Conservation agriculture demonstration guide

Prepared for:
Agricultural extension staff under Sudan Productive Capacity
Recovery Programme (SPCRP)

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1 Background

This manual guideline for conservation agriculture demonstration plot was developed as one of the output of the training on CA/Animal traction held in Rumbek from 20th March to 1st April 2009. The training was organized by Sudan Productive Capacity Recovery Programme (SPCRP) which is a GOSS programme executed by FAO and funded by European Commission (EC). The participants at the training were 18 front line extension officers from the ministry of agriculture from three states of Lakes, Western Bahr El Ghazal and Northern Bahr El Ghazal.

The training was facilitated by two consultants; one on conservation agriculture was from the African Conservation tillage network (ACT) while the other ox plough consultant came from FAO Juba.

This manual guideline is intended to support the ToT trainees especially in the establishment of the conservation agriculture demonstration plots within their states and also within the counties where FFS are already established.

2 Introduction

This is a simple guide manual for the freshly trained ToTs on conservation agriculture. As a trained ToT, your ultimate goal will be to translate all that you have learnt into practice but first create awareness among your target group and offer simplified training to the farmers with an aim of making them understand the conservation agriculture technology. The initial objective will be to convince them that it is indeed a good farming practice which is capable of giving them better result compared to the normal farming practices they are used to.

To do this successfully, you will first of all need to prepare yourself by revising your training notes and convincing yourself first about the benefits of the technology. **YOU HAVE TO BE A CONVERT BEFORE PLANNING TO CONVERT OTHERS IF YOU ARE TO SUCCEED.**

The purpose of this guide manual therefore is only to highlight key issues and where necessary, you are advised to refer to your training handouts or any publication on conservation agriculture.

3 Introduction to Conservation Agriculture

Crop production in tropical and subtropical areas in the world has been influenced heavily by European developments. Advances in machinery and equipment were introduced in tropical areas without critically testing and validating them first. We now know that discs are not the most suitable equipment to be used under tropical conditions. In Southern Sudan however, minimal or no advances in agro machinery has been achieved due to many years of war. The agricultural development in the country is therefore at formation stages hence care should be taken not to repeat past mistakes which have been experienced in other African countries.
Traditionally, tillage forms an important part of crop production in Southern Sudan, the use of *maloda*\(^1\) is a common practice. The principal motive is always to prepare the soil so as to facilitate planting and accelerate seedling growth.

Besides that, land preparation is considered necessary to obtain a uniform crop, without the interference of weeds. Just like in a lot of places in the world, a bare soil is still considered pleasant to the eyesight and a farmer with nicely ploughed fields is considered a good farmer.

The passage of machinery and continuous use of ploughs and harrows at the same depth and during periods of high moisture content, creates compact sub-surface layers known as plough pans or harrow pans or hard pan.

These hard pans have damaging effects on the development of plant root systems, oxygen availability and soil water movement. The consequences are disastrous. The rate of water infiltration is drastically reduced with a simultaneous increase in surface runoff, loss of soil, nutrients, organic matter, calcium and seeds. The activity of soil biota is also negatively affected.

Over the last decades, farmers have expressed their concern about increased soil erosion, labour and input costs caused by heavy ploughing.

Some farmers have tried to reduce the intensity of land preparation, but often ended up facing problems like low germination, low productivity and high weed infestation.

The developments in research have resulted in adaptation of seeding machinery, crop rotation with cover crops and improved herbicides. This has allowed farmers to reduce, and even eliminate land preparation activities and at the same time maintain or improve yield levels.

At the moment alternative options to soil tillage exist, like conservation agriculture, which breaks with former beliefs. Conservation agriculture maintains the agricultural lands of the world in a sustainable way.

In order to be able to transfer and realize this technology, it is necessary to understand all its different technical aspects.

### 3.1 MAIN PRINCIPLES OF CONSERVATION AGRICULTURE

Conservation agriculture technology is a farming system that embraces the following principles:

- Minimum soil disturbance

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1 A traditional tool used for land preparation, planting and weeding
• Permanent soil cover and
• Crop rotation/association

The farming technique utilizes soils and crops with the aim to redress the excessive mixing-up of the soil and maintain the crop residues on the soil surface in order to minimize damage to the environment.

In this way, it will:

• Provide and maintain an optimum condition of the root-zone to maximum possible depth for crop roots to function most effectively and without hindrance, in capturing high amounts of desired plant nutrients and water.

• ensure that water enters the soil so that:
  ▶ plants never, or for the shortest time possible, suffer water stress that will limit the expression of their potential growth; and so that
  ▶ residual water passes down to groundwater and stream flow, not over the surface as runoff.

• favour beneficial biological activity in the soil in order to
  ▶ maintain and rebuild soil architecture;
  ▶ compete with potential in-soil pathogens;
  ▶ contribute to soil organic matter and various grades of humus;
  ▶ contribute to capture, retention, and slow release of plant nutrients.

• Avoid physical or chemical damage to roots that disrupts their effective functioning.

3.2.1 NO OR MINIMAL MECHANICAL SOIL DISTURBANCE

Direct seeding involves growing crops without mechanical seedbed preparation or soil disturbance especially after the harvest of the previous crop.

• Other implements used in seed bed preparation which causes minimal disturbance to the soil include Magoye ripper and sub soiler. In cases of virgin lands however, limited use of ploughing either using ox or disc plough or maloda is permitted at the initial stages which should be immediately followed by other steps of CA.

• The term direct seeding is used synonymously with no-till farming, zero tillage, no-tillage, direct drilling, etc.

• No-tillage involves slashing the weeds and previous crop residues or spraying herbicides for weed control, and seeding directly through the mulch. All crop residues are retained, and fertilizer and amendments are either broadcast on the soil surface or applied during seeding.
Effects:

- minimal destruction of soil structure through compaction and/or plough pan development
• slower mineralization of soil organic matter through less exposure to climatic elements and soil micro and macro fauna
• no disturbance of worms and other soil inhabitants, maintained soil biodiversity and balanced activity and food web in the soil including natural predation and no breaking of roots
• better infiltration and circulation of air and water into and through the soil profile through maintained bio-pores and vegetative cover and optimal rooting
• reduced evaporation from bare soil surfaces
• soil regeneration rate through mineralization and decomposition and re-structuring higher than soil degradation through loss of porosity and soil particles (erosion) and loss of plant nutrients (fertility)
• improved nutrient retention and availability for plant growth and reduced leaching of nitrogen and other nutrients

Means and practices:
• no or minimal ploughing, discing, harrowing etc.
• use of direct seeding through crop residues
• no crop residue burning
• no incorporation of crop residues into the soil
• permanent bed planting/planting station ridgeline/rip line
• use of crop rotations, balanced biodiversity and pesticides for weed/pest control instead of ploughing or using high rates of chemicals that endanger soil life and disturb the soil and ecological processes including the hydrological cycle and water quality

3.2.1 PERMANENT SOIL COVER
A permanent soil cover is important to protect the soil against the impact of rain and sun, to provide the micro and macro organisms in the soil with a constant supply of “food” and to alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots.
Effects:

- improved infiltration and retention of soil moisture resulting in less severe, less prolonged crop water stress and increased availability of plant nutrients
- source of food, habitat and energy for diverse soil life: creation of channels for air and water, biological tillage and substrate for biological activity through the recycling of organic matter and plant nutrients
- increased humus formation
• reduction of impact of rain drops on soil surface resulting in reduced crusting and surface sealing
• consequential reduction of runoff and erosion
• soil regeneration is higher than soil degradation
• mitigation of temperature variations on and in the soil
• better conditions for the development of roots and seedling growth

Means and Practices:
• use of appropriate/improved seeds for high yields as well as high residue production and good root development
• integrated management and reduced competition with livestock or other uses e.g. through increased forage and fodder crops in the rotation
• use of diverse cover crops, especially multi-purpose crops, like nitrogen-fixing, soil-porosity - restoring, pest killers, etc.
• optimization of crop rotations in spatial, timing and economic terms
• targeted use of herbicides for controlling cover crop and weed development

3.2.1 CROP ROTATION
Rotation of crops is not only necessary to offer a diverse "diet" to the soil micro organisms, but as they are rooting at different soil depths, they are capable of exploring the different soil layers for nutrients.

Nutrients that have been leached to deeper layers and that are no longer available for the commercial crop can be "recycled" by the crops in rotation. This way the rotation crops function as biological pumps. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna, as the roots excrete different organic substances that attract different types of bacteria and fungi, which in turn, play an important role in the transformation of these substances into plant available nutrients.
**Effects:**

- higher diversity in plant production and thus in human and livestock nutrition
- reduction and reduced risk of pest and weed infestations
- greater distribution of channels or bio-pores created by diverse roots (various form, size and depths)
- better distribution of water and nutrients through the soil profile
- exploration for nutrients and water of the whole soil profile by roots of many different plant species resulting in an optimal use of the available nutrients and water
- increased nitrogen fixation through certain plant-soil biota symbionts and improved balance of N/P/K from both organic and mineral sources
- increased humus formation

**Means and practices:**

- Design and implementation of crop rotations according to the various objectives: food and fodder production (grain, leaf, stalks), residue production, pest and weed control, nutrient uptake and biological subsurface mixing/cultivation, etc.
- Use of appropriate/improved seeds for high yields as well as high residue production of aboveground and below-ground parts, given the soil and climate conditions
4 ADVANTAGES OF CONSERVATION AGRICULTURE

• All new technologies need to have benefits and advantages that attract a broad group of farmers who understand the differences between what they are doing and what they need.

• In the case of conservation agriculture these benefits can be grouped into three as follows:
  – economic benefits that improve production efficiency
  – agronomic benefits that improve soil productivity
  – environmental and social benefits that protect the soil and make agriculture more sustainable

4.1 ECONOMIC BENEFITS

• Three major economic benefits can be observed in this category:
  – Time saving and thus reduction in labour requirement.
  – Reduction of cost of production,
  – Higher efficiency.

• The positive impact of conservation agriculture on the distribution of labour during the production cycle and, even more importantly, the reduction in labour requirement is the main reason for farmers especially other parts of the world such as in Latin America to adopt conservation agriculture, especially for farmers who rely fully on family labour.

• The substitution of conventional tillage by conservation agriculture allows a more even distribution of labour throughout the year, because of the elimination of burning of the crop residue, ploughing, harrowing and intensive/deep weeding activities and the use of cover crops and some circumstances herbicides.

• Not only the total time required for agricultural production is reduced, but also the number of activities is reduced.

• Especially in areas where (family) labour is becoming a constraint, because of migration or death, war conflicts, conservation agriculture is a good option for farmers. The returnees from post war conflict in Southern Sudan could embrace the farming method since it is less demanding in terms of labour requirement.

• The reduction in on-farm labour requirements allows farmers to:
  – extend the cultivated area,
  – hire themselves out in off-farm employment,
  – diversify their activities, including processing of agricultural products, or
  – reduce the cultivated area, because of increased production and allow the marginal area to regenerate.

• In the case of animal traction the reduction in labour when applying conservation agriculture can be as high as 86%.
• Time required to prepare the land using a tractor is reduced by 58% under conservation agriculture.
• Crop yields under conservation agriculture are less variable through the stabilizing effects of favourable conditions of soil properties and microclimate.
• Overall, with equal or slightly higher yields and reduced costs, the farm income increases under conservation agriculture.
• In production systems that use manual labour (Maloda) or animal traction physical exercise of the farmer (i.e. walking in the field) is also reduced considerably. Besides a reduction in time required for field activities, the costs for operation and maintenance are also reduced.
• Fuel and lubricants are reduced and also wear and tear of tractors, machinery and other equipment is less, resulting in lower maintenance and repair costs, and an increase in life span of the equipment.
• As ploughing activities are eliminated, farmers do not need heavy machinery or tractors, resulting in lower investment or write-off costs.
• Generally, the costs for inputs are a bit higher in conservation agriculture compared to conventional tillage, due to cover crop seeds and agrochemicals.

4.2 AGRONOMIC BENEFITS
• Adopting conservation agriculture leads to improvement of soil productivity:
  – Soil Organic Matter increase
  – In-soil water conservation
  – Improvement of soil structure, and thus rooting zone
• The constant addition of crop residues leads to an increase of the organic matter content of the soil.
• In the beginning this is limited to the top layer of the soil, but with the years this will extend to deeper soil layers.
• Organic matter plays an important role in the soil: fertilizer use efficiency, water holding capacity, soil tilth, rooting environment and nutrient retention, all depend on organic matter.
• The increased organic matter content together with soil cover leads to increased water holding capacity of the soil.
• As a consequence less irrigation water is needed to irrigate a crop especially in areas with scarcity of irrigation water. CA can result in a large area being irrigated with the same amount of water.

4.3 ENVIRONMENTAL BENEFITS
• Environmental and social benefits that protect the soil and make agriculture more sustainable through:
  – Reduction in soil erosion, and thus of road and power plant maintenance costs
  – Improvement of water quality
- Improvement of air quality
- Biodiversity increase

• Residues on the soil surface reduce the splash-effect of the raindrops, and once the energy of the raindrops has disappeared the drops proceed to the soil without any harmful effect.
• This results in higher infiltration and reduced runoff, leading to less erosion.
• The residues also form a physical barrier that reduces the speed of water and wind over the surface, of which the latter reduces evaporation.
• More water infiltrates into the soil with conservation agriculture rather than running off the soil surface.
• Streams are then fed more by subsurface flow than by surface runoff. Thus, surface water is clearer and more closely resembles groundwater in conservation agriculture than in areas where intensive tillage and accompanying erosion and runoff predominate.
• Greater infiltration should reduce flooding, by causing more water storage in soil and slow release to streams. Infiltration also recharges groundwater, and thus increasing well supplies.
• One aspect of conventional agriculture is its ability to change the landscape. The restoration of the vegetal cover affects the plants, animals and microorganisms. However, most organisms are negatively affected and either they disappear completely or their numbers are drastically reduced.
• With the conservation of soil cover in conservation agriculture a habitat is created for a number of species that feed on pests, which in turn attracts more insects, birds and other animals. The rotation of crops and cover crops restrains the loss of genetic biodiversity, which is a consequence of mono cropping.

5 LIMITATIONS OF CONSERVATION AGRICULTURE

• The most important limitation in all areas where conservation agriculture is practiced is the initial lack of knowledge.
• There is no blueprint available for conservation agriculture, as all agro ecosystems are different.
• Especially information on locally adapted cover crops that produce high amounts of biomass under the given circumstances is often lacking.
• The success or failure of conservation agriculture highly depends on the flexibility and creativity of the practitioners and extension and research services of a region.
• Trial and error, both by official institutes and farmers themselves, is often the only reliable source of information.
• However, as conservation agriculture is gaining momentum rapidly, in a lot of regions there already exist farmer organizations and groups of interested people who exchange information and experiences on cover crops, tools and equipment used in conservation agriculture.
6 ADOPTION OF CONSERVATION AGRICULTURE

In order to facilitate the change in production system towards conservation agriculture, it is important to understand why farmers think that soil tillage is such an important part of the farming system.

Soil is being tilled in order to break-up the soil after harvest of the previous crop, to eliminate weeds and to prepare the seedbed for the next crop.

Farmers perceive it as being important and besides that they feel comfortable with the technology, they know how to manage the technology and they know that tillage activities render good crop yields.

- Soil tillage is a traditional practice and thus presents some cultural barriers. Tillage is perceived as:
  - necessary
  - soil improvement facilitating crop management giving higher yields

- Tillage is considered a tradition by farmers and changing the practice is difficult because:
  - they are satisfied with the actual practices
  - they know better than anyone else to manage their production
  - they don’t feel an economic pressure to change
  - the attitude towards tillage defines a good farmer and this results in self confidence

6.1 What do one require to start CA?

To start with conservation agriculture you will require:
- a change in crop management system
- an implement or tool that can manage the crop residues or cover crops
- to consider the soil as a biological and self-sustaining productive system
- to adopt a new way of thinking as far as weed management and crop production are concerned
- improve the capacity to tackle new challenges and find a solution

6.2 How a farmer can start conservation agriculture experimentation?
- start with composure and concentrate on achievable objectives in order to gain experience,
- start on a small part of the farm
- start in an area where there is enough cover and use a tool or implement that can easily do the job such “maloda”.

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- in the case of using herbicides, take time to learn to identify and use herbicides in a correct way
- learn to identify and manage different problems
- talk to other farmers who are practising conservation agriculture and learn from their experiences and mistakes

6.3 Important aspects to be considered in the CA adaptation!
- Before starting with conservation agriculture one very important aspect is to plan a good crop rotation.
- As CA is based on soil life, soils have to be brought up to a condition where life can develop.
- Physical and chemical soil limitations, like compaction, drainage and pH, P and K, Should be corrected before changing towards CA.
- Especially in highly degraded or depleted soils this means some sort of melioration investment might be necessary to recover them, such as removing compaction, liming, use of green manure and synthetic fertilizer to correct extreme nutrient deficiencies.
- Soils under CA are usually improving, which means the rate of degradation and erosion is lower than the rate of soil buildup.
- For that reason even degraded soils will recover and might become productive under this system. A good example are the Brazilian Cerrados, which were considered degraded land unsuitable for farming and which have been converted by CA into a highly productive area.
- The focus of conservation agriculture will shift, especially in the first years towards weed control and (cover) crop residue management, and monitoring pest and disease incidence.
- A farmer should be prepared for new habits and timetables.
- Conservation agriculture is based on restoring natural occurring processes and therefore needs a conversion period before the new system is established and the natural balances are restored.
- It is good that starting farmers know each other and they be guided to set realistic expectations. The farmer field school (FFS) will provide an excellent avenue for sharing experience on CA. They as well need a period in order to gain experience with conservation agriculture.
- The experiences of farmers who have been implementing conservation agriculture for a longer time might give indications to new ones which key practices generate success and what mistakes to avoid.
- Information sharing and exchange of experiences is necessary for farmers who are starting with conservation agriculture.
- Especially in the beginning a lot of information is needed on the use and adjustment of tools and implements.
- One of the problems in promoting CA is the fear of changing "good" practices into new practices and the fact that these "good" or actual practices are culturally linked to the communities.
• The change will generate opposition within the community, which is completely normal, but it is useful to identify reasons and strategies for changing before hand.

As extension officers

• You will be the change agent in a your state, county and payam, you should assume a facilitating role that will encourage the confidence of starting farmers that the technology is working.

• This includes demonstrating the technology in other farmers' fields, demonstrating the economic benefits with facts and numbers and training people in the state, county and payams to help others.

• As tillage is considered traditional, some cultural barriers that might aggravate the change process can exist in the region of your mandate. It will always be important to recognize these barriers. They include:
  – not understanding the technology
  – being afraid of the economic risk not being able to buy equipment
  – soils or crops are not adequate and need to be adjusted

• Change usually does not appear "overnight" and will take time. Extension personnel therefore need to be patient and accept that agricultural technologies are adopted step-by-step, because farmers:
  – need to feel at ease with the new technology
  – do not have the capital to invest
  – cannot run a big risk, especially not when the technology is not known
  – need a learning-by-doing environment

6.4 Using FFS groups as an Entry point to CA
Farmer field school approach will be used to introduce CA and to promote adaptation and adoption of the technology among the smallholder farming communities targeted under SPCRP project. The CA demonstration plots will be established and managed by the FFS group members with guidance and support of trained FFS facilitator.

6.4.1 Farmers need assessment
Conservation agriculture as a farming system will be adapted to suit the needs of the farmers and since these needs vary depending on a number of factors, situational and problem analysis will be undertaken by the facilitators prior to the introduction of CA to the established FFS groups. This exercise will serve to inform the facilitator and the project managers on the suitable CA option that would mitigate the production challenges pointed out by the farmers.

i. Situation analysis:
Look at what are the central factors/ issues in the life of a typical household/community in the area:
Highlighting:
  - physical (geographical location, roads, rivers, other physical land marks)
  - climate (rainfall patterns/duration/character, temp)
ii. Problem analysis

- Comparing the status (performance/role/importance) of agriculture “today” to 20 – 30 years ago, list/explain the factors that (i) have not changed, (ii) have declined (iii) have increased/are better
- Develop a chart illustrating how agricultural performance is relating to social problems/issues such as poverty, food insecurity, HIV-aids, etc...
- List in priority order factors (constraints/opportunities) limiting agricultural production-productivity in your area

For the first factor on your priority list identify (i) causes of the problems and causes of causes (ii) effects of the problem (problem tree analysis)

The output of the above exercise will be a simplified baseline report/information which would justify the need for the introduction of a new farming system such as CA but also it will serve to enhance the understanding of the FFS group members on changing climatic conditions hence need to embrace modern farming system with greater chances of adapting and enhancing resilience.

6.4.2 Roles of FFS group members and facilitators

The success of FFS in the promotion of any technology/concept relies heavily on the active involvement, interest and commitment of the FFS group members themselves and the facilitator. The table below therefore highlights the specific roles and responsibilities of both.

<table>
<thead>
<tr>
<th>KEY FFS activities</th>
<th>FFS group members</th>
<th>FFS facilitator</th>
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</thead>
<tbody>
<tr>
<td>• Village immersion</td>
<td>At this stage FFS group not yet formed.</td>
<td>- Entry into the community to explain the objectives and goals of FFS</td>
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<td></td>
<td></td>
<td>- Hold a series of meetings with the local opinion leaders and local administrators</td>
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<td></td>
<td></td>
<td>- Explain the roles of the facilitators</td>
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<tr>
<td></td>
<td></td>
<td>- Discuss what is expected of the community</td>
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<td></td>
<td></td>
<td><strong>The main outcome of this activity</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>The opinion leaders are sensitized on the goals and objectives of forming the FFS and hence supporting the formation of the schools</strong></td>
</tr>
<tr>
<td>• Ground working</td>
<td></td>
<td>- Convenes an open meeting with the opinion leaders with the purpose of explaining the objectives and goals of the anticipated activities to community <strong>(Introduction of CA)</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Highlight the roles of the</td>
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</tbody>
</table>
facilitators, what is expected of the community and the facilitators (levelling of expectations).
- The site(s) for the school(s) is/are chosen and farmers willing to enrol in the respective school(s) are enlisted.

**Expected outcome of this activity**
- Farmers sensitized on objectives of forming FFS
- Farmers enrolled in FFS
- FFS site selected

<table>
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<tr>
<th>Day one of FFS</th>
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- The school leadership is chosen
- Norms and rules governing the school are set
- The FFS concepts and objectives / goals are spelt out to the enrolled participants
- The types of records kept by the school are also spelt out

**Expected outcome of the activity**
- School register developed
- FFS concept, objectives and process understood by farmers
- School leadership put in place
- Host teams (with name and slogan) formed
- FFS meeting day identified
- Procedure for sharing benefits agreed
- Norms and rules of school established

- Facilitate the process on the sideline.
- Keeps copies of the records of the outcome

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<tr>
<th>Setting PTD (CA Demo plot)</th>
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</table>
- Plots are laid out and planted as per the CA layout design shown at the end of this manual guide.
- Participates in planning, laying out preparing the land and planting the designated plots suing the selected CA options.
- Participates in the management of the plots

Must be present during this activity to ensure quality, accuracy and consistency in setting out the plots.
Help the farmers to understand the importance; WHY? Different plots are established.

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<tr>
<th>Running FFS</th>
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- Undertake the day to day management of the CA demo plots.
- Hold regular meetings (weekly/fortnight) and follow the FFS programme
- Host teams created manages sub plots, observes (AESA) and presents to the wider group for more input. The AESA presentations charts should be kept by the secretary of the FFS group for future referencing.

- Participate in the regular FFS meetings only to provide guidance and not to overshadow the FFS group members.
- Provide insight on topical issues observed by the farmers in the field.
- Supervises the farmers records and provides guidance where necessary.
- Help in identifying constraints and challenges and give advise on how to overcome/way forward

<table>
<thead>
<tr>
<th>Special topics</th>
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- Will be demanded by FFS

- Will facilitate the process of
members to address their needs that are not related to lesson of the day e.g. disease control, animal production, social dynamics (group leadership) or physical e.g. water provision.

- Getting the assistance of an expert locally or regionally to come to the aid of the group.
  - Will liaise with the project management

- Hosting a field day
  - This is an open day for exchanging messages/information about CA technology demonstrated to the wider community with the intention of increasing diffusion and a possibility of enhancing adoption.
  - The hosting FFS group members take charge in the entire preparation, setting up the demos, invites guests, welcoming the visitors and taking them around, explaining the demos, entertaining the visitors with CA songs, poems, drama and role plays.

  - Liaise with the project management for logistical support
  - Support the FFS group in the entire preparation.

6.5 How best can farmers’ experiment a new ideas like CA?
To see whether one has successfully tried out a new technique one needs to compare it to the usual practice. Without a comparison one does not know whether the new technique is better or worse than the old one.

6.5.1 How to compare?
- An easy way to compare a new technique with the usual practice is putting the two side by side in the same field.

- It is important to put the two techniques in one single field because conditions in one field are more comparable than in different fields.

- However, take care that the field sites are not too different. For example if one side is a wetland and the upper slope is dry, you cannot compare the two.

6.5.2 What to consider when experimenting?
- If you are concerned how a new technique or idea will perform, try it on a small piece of land only. This will help you to avoid loss of crop if the technique fails.

- Remember testing not only results in success but also in failure.

- Use the same seed and the same spacing on both sides (unless you want to compare varieties and spacing)

- Plant both sides on the same day to ensure that plants on both sides have the same conditions

- Apply the same amount of fertilizer/manure on both sides unless you want to see how the plants grow with different amount of fertilizer or manure
• Weed on the same day in the same way on both sides unless you want to observe the effect of different types or times of weeding.

6.5.3 How to observe and monitor simple trials?
• Observing your trials helps you to identify the reasons why a certain technique performs better or worse than another one.
• When the crops are grown with two different techniques side by side in the same field you can see the differences with your eyes. For example, on one side the sorghum might grow faster or be higher than on the other side, or cobs might be bigger on one side.
• Such observations need to be recorded so that they are not forgotten and can be analyzed in more detail in future. It is important to be honest in one’s own judgments.
• More often than not one is in favour of an improved technique and becomes ‘blind’ of the other technique even if the new technique is not as promising as it looks.
• Keep a trial record sheet with your observations for each. It will help you to share your experiences with other farmers and the extension worker and you will be able to look at it next year and build on these experiences.
• If a technique or idea is successful, you can increase the area on which you apply this technique next season.
• In case you have a failure, it is very important that you discuss with other farmers and your fellow extension worker why it has failed, and how it can be modified and adapted to improve on it.
• Never give up if the success does not show immediately. Try to find the reason why the trial failed, otherwise you cannot learn from it.
• Through recording of your long-term observations on the crops and your fields season by season you can create your own reference material and build up your farming knowledge step by step.
• The benefit is that you do not repeat mistakes, as you can recall the best ways of doing things, building on experiences of previous years.
• The record sheet that follows this section might help you in observing and recording:

6.5.4 Things to remember in CA experimentation!
• Keep it simple
• Build upon what farmers are already doing - ensure demonstrations/trials are within the farmers capabilities
• Keep experiments/demos simple - two to four treatments - one of which must be what the farmers are currently doing.
• Characterize the farming/cropping system and ensure that any trials are based on what the farmers do on each soil type
• Agree with the farmers/FFS groups on area to be used for demo plot
• Agree with the farmers/FFS groups on the management of the demo plot and ensure all inputs for the demo plot are available in time to coincide when farmers carry out own operations.
• A demo/experiment is pointless if it is planted after the farmers have planted.
• An ideal size of trial must allow farmers to assess the labour requirements of new technologies/interventions being suggested.
• Agree with farmers what will be monitored - farmers only monitor issues that they will discuss and analyse.

7 Conservation agriculture demonstration layout

A layout is a practical plan/arrangement of the technologies under comparison. Conservation agriculture demonstration layout aims at highlighting the differences between the three principles and the usual farmer practice. The demonstration treatments/plots should range between 2 and 4 and must be distinct and clear so as not to bring confusion to the experimenting farmers/FFS groups.

7.1 Important factors to consider when establishing a CA demo plot

To establish a successful CA demonstration, the following must be taken into account:

• Ensure that farmers/FFS groups are part and parcel of the design of the layout. Let them contribute on issues such as: (what crop do we plant here? Why here? How do we plant? What is the difference between this and that?) and try and build consensus around such questions. This will enhance understanding and ownership.
• Let the farmers themselves provide a piece of land for the demonstration. The land may be a community land or any of the group members may volunteer to provide a piece.
• Ensure that the designated piece of land where the CA demonstration is to be established in next to the homestead on a group member. This group member will be called a host farmer. This is important for security and to prevent invention by livestock/intruders.
• The designated demo plot must be fenced and each plot from 1-4 designated as shown in fig 1
• It is recommended that you the demonstration covers 1 fedan (60*70m)
• Create foot paths accordingly as shown in fig 1

7.2 Steps to follow when establishing a CA demo plot

The following are steps which will help you in the establishment of the CA demo plot:

• As a facilitator, survey the piece of land allocated by the farmer/FFS group with an aim of confirming its actual measurement and the general condition of the land assess its viability. Remember to be accompanied by the farmers when doing this.
• Design the layout as shown in fig 1 and make the farmer/FFS groups to understand reasons for everything that is being done in every plot.
• Once you have the layout, proceed to the plot with a rope, pegs, tape measure and a hammer and demarcate the entire demo plot with the assistance of the farmer/FFS groups
After the demarcation, start preparing the plots as per the agreed design layout and take note of the instruction provided in sub section 5.4 above.

7.3 How to manage a CA demo plot
It will be the responsibilities of the farmer/FFS groups to manage the CA demo plots while your role as an extension agent will only to facilitate and provide guidance. Assist the farmer/FFS groups to development a management criteria which is simple and acceptable to the majority. Be careful not to allow a situation where the host farmer dominates in the management of the group demo plots. This will serve to avoid alienating the rest. Take note of sub section 5.4.3 above with regard to what to observe and how to monitor the progress of the CA demonstration.

Fig 1: Typical CA demo plot layout

![CA demo plot layout diagram]

The above illustration is a typical CA layout which will serve to provide guidance in the establishment of the demo plots. It should however be noted that the choice of the main crop and the cover crop options will depend on the prevailing condition and the farmers preference.

Depending on the outcome of the assessment of the physical condition of the plot designated for the demo, immediate amendment may include use of ox plough, sub soiler or ripper to open up the soil. Such amendments will however be applied across all the 4 trial plots.

8 Monitoring parameters

Once the CA demos will have been fully operationalized within the FFS groups, there will be need for Participatory Monitoring and Evaluation PM&E exercise to be undertaken at farmer level so that FFS group members could identify their own monitoring indicators/benchmarks upon which they will continually monitor and record progress. For the start however, records of the following data at FFS group level will be critical;

- Baseline information/report gathered as per the situational and problem analysis described
in section 6.4.1 above.
- Experimentation plot sizes (Area)
- Time taken/man hour devoted for every operation in each experimentation plot ie land preparation, planting, weed control and harvesting
- Cost of farm inputs and all operations
- Germination percentage and rate in every demo plot
- Plant population
- Crop yield
- Soil fertility improvement

ALL FARMERS LEARN AND ACCEPT NEW THINGS DIFFERENTLY