

Designing and implementing conservation agriculture in sub-Saharan Africa

Environment and climate change



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Introduction

Conservation agriculture (CA) in sub-Saharan Africa has multiple, but often very specific, niches for investment that need to be understood to support its inclusion and implementation in projects. CA has considerable potential for increasing agricultural productivity in the region: this toolkit outlines how the potential can be achieved.

This document introduces and defines CA in the context of sub-Saharan Africa. It raises the main issues and poses questions that are addressed in the “Lessons Learned” document, which presents, discusses and analyses experience based on recent literature and country case studies. The “How To Do Note” – looks at these issues in terms of guiding teams involved in designing, supervising and managing CA programmes.

Background and context: what is conservation agriculture and why does it matter?

Background

Conservation agriculture is the combination of minimum soil disturbance, continuous soil cover and crop rotation (Box 1). When these three “principles” are implemented together and are associated with supportive agronomic measures, CA has the potential to reduce losses in soil organic matter associated with traditional tillage, raise fertility levels, improve rainfall infiltration and water use efficiency, reduce erosion, and improve biodiversity in the soil. It can also reduce costs (by saving fuel and labour) and assist in timely planting because fields can be prepared more quickly and in advance of the first rains. As a result CA – at its best – can help to counter land degradation, reduce greenhouse gas emissions, sequester carbon in the land, confer climate resilience to a landscape within a healthier ecosystem, and lead to higher and more stable crop yields. It can thus make a vital contribution to sustainable intensification of food production and people’s food security and livelihoods.

Box 1. The three principles of conservation agriculture

- Continuous minimum mechanical soil disturbance
- Permanent organic soil cover
- Diversification of crop species grown in sequences and/or association

Source: Food and Agriculture Organization of the United Nations.¹

In simple terms, the first principle implies that the plough is dispensed with and crops directly planted into unploughed soil. This improves soil structure and biodiversity, which are otherwise damaged through inversion. Furthermore, conventional ploughing exposes soil organic matter to the atmosphere and greenhouse gases are emitted through rapid decomposition. The second principle involves keeping the surface covered with living plants, or an organic mulch (especially crop residues), which protects the soil from erosive rainfall and temperature extremes, suppresses weeds when used in sufficient quantities, and reduces erosion. The third principle involves crop rotation and/or forms of intercropping that help maintain and improve soil fertility. Some proponents view CA as being a more “natural” system of farming, imitating forests or undisturbed grasslands where litter is allowed to fall and accumulate, no soil inversion occurs, and biodiversity develops. Of course CA differs in that crops are planted and harvests taken from the land; thus, it is not a closed system but one that needs to be managed and soil fertility strategically replaced.

Global spread

The evolution and spread of CA over the last 25 years has been little less than a global phenomenon: currently, almost 10 per cent of all arable land is farmed under some aspects of this system. In the Americas, in particular, specially designed mechanized equipment, together with herbicides (often in combination with genetically modified seeds resistant to the herbicides), medium- to large-scale farms, rainfall supportive of green cover crops and farmers keen to cut costs, has led to very high levels of CA adoption (see Figure 1). These high levels of mechanization and input use are also true in Asia and Australia, where CA is predominantly practised on large commercial farms.

This toolkit focuses on the smaller rural farming household using hand tools and maybe animal traction, as these are the majority of IFAD’s target beneficiaries for our loan and grant programme. Therefore, this toolkit focuses on sub-Saharan Africa and IFAD’s experiences to date, and developments in promoting CA in the region. There is an emphasis on East and Southern Africa, which is where CA has been most strongly promoted. In the Sahelian zone of West Africa, the focus has been more on the development of water-harvesting systems because crop residues are highly prized for animal fodder. Thus, most of the lessons drawn and recommendations made are from experiences in East and Southern Africa.

Conservation agriculture in Africa

Africa, however, appears not to be joining in this widespread adoption of CA. After considerable development investment over the past 20 years, why is this? Some initial indications are that:

- CA has generally been introduced as a complete technological package without first considering farmers' problems and constraints, which may either lie outside CA and/or inhibit its adoption.
- Sub-Saharan Africa is extremely heterogeneous in climate, farming systems and traditions: a "one-size-fits-all" approach has never had a good record in terms of technology adoption.
- Farmers have run into problems with inputs – namely labour, machines and equipment, fertilizers, and herbicides – as well as increased weed burdens and lack of residues for mulching.
- Initial yield responses have often been disappointing because of too little emphasis on soil fertility amendments.

Nevertheless, there have been emerging success stories, and while these have been almost exclusively limited to Southern Africa, there is real reason for optimism. Smallholder farmers in Zambia and Zimbabwe have widely adopted various forms of CA, and larger-scale mechanized farms have also begun to use CA in these two countries, as well as in South Africa.

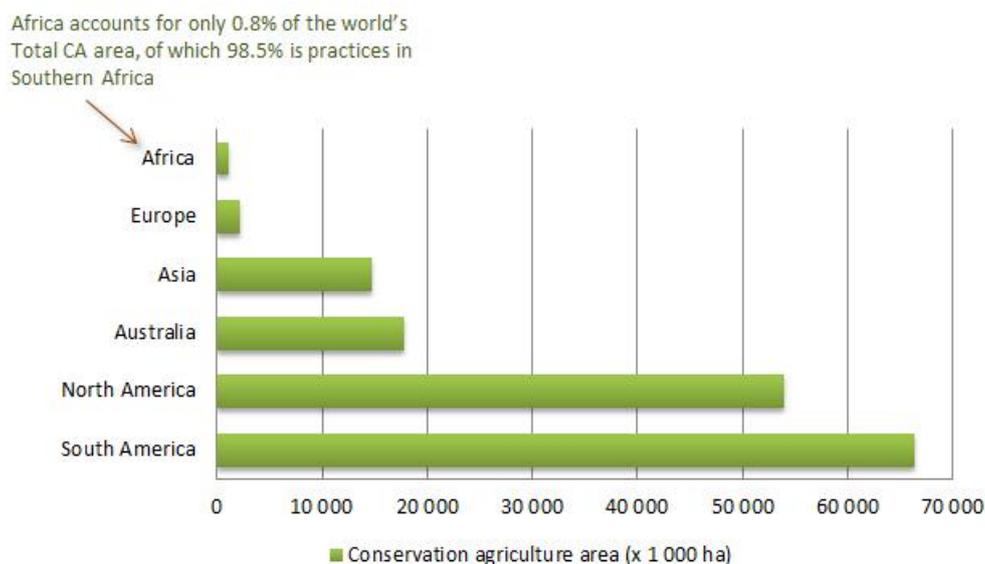


Figure 1. Global area under conservation agriculture
(source: Aquastat, accessed 14 October 2015)

Rationale: why is this toolkit needed?

This three-part toolkit explores the challenges of promoting and adopting CA in Africa, highlights where there have been successes, and analyses the factors underpinning adoption and "dis-adoption". It also examines how controversy and opposing positions have complicated the debate about how best to go forward. While it acknowledges the potential of "full-package" CA, it argues for a systems approach and shows how even "partial" CA can lead to productivity and environmental benefits. Most importantly, the toolkit balances the evidence from the field and sets out practical steps to introduce and sustain CA in IFAD investment projects within sub-Saharan Africa.

IFAD first summarized previous work and the future potential of CA for smallholders in 2011.² Since then, various other initiatives have been designed and initiated by IFAD in sub-Saharan Africa – for example, in Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Rwanda, Swaziland, Uganda and Zambia – though many of these

are in their early stages of implementation and have few documented lessons from experience. IFAD's 2011 report stated that: "CA is a climate-resilient technology and management system that has demonstrable potential to secure sustained productivity and livelihood improvements for millions of climate-dependent farmers... ." This mirrors the viewpoint of the Food and Agriculture Organization of the United Nations (FAO) that CA is a base for sustainable agricultural production intensification. It is further described by FAO as "an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security, while preserving and enhancing the resource base and the environment".³ Box 2 summarizes how CA matches IFAD's mandate.

To help decide if, when, where and how CA should be included in IFAD investments, a toolkit is needed to guide design and implementation of CA components within projects through an incremental approach.

First, CA, despite compelling reasons for its promotion, continues to be misunderstood and misinterpreted: it is complex in the sense that its full benefits are achieved through interactions of the three principles and essential complementary practices. Second, there remain concerns about the way it is being introduced in Africa, often without the context being adequately considered, or the specific problems it is intended to address being first identified. And third, there are a series of genuine practical constraints to its adoption that this toolbox takes on as "challenges" – obstacles that need to be confronted and, with the correct guidance, overcome through strategic investments in the supply chain and extension services.

Box 2. Conservation agriculture and IFAD's strategy

Conservation agriculture can make an important contribution to IFAD's strategic efforts to focus on poor rural people, their livelihoods and food security through small-scale agriculture.⁴ Women can be major beneficiaries through a reduction in labour, increased crop production and improved systems resilience. Two of IFAD's strategic objectives are clearly reflected:

- Strategic Objective 1: Increase rural people's productive capacities.
- Strategic Objective 3: Strengthening the environmental sustainability and climate resilience of rural people's economic activities.

It is also important to note that conservation agriculture is a specialized form of "climate-smart agriculture" with its combination of improved crop production, reduction in greenhouse gas emissions and better climate resilience, which IFAD strongly supports.⁵

Past experience: early analyses and emerging issues

Experience with promoting CA in sub-Saharan Africa has been mixed. Even where success is reported, it is more commonly associated with "promise and potential" from pilot initiatives working with small numbers of farmers than on-the-ground spread ("outscaling").

This toolkit analyses a range of key issues and supports these with country experience from sub-Saharan Africa. It is also an important update, as CA is highly dynamic in terms of both development intervention and biophysical processes.

In the 2011 report,⁶ IFAD correctly identified some important factors behind the generally low adoption recorded up to the time of writing, namely, the lack of an enabling policy environment, low investment through national budgets, and weak technical capacity at all levels of both the public and private sectors. To close the gap, other constraints must also be overcome. There needs to be a change in mindset because discarding the plough means deeply ingrained farming traditions are overturned by CA. Positive feedback from extra production may not happen immediately and weeds can present a particularly troublesome and unsightly problem. Not surprisingly, introducing CA can be an uneasy process. These are not impossible problems, but instead need to be looked upon as challenges that can be addressed and answered if sub-Saharan Africa is to share in the multiple benefits of CA that others enjoy elsewhere.

Issues: key questions to be answered

The topic of CA – especially in relation to its introduction and promotion in sub-Saharan Africa – gives rise to numerous questions and emotions. Our recent analysis of IFAD-supported (and other) projects that include CA has raised a series of issues that need to be included in the project design/review process to identify if CA is an appropriate option for promotion or not. Below, the key issues are set out. These are expounded upon, in the light of analysed experience, in the Lessons Learned document.

1. Purism or pragmatism?

Those familiar with CA in Africa will remember the impact made in 2009 by Giller and colleagues through their article *CA and smallholder farming in Africa: the heretic's view*.⁷ Their basic argument is that sub-Saharan Africa cannot simply follow a prescribed course, dictated by strict principles. But can there be “gradations” of CA, tailored to particular situations? A recent follow-up article argues cogently for a “context-sensitive approach based on systems agronomy”.⁸

2. Residues – for mulch or other uses?

One example of how Africa presents a difficult basis for rapid transfer to CA is availability of crop residues to support the principle of continuous soil cover. In much of Africa, particularly in semi-arid zones, residues are relatively few and have a high opportunity cost if not used as fodder for livestock or fuel for cooking. How then is it possible to break into the cycle of CA, where many of the benefits, and the sustainability of the system, depend on residues remaining on the ground? Should biomass imports be supported, e.g. use of forest-leaf litter or cut grasses?

3. Fertilizer and fertility management – can yields be sustainably improved?

The need to improve soil fertility alongside the introduction of CA in Africa has led some to propose that fertilizer addition be labelled a “fourth principle”.⁹ The infertility of Africa’s soils, and reduced mineralization of nutrients through no-till, means yields in the early years of CA can be lower than under conventional ploughing. This is a significant disincentive to farmers: understandably, rapid benefits are a key to adoption. How can soil fertility enhancement be ensured as CA is introduced?

4. Weed control – weeds: a manageable menace?

CA adoption in South America occurred because of the use of herbicides. But in Africa, affording and acquiring herbicides are beyond the means of many smallholders. Traditionally, ploughing the land buried the first flush of weeds: no-till places an extra weeding burden on farmers unless herbicides can be supplied and farmers supported in their use. How can farmers be best helped to control and manage weeds?

5. Crop rotation – what to do where the market for legumes does not exist ?

Crop rotations conventionally include a legume crop in the cycle. Legumes can be nitrogen-fixing (if soils are fertile enough) as well as nutritious. But is it realistic to propose a pure stand if holdings are very small and if a market does not exist? Are there adequate alternatives for the African situation, for example, intercropping with legumes? Another alternative, or supplement, is agroforestry with leguminous tree species, which (counterintuitively) is growing in importance as farms decrease in size.¹⁰ What is the best way to ensure that crop rotation and/or association brings legumes into an overall CA system?

6. Labour – does CA ease the hard work?

Seventy per cent of power on sub-Saharan Africa’s farms comes from manual labour. It hardly needs repeating that the majority of this is women’s work. Any sensible development in agriculture thus requires that labour demands are reduced and women’s input lowered (absolutely and relatively). Thus, the question is: does CA reduce labour requirements in reality, and rapidly, or does the extra labour demand related to weeding negate such potential benefits?

7. Water harvesting – can CA play a role?

Throughout the semi-arid zones of sub-Saharan Africa, water harvesting – the concentration and collection of runoff water for plant production – has, historically, provided food from plants in zones where rainfall alone would be inadequate. Water harvesting depends on bare areas of land (which may be external to the field) to act as an efficient catchment with a high runoff coefficient: yet this appears to contradict the principles of CA. Can the two be reconciled, for example, by focusing mulch in the planted zones/planting stations?

8. Soil and water conservation structures – are they still needed under CA?

Many of the areas where CA is being introduced have existing soil and water conservation structures – principally earth bunds and contour grass strips. Yet current CA documentation, whether from research or project experience, has little to say about their continuing value as support infrastructure for CA or whether they are now superfluous. Can it be argued that, where these exist, they still have important and complementary roles to play in supporting CA in various ways, including production of mulch/fodder?

9. Livestock – how can they best be integrated into CA systems?

Few African farming systems are based on crops alone. They are either mixed systems, or there may be reciprocal arrangements with livestock herders, for example, stubble grazing in exchange for manure deposited. The competition for crop residues has already been noted above. How can livestock be best accommodated within a CA system? Can livestock herders be brought into the picture? Should zero-grazing be promoted alongside CA? What is the role of livestock in mechanizing CA?

10. Mechanization – can CA help take the burden out of farming?

The two basic forms of CA field operations under smallholder systems in sub-Saharan Africa are likely to remain hand-hoe pitting and ox-drawn furrow openers. Two-wheel (or four-wheel) tractors with appropriate direct-drill attachments may be feasible in some situations, but lack of appropriate machinery is a real constraint to the spread of CA in sub-Saharan Africa. What is the role of animal-drawn direct seeders? Can simple and cheap machines and appropriate tools be manufactured locally in adequate numbers? Or could mechanization services be provided by local entrepreneurs or youth groups? Does the animal-drawn plough have a role, or is it simply discarded to sit and rust in the homestead compound?

11. Incentives – are they kick-starters, bribes, shared costs, rewards or compensation?¹¹

It is almost inevitable that farmers will need a kick-start to help them on their way towards sustainable systems of CA. There are set-up costs involved, including use of new equipment or novel ways of using existing equipment – especially the plough – and investments needed in machinery, fertilizer, herbicides and improved seed-input systems. Fields may need to be protected against livestock. Thus, alongside training, farmers will require material support in the short to medium term. How can this be achieved without incurring a “dependency syndrome”? Alternatively, or in tandem, could microcredit facilities be an important help where the adoption of CA reduces risk (and hence crop insurance premiums)?

12. Scaling up – how to break out of the project/pilot enclave to reach the majority?

Many reports testify to the “promise” of CA under project support. But experience dictates that this is little guarantee of sustained upscaling (institutionalization) and outscaling (spread) to a significant number of farmers once the project ends. CA thrives best where it picks up a critical mass of participating farmers. Yet the age-old question remains: how is outscaling to community level and beyond best stimulated and ultimately supported by both public and private sectors?

13. Triggers – what fires the starting gun?

In most cases of technology adoption, it is possible to identify a “trigger” or driver that stimulates the process. With CA, these can be very different: for example, it was air pollution from straw burning in parts of China; in much of Latin America it was high costs of traditional land preparation. On large-scale farms in Zimbabwe,

the trigger was soil degradation – but also fuel shortages during the days of international sanctions. Triggers are often the reciprocal of problems: so do we know enough about farmers' primary constraints in different farming systems of sub-Saharan Africa? This can guide us towards the potential entry point for action and advocacy.

14. Socio-economic issues – do we focus too much on technology?

CA may appear to be a case of a new technological approach that, once adopted, provides clear benefits. But it is wrong to assume that things are always simple. Already it has been noted that there can be competition for residues between the needs of livestock herders and crop farmers. It may be that burning of residues and dry weeds is valued for driving small animals towards waiting hunters. Perhaps as important as anything else is breaking with the age-old tradition of ploughing. Are such factors taken adequately into consideration?

15. Extension and advocacy – in what ways can change agents become more relevant?

Conservation agriculture is knowledge intensive, combining many new concepts and techniques. It is vital that public, private and NGO extension systems, and their respective change agents, are brought “up to speed” with developments and are convinced of the benefits and promote the same messages in the same areas. Farmer field schools have worked well for other technological advances and the lead farmer system, too. But what about community-to-community exchange visits and even internships where farmers from pilot areas spend a season in a CA community?

16. Research – can the scientific community add value?

CA offers a particular opportunity for applied research simply because it is still developing in sub-Saharan Africa, and it is evident there is much potential for improvement. Better monitoring and evaluation is a basic but crucial requirement and one area where research can help. Encouragingly, researchers may find publication easier with CA gaining so much international renown. Could it also be that innovative farmers and communities have important contributions to make as they test and try the system for themselves?

17. National campaigns – pulling together to bring about change: the only way to create real impact?

It is becoming increasingly clear that for CA to be upscaled and outscaled there needs to be input from all stakeholders – ranging from government, the private sector, NGOs, research institutions to farmers' associations and, indeed, communities themselves. But these can only be brought together with a strong and sustained national campaign, endorsed at the highest level. How is it possible to stimulate sufficient commitment at all these levels so that a national campaign is brought together to talk with one voice?

Further reading on CA in this toolkit

The How To Do Note – is framed around a step-by-step progression from planning to field implementation. These are guidelines to shaping and developing a CA component within a project framework. The How To Do Note is based firmly in what has worked before and, equally important, what has failed. As illustrated in a conceptual graphic in the document, the three central principles of CA need to be embedded in appropriate practices, which are often situation-specific, and embraced by policies that establish an enabling environment.

The Lessons Learned document expands on what has been summarized in this overview. It answers the questions posed here by exploring what has been experienced in Africa, taking specific countries where CA has been tried and tested. In some countries, notably Zambia and Zimbabwe, there have been significant advances. In others, progress has been slow and uncertain. Some highlights are:

- There are common denominators to be found: among these is a comprehensive campaign based on advocacy, training, and appreciation of farmers' needs and aspirations. Lessons span both down-to-earth practical considerations, such as weeding and fertility management, and higher-level considerations, including incentive systems and supply of appropriate tools and equipment.
- Drawbacks are set out in Lessons Learned, too – because these are at the heart of failed attempts to introduce the system.

A key message that emerges is that the conversion from current farming practices to CA in sub-Saharan Africa will take time and perseverance, and can only succeed if farmers' constraints are adequately appreciated, addressed and answered. Introduction of CA requires carefully considered support and enlightened guidance.

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