The children will usually come in handy if their parents start to struggle with numbers!
- Work to ensure that conservation agriculture training initiatives and promotion activities feature in the workplan of your District Extension Office.

If you are an NGO field officer:

- Work with and through AGRITEX – do not create a parallel extension service.
- Facilitate training AGRITEX staff in conservation agriculture including some simple paired plot demonstrations that they can own and manage.
- Keep the program small, simple and manageable with a number of paired plot demonstrations to act as focal points for training activities and group discussions.
- Involve the local leadership – traditional, church or political - as appropriate. They are useful for mobilizing communities.
- In addition to training farmers in conservation agriculture, you may need to support them in establishing and sustaining farmer groups.

You may have your suggestions on how conservation agriculture implementation can be made more sustainable. And the farmers may have their own ideas too; talk to them and get their views.

2.4 Principles and methods for training and extension

Teaching adult learners

Traditional extension strategies tended to use a teacher-pupil model for interacting with farmers where the farmers were passive recipients of research developed by external researchers. Over the past three decades the weaknesses of this approach have been revealed through the non-adoption or lack of sustained adoption of new agricultural technologies. This has led to the development of two-way, more inclusive extension methods that view the farmer as experimenter and practitioner and the extension worker as a facilitator of change, and which recognise the importance of indigenous or local knowledge and practices (even where, as with planting basins, this has been lost to the current generation of farmers).

Part of this re-evaluation of extension has arisen out of a deeper understanding of how adults learn. Unlike children, adult learners possess both the formal knowledge they may have acquired at school as well as years of "on the job" experience. Adult learners learn best when they can relate new ideas to their existing body of knowledge and practice. Theory should be presented, if at all, in the context of what is happening or what is possible on the ground, in other words, in a practical, relevant manner. Adult learners learn best in a supportive environment where they are accepted without judgement or criticism. Ideally they should be involved in planning their own learning experience. Adults learn best when they not only hear information, but see, reflect on, question, try out and finally put into practice their learning.

Participatory approaches

Generally speaking participatory methods are recommended for training farmers in conservation agriculture. Some extension officers in Zimbabwe will already be familiar with participatory approaches to research and problem identification (e.g. Participatory

Rural Appraisal – PRA; Participatory Learning and Action - PLA) and to extension (e.g. Farmer Field Schools – FFS; Participatory Extension Approach - PEA). The core principles of participatory approaches include visualisation, exchange, sharing and discovery, leading to action. Participatory methods can be used to raise awareness of conservation agriculture: community drama is always popular and short skits can promote the concepts in an entertaining way. You can work with farmers already practising conservation agriculture to develop short skits and dramas or link with existing drama groups in the area. It may be appropriate to tie in with health education programmes which are promoting improved food security and nutrition.

Farmers participate in a training session

Reflection and experimentation

Conservation agriculture is quite knowledge intensive because farmers are learning to adopt a range of practices and management techniques. A farmer-centred learning process is required which involves reflection (on existing problems and practices) and discovery (of how different approaches can provide solutions) in the farmers' own context.

The principles of Farmer Field Schools (FFS), originally developed for IPM programmes (see Section 1), are being used to promote conservation agriculture.

Farmer Field School Learning Method

Doing/participating
↓
Experimenting
↓
Experiencing
↓
Discovering

Learning is based on comparisons of technologies, usually farmer practice versus improved technologies. This approach assumes that farmers already have a wealth of experience, and knowledge. It also assumes that there may be misconceptions and bad habits learned during previous education and training programmes (e.g. the plough is king, fields should be kept clean of crop residues). Field Schools are oriented to providing basic agro-ecological knowledge and skills, but in a participatory manner so that farmer experience is integrated into the programme.

For example, when observing in the field, an extension officer might ask farmers what methods of land preparation they commonly use, and what are the advantages and disadvantages of these. Farmers give their response, and the extension worker adds his/her knowledge and corrects any misconceptions. The extension worker and farmers can set up simple demonstrations to assess the difference between farmer practice and improved technologies.

Showing evidence of benefits

There is no surer way of convincing a sceptical farmer of the worth of an unfamiliar technique than to show its benefits. These benefits should provide solutions to actual problems he or she faces; a general listing of advantages of, say, planting basins, will not be nearly as effective as describing how they can help the farmer to feed his or her family. And even more effective will be the opportunity for another farmer to show her conservation agriculture plot and explain what she has been able to achieve and what difference it has made to her life.

Trials and demonstration plots

Discovery of evidence of benefits through experimentation and demonstration lie at the heart of implementing a conservation agriculture programme. This can best be achieved by setting up demonstration plots and field trials. See Section 4 for guidelines on how to lay out a demonstration plot.

Field days

Field days are always a popular way of spreading information about new practices. You can organise these with the district AGRITEX office.

Farmer to farmer exchange

Most farmers learn best from their peers. Farmer exchanges benefit all participants: people who share the information develop the confidence and skills to teach their new-found skills and learn from their experience, while visiting farmers can ask questions and share concerns. A conservation agriculture programme should provide as many opportunities as possible for farmers to exchange their knowledge and experiences.

2.5 Planning training courses

The entry point and coverage of training courses will depend on what participants already know. You need to think through the questions below before you start training:

Questions to help plan a CA training

- What is special about conservation agriculture that you should take into consideration when training farmers?
- Who should attend the training?
- What do you want to achieve by conducting the training?
- What materials are required for the training?
- Where do you conduct the training?
- When do you train the farmers?

Jot down your answers to these questions before you read on!

Experiences from the field have lead to the development of the following guidelines for developing a conservation agriculture training programme.

What you need to consider during your training?

You need to remember that conservation agriculture is a way of farming – it is not a single technology like micro-dosing or manure application. It is a system that is made up of several technological components. As a result, there are numbers (lengths, quantities) involved as well as practical skills that are required to effectively implement conservation agriculture. The training programme should take all these factors into consideration.

Who should attend?

Your initial targets are farmers who will train other farmers in conservation agriculture. Of course you know you are going to train farmers, but who among the farmers should be trainers of other farmers?

Experience has shown that diversity among the farmers is good for effective learning. You should aim to have the following among your trainees:

- Women, young and older
- Men, young and older
- Community leaders

This mix of social groups will ensure that there is farmer-to-farmer training, even without outside assistance. There are many numbers in conservation agriculture and the young will lead the mature; there are many practical techniques that need skills where the mature will lead the young. And leadership is vital for keeping the group together and for facilitating the scaling up of conservation agriculture. So these social groups complement each other. As an extension officer you should only facilitate the selection process; leave the farmers to choose among themselves the people who should be their trainers, champions and group officials.

Training goals

The first training should give an overview of the conservation agriculture concepts and practices. You want to leave the farmers with an appreciation of:

- The conservation agriculture principles and practices that are appropriate for farmers in their Natural Region.
- Why conservation agriculture is relevant for the farmers in their own environment.

Do not give farmers a lot of detail – leave this for later sessions that are designed to coincide with the implementation of the particular operation on the conservation agriculture calendar. At the same time, do not give too little information as this may lead to confusion and misunderstanding among the farmers. Subsequent trainings should cover theory and practice for each specific stage in implementing conservation agriculture.

Materials needed for the training

If possible try to ensure you have the following materials available to be used in training sessions and to set up demonstrations:

- Stationary: flipchart sheets or manila paper, pens, flipchart stand or board and clips, notebooks and pens for recording data, handouts such as leaflets and calendars.
- Equipment: hand hoes, ripper tines, pegs, planting lines, tape measures, hammer, run-off trays, beakers or tumblers, beer bottle caps, watering can.
- Inputs: seed, inorganic fertiliser (basal and top dressing), manure, crop residues, dry grass and leaves, soil.

If you have to demonstrate the effects of rainfall and mulching have the necessary run-off trays as shown in the photograph overleaf. Alternatively, you can make your own run-off trays. You may also need handouts for farmers to use as reference, for example the conservation agriculture calendar (see Section 4). Ask farmers themselves to provide locally available items. Do not introduce items that are unavailable to the famers you are training or working with.

This equipment (see photo above) can be used to demonstrate the importance of mulch in controlling run-off and direct raindrop impact on soil erosion.

Two metal trays are used one of which has been left bare while the other is filled with straw. Beakers are placed under the trays. When water is poured into the two trays, farmers can observe that there is less run off from the straw into the glass beaker on the right compared to the beaker on the left, where the water runs off a bare surface.

Where to conduct the training?

Remember you are training farmers - adult farmers. You should avoid classroom lectures as much as possible. Conduct the training in farmer's fields, demonstrating the concepts and practice of conservation agriculture. Try to:

- Use examples from the local area. Do not give examples from other countries or districts as they will not be relevant to the community you are working with.
- Encourage participation by all – ensure all participants actively involved, in writing on the boards/flip charts, in doing the practical demonstrations, etc.

Farmers in Chirumanzu learning how to prepare planting basins in the fields.

When to conduct the training?

All training sessions should be timed to coincide with the timing of the operation in the field under farm conditions. In other words, demonstrate digging basins when it is the correct time for basins to be dug, demonstrate fertilizer application at the stage when the crop should be fertilized, etc. The timing of some of the key operations is presented in Table 1.1 in Section 1. An introductory session should ideally be done before land preparation. This staggering of sessions avoids overloading farmers with too much detail, allowing them only to take in what they need to take in at the right time. Also check with the farmers when is a suitable time for them to participate: remember that domestic responsibilities may prevent women from attending at times when men can most easily participate and plan accordingly.

3. PRACTICAL STEPS IN CONSERVATION AGRICULTURE

This section provides detailed practical information about when and how to implement each component of the conservation agriculture planting basins option promoted in Zimbabwe.

Key Principle

Every plant must have the same opportunity to flourish: equal aerial and soil space, equal moisture, equal nutrients and sunlight. This will maximise yields and demonstrate the benefits of precision in conservation agriculture.

3.1 Preparing the basins

Section 1 of this manual describes how planting basins are being successfully used in Zimbabwe to increase crop yields and productivity. Basins are simple to make and require few tools. They can be prepared over a long period in advance of planting, usually between June and October. In the first year of implementation of conservation agriculture it is very important to take the time to align, dig and space the basins correctly so that in future years the same basins can be used.

If you plan to use virgin land it will first need stumping and clearing and roots should be removed. Contours should be prepared. Never plough virgin land that is to be used for conservation agriculture. However the majority of farmers who are starting conservation agriculture in Zimbabwe will use previously cropped land. This should be weeded before digging.

Start on a small scale: table 3.1 opposite lists key recommendations for Zimbabwe, with full agronomic details provided in Section 4. Areas can be increased as farmers get more confident and competent.

Equipment and inputs needed

- A hoe or badza for each person involved in digging basins and weeding
- Strings to mark out the planting rows
- A long string or teren rope, used to measure the correct distance between the basins
- Measuring sticks or tape measure, used to measure the correct row and basin spacing
- Strong pegs to hold the string at either end
- Bottle tops or caps for making the teren rope and measuring out fertilizer
- Seeds – 25kg maize etc
- Manure – 1.5t per hectare
- Stover or other mulching material – 3t per hectare
- Compound D – minimum of 80kg per hectare (optional)
- Ammonium Nitrate – minimum of 80kg per hectare (optional)

Table 3.1 Example household packages

Full package (households with no labour, draught power or financial constraints)

- Three x 0.25 ha plots
- Cereal/cash crop/legume rotation

Standard package

- Two x 0.25 ha plots
- Cereal and legume rotation

Vulnerable Households Package (this is the focus of the Protracted Relief Programme in Zimbabwe)

- 0.25 ha plot
- 0.2 ha cereals, 0.05 ha legume
- Option for cereal/legume intercropping
- In the first two years of conservation agriculture only grow staple cereals to address food security constraints.

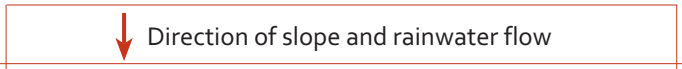
Making planting basins using a hand hoe and planting lines.

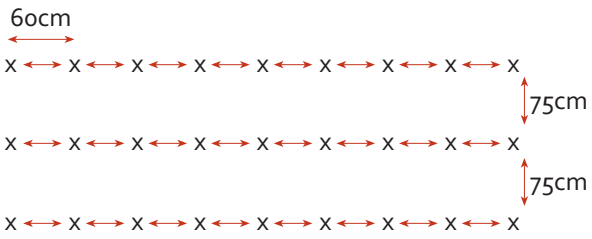
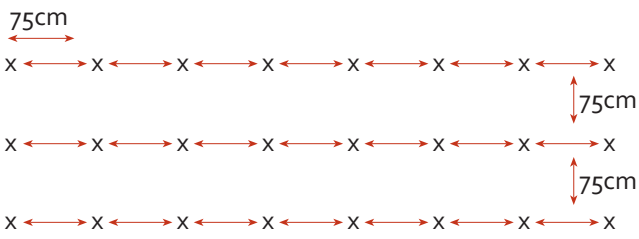
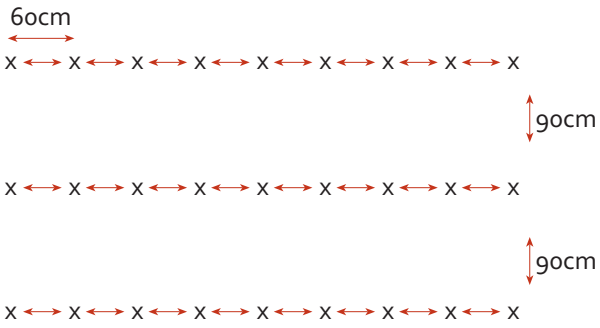
Marking out the basins:

- Mark out a straight line at the end of the field, up and down the slope. The lines should run down the slope and the planting rows should run across the slope on the contour.
- Place small pegs or make marks in the soil along these lines at 60 or 75cm intervals in Natural Region II, at 75cm in Natural Region III and at 90cm intervals in Natural Regions IV and V (See Figure 3.1 overleaf). Use a measuring stick of the appropriate length.
- Stretch strings across the field from the peg at one end to the corresponding peg at the other end to mark out the planting row where you will dig the basins.
- To measure the distance between the basins use a measuring stick or a string, wire or chain marked at 75 or 60cm intervals (known as a teren rope). Planting basins should be spaced 75cm apart in Natural Regions II and III and 60cm apart in Natural Regions IV and V. You can tie bottle caps or knots into the string to mark the basin spacing.

Making basins in Natural Region IV.

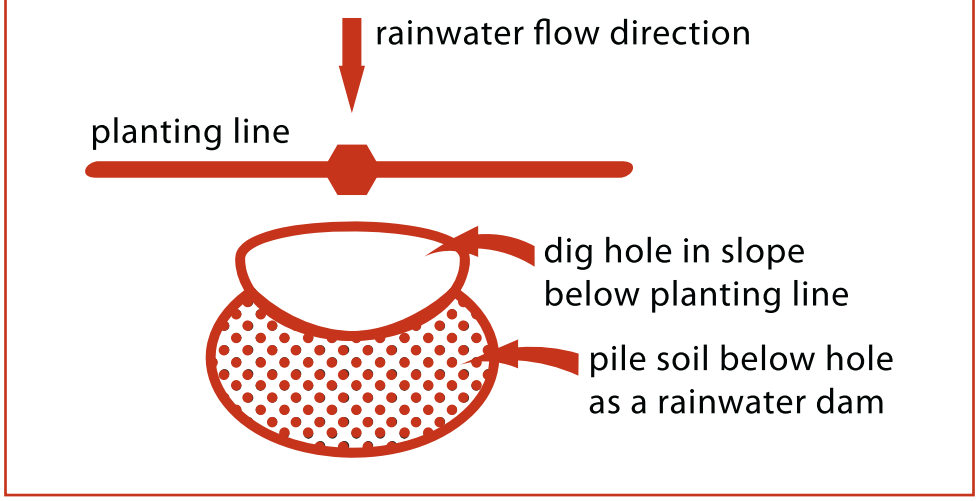
Figure 3.1 Basin Spacing for different Natural Regions



Natural Regions II and III		• Rows made across the slope at 75cm spacing • In-row spacing 60cm apart • Total 22,222 basins per hectare
Natural Regions III, IV and V		• Rows made across the slope at 75cm spacing • In-row spacing 75cm apart • Total 17,777 basins per hectare
Natural Regions II, III, IV and V		• Rows made across the slope at 90cm spacing • In-row spacing 60cm apart • Total 18,158 basins per hectare

- 75cm row spacing suits all crops. Closer row spacing enables earlier crop canopy (plants touching in the rows, thus shading out weeds). Draught animals can be used with 75cm, leaving every third row out, resulting in a twin-row or hedgerow effect. This leaves space for a pathway for spraying and picking.
- 90cm row spacing makes it easier for the use of draught animals, but it makes it more difficult to achieve early crop canopy. If legumes are grown, it would be better to put a double crop line 10 or 15cm either side of the regular 90cm lines.

Figure 3.2 Planting Basin



Digging the basins

- Starting at the first knot at one end of the string, stand facing uphill and dig each b asin about 15cm (or the length of your hand) long, 15cm wide, and 15cm deep. Keep the soil dug from the basin on the downslope side of the basin, to use for cover later on. (See Figure 3.2).

Field of basins

Key Principle

Ensure minimum soil disturbance by not tilling. Prepare basins precisely and to standard. Basins allow you to use the correct amounts of seed and fertilizer at the correct time. This avoids waste and saves money.

- When the basins for that row have been made use the sticks to measure the distance to the next row. Move the pegs and stretch out the string between them.
- Repeat the process of digging holes. The rows of basins can be in line with each other or staggered.

3.2 Applying manure, fertilizer and lime

Both organic and inorganic basal fertilizer can be applied soon after land preparation and before the rains (September to November).

- Manure: one to two handfuls of manure or compost should be applied to each basin and mixed with soil. Make sure the same amount of manure or compost is placed in each basin.
- Compound fertilizer: if inorganic basal fertilizer is available, put one level beer bottle cap per basin. Compound fertilizer can be placed directly under the seed, making sure that each seed has equal access to the fertilizer. A 1cm layer of soil should be placed over the fertilizer before seeding, to protect the seed from hydroscopic 'burning' by the fertilizer.

Manure application

Compound D application

- Use slightly more manure and fertilizer in wetter areas.
- Wherever possible soil samples should be taken and lime applied according to PH.

After you have applied the manure, fertilizer and lime, use a hoe to partly fill the basins with clod-free soil from the pile next to the basin. Make sure you leave the surface lower than the ground so that water collects in the basin.

Key Principle

Avoid waste: use inputs precisely and efficiently to maximise returns to labour and money.

Basal Compound D application

Basins are ready for manure or fertilizer application

3.3 Planting

It is important to plant at the correct time so that the seeds germinate quickly and evenly. Sowing should be done immediately after the first effective rains that fill the basin and when the basin is still moist. An effective rainfall event is 30mm for sandy soils and 50+mm for heavier soils.

- Plant after rainwater has collected in the basin and drained away.
- Plant seeds at the population and depth appropriate to your crop. For example for maize and sorghum seeds plant at a rate of three seeds per basin.
- Place the seeds in an evenly spaced line in each basin, one at each end and one in the middle of the basin.
- Cover the hole using the remaining heaped soil next to the basin leaving a level surface.
- Make sure no stones or heavy clods cover the seeds otherwise they will not be able to push through to the soil surface.
- Try to finish planting a field in one day. Leave the mulch cover intact between the basins.

Plant after rainwater has collected in the basin and drained away

Number of maize plants per hectare in different Natural Regions

- See figure 3.1 for an overview of row spacing, and numbers of basins per hectare for each Natural Region of Zimbabwe.
- In each case three seeds are planted per basin and after germination thinned back to an average of two seedlings per basin.
- In Natural Region II farmers can aim for 44,000 maize plants per hectare when planting at 75 x 60cm.
- In Natural Region III farmers are advised to aim for 35,400 maize plants per hectare when basins are at 75 x 75 cm spacing.
- For Natural Regions IV and V farmers can achieve 37,000 maize plants per hectare. As seen above this means that they dig 18,500 basins per hectare at a spacing of 90 x 60 cm.

Crop choice and rotation

- The benefits of rotating crops are described in Section 1. Recommended crop rotations for Zimbabwe vary between Natural Regions and according to the endowment level of the farmer.
- Broadly speaking, households who have labour, draught power and finances are advised to rotate cereal-cash crop-legumes on three 0.25ha plots. See Table 3.1 for recommended packages.
- The standard package for households recommends cereal-legume rotation only on two 0.25 ha plots.
- Vulnerable households should initially focus on staple crops only, with the option to intercrop cereal and legume on one 0.25 ha plot.
- Recommended cereals include maize (Natural Regions II-IV), sorghum (Natural Regions III-V) and millet (Natural Regions IV and V).
- In Natural Regions II, III and IV, cotton or sunflowers may be grown as a cash crop.
- Recommended legumes include soya (Natural Regions II and III) and cowpeas (Natural Regions III-V). Groundnuts can be grown in all Regions although they require different planting and harvesting techniques, so caution should be exercised and up to date advice sought before growing groundnuts.

See Section 4 for conservation agriculture packages and details of planting populations for different crops in different Natural Regions.

Key Principle

Plant on time and mix and rotate crops.

3.4 Mulching and stover management

We have seen in Section 1 that mulching is a key component of conservation agriculture. Crop residues should be left on the field after harvesting if at all possible. Stalks should be knocked down flat and spread out as evenly as possible. Livestock may be allowed to graze but grazing should be controlled so that at least 30% of surface cover remains. Additional dry organic material such as leaves can be used to supplement or substitute for stover if necessary, and should also be placed on the field as early as possible in the season to buffer the soil against extreme temperatures, suppress weeds and improve soil fertility.

Use crop residues or mulch around the basins to protect the soil and suppress weeds.

3.5 Weeding and thinning

Weeding should be done before, during and after the season for maximum control. In this way you can prevent weeds from growing big, flowering and setting seeds. In successive years of implementing conservation agriculture the weed populations of the plots should reduce.

- Winter weeding should be done after harvesting between May and July. Winter weeding is done before basin preparation to ensure the field is free of weeds and to prevent dispersal of weed seeds.
- It may also be necessary to do pre-planting weeding immediately before planting.
- Post-plant or first weeding should be done about two weeks after planting. Weeding of the plot should be completed in one or two days. Weed before flowering!
- Thin 2-3 weeks after germination by removing the weakest seedling, leaving an average of two seedlings per basin. In the event of a good germination, resist the temptation to leave three seedlings per basin, as this will result in a lower yield.

3 keys to good weed control

1. Hoe weeds when they are still very small - it's easier than removing bigger weeds and it reduces crop loss.
2. Take care when planting your seeds to be precise - this will ensure a good early crop canopy to shade out the weeds.
3. Weed again at the end of the growing phase.

TIP: Finding mulch can be a real challenge, especially in drier areas. All participants should be encouraged to designate a small area (such as 10m x 10m) near their homestead or access roads, and mulch that area heavily and neatly. They should defend this area from livestock as much as possible. This will provide a demonstration that will convince the community of the benefits of mulch!

Weeding

- Some practitioners also recommend that a second weeding is done around six weeks after planting, before topdressing.
- Post-topdressing weeding is essential so that the benefits of the fertilizer go to the crop and not to the weeds.

Thin crops 2-3 weeks after germination.

Key Principle

Weed plots thoroughly and on time: timely weeding can increase yield by up to 50%.

- It is a good idea to slash weeds immediately after the harvest too, to prevent them from producing seeds.
- Whilst weeding, stand between the rows to avoid compacting the basins themselves.
- All weeding should be done by hand or using hand held implements such as hoes and machetes that disturb the soil as little as possible.
- Weeds should be pulled out carefully or cut at the surface and not dug out. Use the hoe as a cutting knife rather than a digger so as not to disturb the soil.

3.6 Topdressing

Nitrogen fertilizer should be applied to cereal crops at the five to six leaf stage or when plants are knee-height or 30cm tall, soon after the first weeding.

Topdressing should be applied at a rate of one beer bottle cap per basin. This is equivalent to approximately 80kg of ammonium nitrate (AN) per hectare. Apply onto moist soils with precision: this will ensure the nutrients are available where they are needed. Place the fertilizer around and not on the plants to avoid burning. Each plant in the basin must have equal access to the topdressing.

Key Principle

Avoid waste: conservation agriculture uses inputs precisely and efficiently to maximise returns to outlay.

Top dress with AN. Apply only one bottle cap of AN per every basin, except where there are no germinated plants in the basin.

3.7 Harvesting and dry season management

Between March and June harvest the crop. Timely harvesting will prevent losses to birds. After removing maize cobs, cut the plant at ground level. Leave the stems and leaves lying in the field, to protect and improve the soil. Leave the roots in the soil, do not uproot them. This disrupts the life cycle of the stalk borer larvae so it cannot develop.

Keep crop residues to protect the soil.

Key Principle

Keep crop residues! Do not burn.

After harvesting prepare basins for planting, in the same positions as last season. You will be able to re-use most of the basins with only minor repairs.

3.8 Frequently Asked Questions

For extension officers to promote conservation agriculture effectively they must present the pros and cons of the approach and be able to answer farmers' questions. Below are some common questions that farmers and others may ask during training and demonstrations in conservation agriculture.

Q: Is it not true that conservation agriculture is more labour-intensive than conventional farming?

A: Conservation agriculture uses far less labour than traditional hand-hoe systems. Planting basins can be prepared over several months before the rains come. Also, if basins are marked and made properly in the first year of implementing conservation agriculture then in future years they will need less labour because farmers can make new holes directly over the top of the previous season's hole. Similarly with weeding, if winter weeding is done before basin preparation, this will reduce the number of weeds in the field and the amount of labour needed for weeding later in the season, and again the effort is spread over the year. By the third year of conservation agriculture, the number of weeds will have decreased significantly so weeding become less onerous. And the labour requirement per tonne of maize also declines hugely due to the higher production.

Q: How can we save our crop residues to use on our fields when they are needed to feed our cattle?

A: This is one of the more problematic issues especially in Natural Regions IV and V where alternative grazing and sources of mulch are very limited. Explore with farmers how to integrate livestock and fodder management practices in the conservation agriculture programme. Animals can be allowed to graze conservation agriculture plots as long as 30% of the soil remains covered. If necessary stover can be removed, stored separately and re-laid at the onset of the season. This also helps prevent destruction by termites. However storage reduces the 'mulch effect' which suppresses weeds during the winter and prevents evaporation from the soil prior to the start of the season. If cover crops are grown in the field some of these can be fed to livestock or fodder may be grown separately. You can work with farmers to identify other sources of mulch such as grass and kitchen compost for their fields.

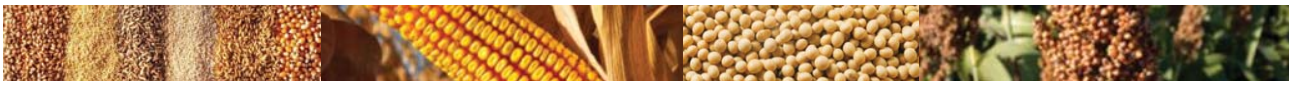
Farmers should start conservation agriculture on a small area where they can ensure residues remain. In the second or third year of implementation they will be able to see that as crop yields increase, so does the quantity of stover, and more becomes available for both livestock and mulching. Then they can increase the area under conservation agriculture.

Q: How can we prevent crop destruction by cattle of early emerging crops in our conservation agriculture plots?

A: Because in conservation agriculture, farmers are encouraged and able to plant on time with the first rains, this may result in their plots showing the first green shoots in the community. This may attract livestock who graze the conservation agriculture plots before the official announcement of the need to herd livestock by village elders. Short term solutions might be to guard the field during initial phases and establish live fencing to reduce the field exposure. Longer term solutions require the participation of traditional leaders in discussions prior to implementing conservation agriculture, and increasing the numbers of local farmers in conservation agriculture programmes, so that the time to start livestock herding can be brought forward for the whole community.

Q: If we use maize stover as mulch, will stalk borer damage the crop?

A. Stalk borer does not survive in maize stalk once the stalk has been cut down at ground level. The crop must be broken down at ground level and the stumps laid flat on the ground to kill stalk borers. Crop rotation also helps to reduce pest build up.



4. RESOURCES FOR CONSERVATION AGRICULTURE

4.1 Zimbabwe Conservation Agriculture Task Force members 2009

Action contre la Faim
www.actioncontrelafaim.org/uk/our-missions/worldwide-missions/zimbabwe/

African Conservation Tillage Network
9 Balmoral Road
Borrowdale
Harare
Zimbabwe
Tel: +263 (0)4 882107
Fax: +263 (0)4 885596
Email: actnetwork@africaonline.co.zw
www.act.org.zw

AGRITEX - Agricultural Extension Services
PO Box 8117
Causeway
Harare
Zimbabwe
Tel: +263 (0)4 707311, 794601
Fax: +263 (0)4 730525

CAPNET - Conservation Agriculture Promotion Network
CAPNET coordinates Zimbabwean government departments in conservation agriculture programming.

Care International
8 Ross Avenue
Belgravia
Harare
Zimbabwe
Tel: +263 (0)4 727986/7/8, 708047, 708115, 790878
Fax: +263 (0)4 727989
Email: carezim@carezimbabwe.org
www.carezimbabwe.org

Christian Aid
Africa Synod House
Selous/ Fourth Street
P.O.Box CY 1629
Causeway
Harare
Zimbabwe
Tel: +263 (0)4 737289
Email: wanderson@christianaid.co.zw
www.christianaid.org.uk

Concern Worldwide
Tel: +263 (0)4 705845/9
www.concern.net

CYMMT - International Maize and Wheat Improvement Centre
P.O. Box MP 163
Harare
Zimbabwe
www.cimmyt.cgiar.org

European Union
1 Norfolk Rd
Mount Pleasant
Harare
Zimbabwe

FAO hosts the Zimbabwe Conservation Agriculture Task Force.

FAO - Food and Agriculture Organisation of the United Nations

Block 1
Tendeseka Office Park
Corner Samora Machel Av/Renfrew Rd
Eastlea
Harare
Zimbabwe
Tel: +263 (0)4 253655-58, 791407, 252021
Email: michael.jenrich@fao.org
www.fao.org/ag/ca

ICRISAT – International Crops Research Institute for the Semi-Arid Tropics

Matopos Research Station
PO Box 776
Bulawayo
Zimbabwe
Tel: +263 (0)83 8311-15
Fax: +263 (0)83 8253/850
Email: icrisatzw@cgiar.org
www.icrisat.cgiar.org

River of Life/ Farming God's Way

Plot P
Good Hope Farm
Arnott Road
Westgate
Harare
Zimbabwe
Tel: +263 (0)4 300550, 302264
Email: agriway@mweb.co.zw
www.farming-gods-way.org

University of Zimbabwe

Dept. of Soil Science
PO Box MP 167
Mount Pleasant
Harare
Zimbabwe.
Tel: +263 (0)4 339191
Email: chuma@africaonline.co.zw

Welthungerhilfe

1 & 3 Dundry Close
Strathaven
Harare
Zimbabwe
www.welthungerhilfe.de/home_eng.html

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- Department for International Development (DFID)
- European Union
- European Commission's Humanitarian Aid Office (ECHO)
- Royal Norwegian Embassy
- Government of South Africa
- United States Agency for International Development (USAID)

4.2 Guidelines for Simple Paired Plot Demonstration

The objective of the simple paired plot demonstration is to show farmers and extension staff the benefits of basin tillage and conservation agriculture.

Designate a paired plot layout for the trial, consisting of an area of 0.1ha (0.25 acres) to be used for conservation agriculture (planting basins) and the adjoining 0.1ha (0.25 acres) to be the "control" plot, farmed by traditional farmer practice. The benefits of conservation agriculture should be clearly demonstrated by larger yields than those produced on the control plot.

Planting basins demonstration plot

1. Prepare planting basins spaced at either 0.75m x 0.75m or 0.9m x 0.6m giving a total of 1850 basins per 0.1 ha (0.25 acres) in unploughed land.
2. Apply basal fertilizer at land preparation – either manure or compound fertilizer.
   a) Manure: The implementing organisation may need to buy manure for some of the participating farmers. Apply a handful of manure per planting basin. Cover the manure with a thin layer of soil. Leave the basins open until you receive the first effective rains.
   b) Compound D: If Compound D is available, use a level beer bottle cap per planting basin (8kg per 0.1ha).
3. Plant immediately after receiving a good planting rain that fills the basin. Plant maize/cereal grain in the basins at rate of 3 seeds per basin and cover (2.5 kg maize/0.25 acre, 1kg sorghum, 0.5kg millet). Place one seed at each end of the planting basin and one in the middle.

Possible plot layouts are 20m by 50m by 2
0.1 ha Maize/Sorghum or Pearl Millet - planting basins
0.1 ha Maize/Sorghum or Pearl Millet - farmers' own practices

4. Thin plants 14-21 days after emergence down to an average of two plants per basin.
5. Apply ammonium nitrate, try a level beer bottle cap per planting basin (8kg for 0.1 ha) at 5 to 6 leaf stage.
   - Leave crop residue between the planting rows if available.
   - Keep plots weed free, at least 2 weedings by hand at 2 and 6 weeks might suffice.
6. Weeding of the entire plot should be completed in 1 or 2 days. Weed pressures may be heavier in year 1.

Control Plot: Farmers' own practice

- Provide an equal quantity of manure or basal fertilizer to use on the farmer practice plot as used on the demonstration planting basin plot.
- Host farmer plants the other 0.1 ha of cereal as he/she normally would and manages accordingly. This plot does not have to be planted on the same day as basin plot.
- Supply 8kg ammonium nitrate for topdressing for the farmer practice plot if requested.

Inputs that extension organizations may need to provide in Natural Regions IV and V to establish demonstrations.

Item	Per Farmer	Per Ward (5 farmers)	Per District (10 wards)
Maize Seed	5kg	25kg	250kg
Compound D*	16kg	80kg	800kg
Ammonium Nitrate	16kg	80kg	800kg
Planting line	1	5	50
Tape measure		1	10
Spring Balance 50kg		1	10

** if manure available, encourage farmers to use this resource*

4.3 Conservation Agriculture Calendars

Conservation Farming Calendar - First Year Farmer												
Farmer Activities	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**
Winter weeding												
Mark out fields												
Mulch/residue management												
Land preparation/dig basins												
Apply manure/fertilizer (lime where necessary)												
Pre-plant weeding if necessary												
Plant												
Post plant weeding												
Apply N topdressing at 5 to 6 leaf stage												
Post topdressing weeding												
Clean weeds at harvest time												
Harvest												

NOTES

Conservation Farming Calendar - First Year Farmer												
Implementing Partner/ Extension Activities	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**
Contact and sensitise communities												
Needs assessment planning												
Selecting Farmers												
Order Inputs												
Deliver seed and basal fertilizer												
Deliver Topdressing												
Attend training of trainers at River of Life (To be arranged - TBA)												
Attend Training of trainers at ICRISAT												
Field days/exchange visits (TBA)												
Farmer training/ Methods Demo/Field visits												
Introduce conservation agriculture to Community												
Laying out paired plot & land preparation /application of basal fertilizers												
Visit each farmer field to check basins have been dug												
Visit each farmer field after distribution of basal fertilizer												
Demonstration of pre-plant weed control and planting												
Visit each farmer field at/ just post planting												
Demonstration of post plant weeding/ topdressing at 5 to 6 leaf stage												
Visit each farmer field after weeding/topdress demonstrations												
Visit to each farmer fields pre-harvest to check on weeds etc.												
Field days/Results report back												

Conservation Farming Calendar - Second Year Farmer												
Farmer Activities	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**
Winter weeding												
Mark out fields												
Mulch/residue management												
Land preparation/dig basins												
Apply manure/fertilizer (lime where necessary)												
Pre-plant weeding if necessary												
Plant												
Post plant weeding												
Apply N topdressing at 5 to 6 leaf stage												
Post top dressing weeding												
Clean weeds at harvest time												
Harvest												

NOTES

Conservation Farming Calendar - Second Year Farmer continued												
Implementing Partner/ Extension Activities	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**
Agree modifications to demonstrations												
Identify which Year 2 farmers do what												
Order Inputs												
Deliver seed and Basal Fertilizer												
Deliver Top Dressing												
Attend training of trainers at River of Life (TBA)												
Attend Training of trainers at ICRISAT												
Field days/exchange visits												
Farmer training/ Methods Demo/Field visits												
Introduce rotations to Year 2 Farmers												
Laying out paired plot & land preparation /application of basal fertilizers												
Visit each farmer field to check basins have been dug												
Visit each farmer field after distribution of basal fertilizer												
Demonstration of pre-plant weedcontrol and planting												
Visit each farmer field at/ just post planting												
Demonstration of post plant weeding/ topdressing at 5 to 6 leaf stage												
Visit each farmer field after weeding/topdress demonstrations												
Visit to each farmer fields pre-harvest to check on weeds etc.												
Field days/Results report back												
Discuss how facilitate access to inputs for year 3 and beyond												

Conservation Farming Calendar - Third Year Farmer

Farmer Activities	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Agree modifications to demonstrations												
Winter weeding												
Mark out fields												
Mulch/residue management Land preparation/dig basins												
Apply manure/fertilizer (lime where necessary)												
Pre-plant weeding if necessary												
Plant												
Post plant weeding												
Apply N topdressing at 5 to 6 leaf stage												
Post topdressing weeding and harvest time weeding												
Harvest												
Extention Activities												
Identify which Year 3 farmers do what & encourage farmers to expand area												
Identify, source & distribute inputs												
Attend training of trainers at ICRISAT/ROL (TBA)												
Field days/exchange visits and results report back (TBA)												
Farmer training/ Methods Demo/Field visits												
Introduce rotations to Year 3 Farmers												
Visit each farmer field to check basins have been dug & fertilized												
Visit each farmer field at/just post planting												
Visit each farmer field after weeding/topdress demonstrations												
Visit to each farmer fields pre-harvest to check on weeds etc.												

4.4 Further Reading

A good source of information on conservation agriculture including animal-draught power and mechanised options is *'Conservation agriculture: a manual for farmers and extension workers in Africa'* published by the International Institute of Rural Reconstruction, Nairobi and the African Conservation Tillage Network, Harare.

4.5 Conservation Agriculture Packages

The Zimbabwe Conservation Agriculture Task Force (ZCATF) has developed conservation farming packages for Natural Regions II through IV. These packages are goals that programs should try to achieve within 5 to 7 years. The recommended packages are summarized below.

Based on the possible crop rotations outlined in Table 4.1, three conservation agriculture packages are recommended by the ZCATF for households with different resource statuses (See Table 4.1 opposite).

Table 4.1 Example household packages

Full package (households with no labour, draught power or financial constraints) – see Table 4.3 for comprehensive agronomic details.

- Three by 0.25 ha plots
- Cereal/cash crop/legume rotation

Standard package – see Table 4.4 for comprehensive agronomic details.

- 2 by 0.25 ha plots
- Cereal/legume rotation

Vulnerable Households Package – The focus of the Protracted Relief Programme – see Table 4.5 for comprehensive agronomic details.

- 0.25 ha plot
- 0.2 ha cereals, 0.05 ha legume
- Option for cereal/legume intercropping
- In years one and two it is recommended that the program focus only on staple cereals to address food security constraints.

Table 4.2 Conservation farming cropping packages recommended by Natural Region in Zimbabwe

Natural Region	Rainfall (mm)	Rainfall characteristics	Cropped area	Crops/ Rotation
II	650 to 800	Good distribution	3 x 0.35 ha	Maize-Cotton-Legume (Groundnuts* /Soybean
III	650	30 to 40 rain days	3 x 0.35 ha	Maize-Cotton-Legume (Groundnuts/Cowpea/ Soybean)
IV	500 to 650	30 rain days	3 x 0.35 ha	Maize/Sorghum/Pearl Millet Groundnuts/Cowpea Sunflower/Cotton
V	Less than 500	16 to 30 rain days	3 x 0.35 ha	Sorghum/Pearl Millet/ Maize Groundnuts/Cowpea

**Groundnuts are not recommended for the Planting Basins Package as spacings are unsuitable and leave the groundnuts susceptible to disease and pests.*

Table 4.3 The "Full Package" - ZCATF cropping recommendations for households with no financial or labour constraints					
Full package		NR II	NR III	NR IV	NR V
Plot size		3 by 0.25 ha	3 by 0.25 ha	3 by 0.25 ha	3 by 0.25 ha
Crops	Cereals	Maize (0.25 ha)	Maize or red sorghum (0.25 ha)	Maize, millet or sorghum (0.25 ha)	Millet or sorghum (0.25 ha)
	Legume	Soya, Groundnuts (0.25 ha)	Soya, Groundnuts Cowpeas (0.25 ha)	Cowpeas Groundnuts (0.25 ha)	Cowpeas Groundnuts (0.25 ha)
	Cash	Cotton, sunflower (0.25 ha)	Cotton, sunflower (0.25 ha)	Cotton, sunflower (0.25 ha)	
Spacings: maize/cereal/ cash crop (cm) (basins per hectare)		75 by 60 (44,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)
Spacings: legumes		Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin
Fertilizer for cereals Compound D/Topdress		A minimum of 80kg/ha compound (1 level beer bottle cap per basin) A minimum of 80kg/ha Ammonium Nitrate (1 level beer bottle cap per basin)			
Liming		Based on soil samples			
Planting Date		Early to mid November with first good rains	Mid to late November with first good rains	Late November to early December with first good rains	Early December with first good rains

Table 4.4 The "Standard Package" - ZCATF cropping recommendations					
Standard package		NR II	NR III	NR IV	NR V
Plot size		2 by 0.25 ha	2 by 0.25 ha	2 by 0.25 ha	2 by 0.25 ha
Crops	Cereals	Maize (0.25 ha)	Maize or red sorghum (0.25 ha)	Maize, millet or sorghum (0.25 ha)	Millet or sorghum (0.25 ha)
	Legume	Soya, Groundnuts (0.25 ha)	Soya, Groundnuts Cowpeas (0.25 ha)	Cowpeas Groundnuts (0.25 ha)	Cowpeas Groundnuts (0.25 ha)
Spacings: maize/cereal (cm) (basins per hectare)		75 by 60 (44,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)
Spacings: legumes		Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin
Fertilizer for cereals Compound D/Topdress		A minimum of 80kg/ha compound (1 level beer bottle cap per basin) A minimum of 80kg/ha Ammonium Nitrate (1 level beer bottle cap per basin)			
Liming		Based on soil samples			
Planting Date		Early to mid November with first good rains	Mid to late November with first good rains	Late November to early December with first good rains	Early December with first good rains

Table 4.5 The "Vulnerable Household Package" ZCATF cropping recommendations for vulnerable households					
Vulnerable households		NR II	NR III	NR IV	NR V
Plot size		0.25 ha	0.25 ha	0.25 ha	0.25 ha
Crops	Cereals	Maize (0.2 ha)	Maize or red sorghum (0.2 ha)	Maize, millet or sorghum (0.2 ha)	Millet or sorghum (0.2 ha)
	Legume	Soya, Groundnuts (0.5 ha)	Soya, Groundnuts Cowpeas (0.5 ha)	Cowpeas Groundnuts (0.5 ha)	Cowpeas Groundnuts (0.5 ha)
Spacings: maize/cereal (cm) (basins per hectare)		75 by 60 (44,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)	75 by 75 or 90 by 60 (37,000 p/ha)
Spacings: legumes		Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin	Same but plant 10-12 seeds per basin
Fertilizer for cereals Compound D/Topdress		A minimum of 80kg/ha compound (1 level beer bottle cap per basin) A minimum of 80kg/ha Ammonium Nitrate (1 level beer bottle cap per basin)			
Liming		Based on soil samples			
Planting Date		Early to mid November with first good rains	Mid to late November with first good rains	Late November to early December with first good rains	Early December with first good rains

Note: In initial years plant cereals to address food security issues. Consider introducing the legumes in year 3 or 4.

Farming for the Future

Conservation agriculture is a way of farming that conserves soil and water while promoting sustained, improved crop yields.

Farming for the Future is the indispensible manual on conservation agriculture for agricultural extension officers, trainers, project officers and field staff in Zimbabwe.

Drawing from field experience and farmer testimonies, practical guidance is provided on:

- how to work with rural communities to promote conservation agriculture
- how to overcome barriers to the uptake and implementation of conservation agriculture
- how to plan and conduct field-based training, and
- how to prepare and manage planting basins, with tailored guidelines for each Natural Region of Zimbabwe.

Published by the Zimbabwe Conservation Agriculture Task Force, **Farming for the Future** also contains guidelines for simple paired plot demonstrations, a 3 year implementation calendar, and recommended conservation agriculture packages.

The manual also includes a simple theoretical overview of the origins, principles, significance and relevance of conservation agriculture, as well as contacts for further information and resources.