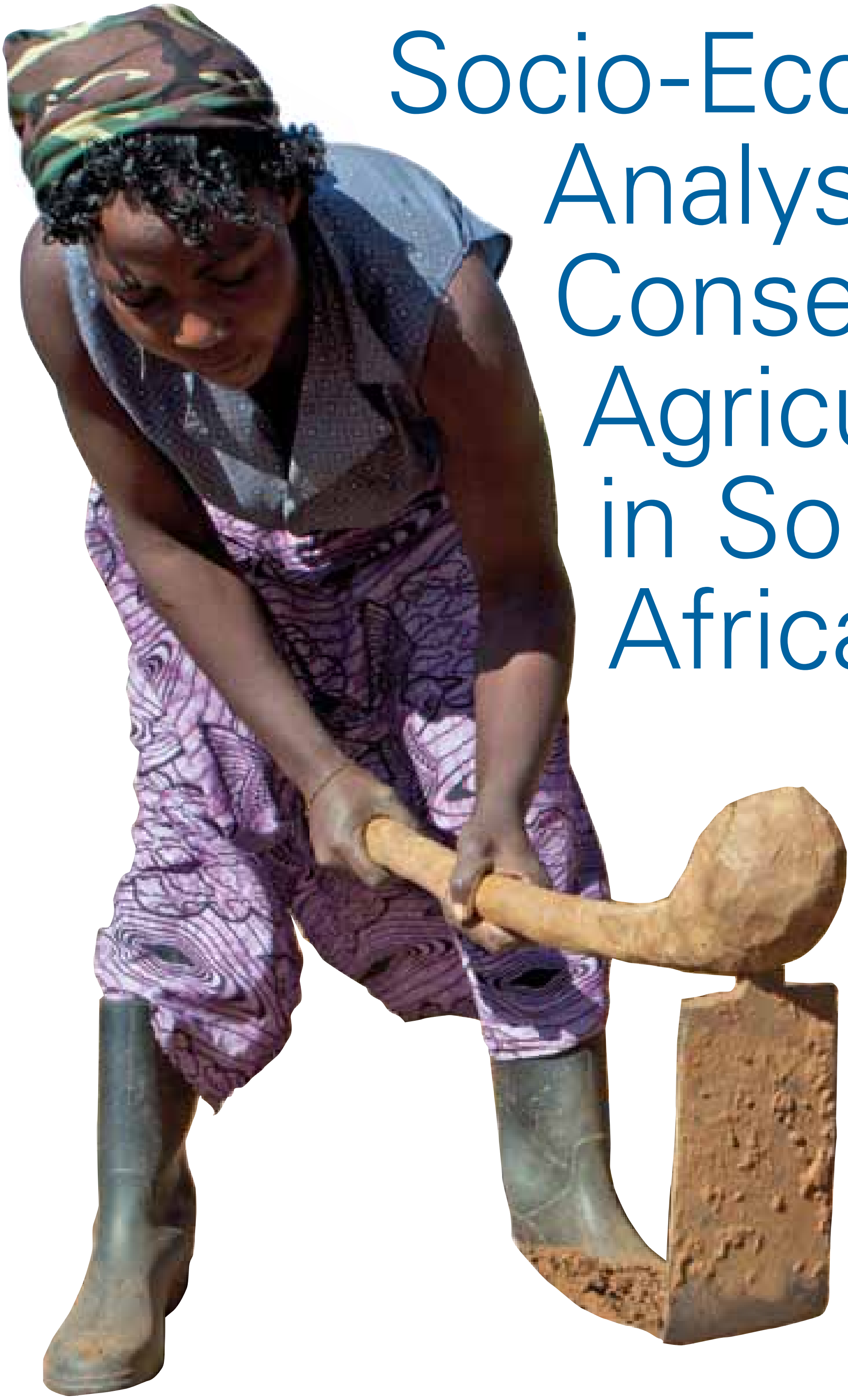
Socio-Economic Analysis of Conservation Agriculture in Southern Africa



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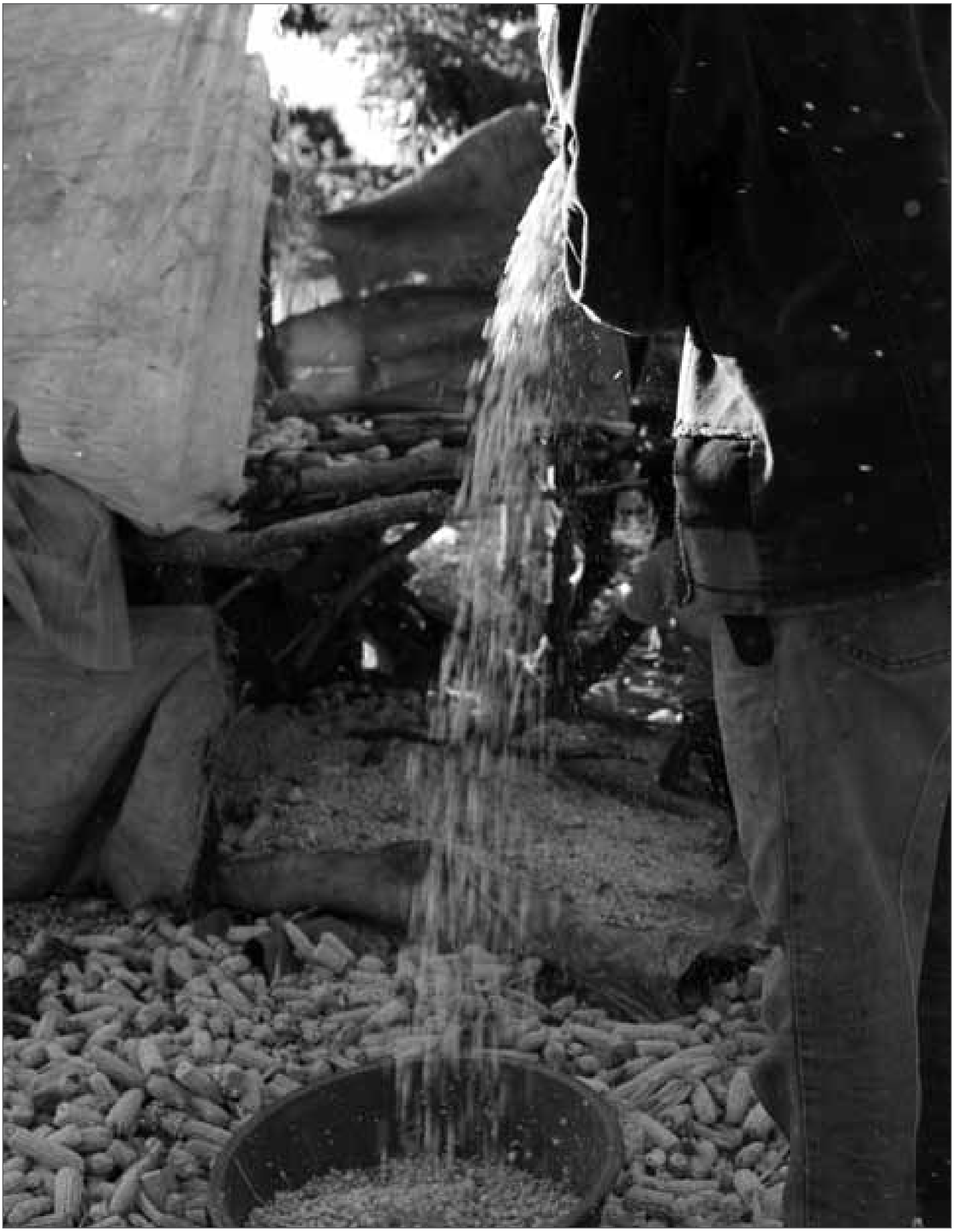

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Acronyms


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AGRITEX	Department of Agricultural Extension and Technical Services, Zimbabwe
AIDS	Acquired Immunodeficiency Syndrome
ARC-GCI	Agricultural Research Council Grain Crops Institute, South Africa
ARC-ISCW	Agricultural Research Council Institute for Soil, Climate and Water
ART	Antiretroviral Therapy
ART	Agricultural Research Trust, Zimbabwe
ARV	Antiretroviral
BMZ	Federal Ministry for Economic Development Cooperation, Germany
CA	Conservation Agriculture
CD	Conventional Draft Tillage
CAP	Conservation Agriculture Programme
CART	Conservation Agriculture Thrust
CASP	Conservation Agriculture Support Programme
CASPP	Conservation Agriculture Scaling Up Projects
CF	Conservation Farming
CFU	Conservation Farming Unit, Zambia
CLUSA	Cooperative League of the United States of America
CIDA	Canadian International Development Agency
CIMMYT	International Maize and Wheat Improvement Centre
COMESA	Common Market for Eastern and Southern Africa

DAPP	Development Aid from People to People
DFID	Department for International Development, United Kingdom
ECAZ	Environmental Conservation Association of Zambia
ECDARD	Eastern Cape Department of Agriculture and Rural Development, South Africa
ECHO	Emergency Coordination and Rehabilitation Unit
ERCU	European Commission Humanitarian Aid and Civil Protection
EU	European Union
FFF	Foundations for Farming
FAO	Food and Agriculture Organization of the United Nations
FISRI	Farmer Input Support Response Initiative
GART	Golden Valley Agricultural Research Trust
HIV	Human Immunodeficiency Virus
ICRISAT	International Crop Research Institute for the Semi Arid Tropics
IEC	Information, Education and Communication
IFAD	International Fund for Agricultural Development
IMAG	Emergency Coordination and Rehabilitation Unit
LMCF	Land Management and Conservation Farming Project, Zambia
MACO	Ministry of Agriculture and Cooperatives, Zambia
NDA	National Department of Agriculture, South Africa
NGOs	Non-Governmental Organizations
NORAD	Norwegian Agency for Development Cooperation
NZP+	Network of Zambia People Living Positively with AIDS
OFF	Own Farm Facilitators
PAM	Programme Against Malnutrition
PRP	Protracted Relief Programme
RoL	River of Life Church, Zimbabwe
SIDA	Swedish Development Cooperation
ULV	Ultra Low Volume
WFP	United Nations World Food Programme
ZNFU	Zambia National Farmers Union

Foreword

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The Green Revolution initiatives of the 1940's to 1970's brought about increased industrialized agriculture in Asia and other parts of the world. Africa did not benefit much from these developments. In southern Africa, agricultural scientists continue to face the need to increase food production to meet the demands of a growing population. This demand is occurring within an environment of rising agricultural input costs and high levels of poverty and disease. In addition, this region constitutes part of the global regions where, predictably, the negative impacts of climate change will be most heavily felt. The Intergovernmental Panel on Climate Change (IPCC, 2007) projected that by the year 2050 crop losses in the region could reach 20% due to adverse temperatures. The region is also projected to experience higher frequencies of floods and droughts. Such impacts will affect an already vulnerable region which relies heavily on rain-fed agriculture.

To help adapt to and address the challenges outlined above, it is imperative that the region adopts more sustainable and productive ways of farming. Conservation Agriculture (CA) is one such method. CA is a way of managing farming systems to achieve improved, sustained productivity, increased profits and food security while preserving and enhancing the environment and the resource base. It comprises the simultaneous application, through good management, of three key principles:

- Minimum mechanical soil disturbance
- Permanent organic soil cover
- Diversification of crop species grown in sequence or associations

CA is currently being practiced to varying degrees in different countries of this region. While there generally may be visible benefits from CA practice, farmers and other stakeholders who are new or are at the initial stages of converting to CA still require tangible evidence on the benefits and impacts of CA. They need to know - will CA significantly increase productivity and food security for their families? Will CA help them save on production costs and generate income? These and other questions can be fully answered by conducting an analysis of the socio-economic impacts of CA.

This Network Paper provides an analysis of the benefits and impacts of CA in southern Africa. Although it focuses on three countries, South Africa, Zambia and Zimbabwe, the findings are applicable to a large extent to other countries as agricultural productivity levels and socio-economic constraints are generally common across the region. The information in this study was generated through a literature review, consultation with stakeholders promoting CA in the selected countries, and dialogue with CA farmers.

We envisage that the analysis provided on labour demands, crop yields, returns on investment and profitability, and suitability of various CA technologies to different farmer categories will assist stakeholders to make more informed decisions. These include farmers, extension agents/staff, researchers, private sector and policy and decision makers at various levels in the region. The information can also potentially benefit those beyond the region who may find some of the evidence on CA compelling and make use of it in planning and programming for agricultural and related activities. FAO will continue to collaborate with national, regional and global institutions in generating more evidence on CA and promoting its use and application for the benefit of millions of farming households and communities in southern Africa.

We acknowledge the contributions from the Conservation Agriculture Regional Working Group (CARWG) in southern Africa through which the study was formulated and implemented. The study also benefited from the assistance of Government and academic Institutes and Parastatals, NGOs, Donors, and FAO offices in the various countries visited. Contributions from CGIAR, COMESA, SADC and FANRPAN are also gratefully acknowledged.

Cindy F. Holleman
Sub-Regional Emergency Coordinator of
Southern Africa

Executive Summary

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Conservation agriculture (CA) is becoming increasingly important in overcoming the problems of declining agricultural productivity in southern Africa. Climatic models are suggesting that the southern African region will be strongly affected by future climatic changes, with predicted increases in the frequency and severity of drought. CA has the capacity to increase infiltration and efficient use of rainfall, and reduce water runoff and evaporation, making more water available to the crops. CA can mitigate, to some extent, the climatic and socio-economic challenges faced by farmers.

The study gives a socio-economic analysis of CA in terms of practice, adoption, viability, gender dynamics and scaling out strategies. The study highlights the contrasts in approaches between three countries in southern Africa where significant CA practice exists, Zambia, Zimbabwe and South Africa, as well as the gaps in knowledge. The current study provides a synopsis of the three countries and provides a wealth of information in one document which makes the study appeal to a wider readership.

In both Zambia and Zimbabwe, it is evident that introduction of CA technology into the smallholder farming sector has been primarily through programmes aimed at improving the livelihoods and food security status of vulnerable households. As such, targeting has included a significant proportion of resource-limited households which have no draft animals for land preparation and have also been affected by the HIV and AIDS pandemic, among other factors.

Available data from 12 districts in Zambia shows that 17 percent of the people from 232 households that were practising CA were orphans, one of the proxies for HIV/AIDS impacts on a household. Because the planting basin technique of CA utilizes a hand hoe as the primary implement for land preparation, these vulnerable households have benefited from CA through its capacity to enable timely land preparation and subsequent planting, and also from increased crop yields. It can be argued that the high number of orphans (17 percent in Zambia and 20 percent in Zimbabwe) and the presence of chronically ill household members, as well as the number of deaths recorded in the past 12 months in some study samples, negatively impacts on labour quantity and quality for CA. However, it is important to recognize that some coping mechanisms exist within the communities to address these constraints. In some districts non-govermental organizations (NGOs) purposely target HIV/AIDS for CA promotion, and with good training and staggering some of the required operations, the implied negative effects of the epidemic are reduced.

CA results in higher crop yields compared to conventional draft tillage (CD). CA maize grain yield during the 2008/2009 cropping season was 3 000 kg/ha and 1 780 kg/ha in Zambia and Zimbabwe respectively. These yields were 42 and 105 percent higher than yields from conventional draft CD tillage for these two countries respectively. Estimated maize gross revenues for the two countries are different, mainly due to the high maize price in Zimbabwe as compared to Zambia. The maize gross margins in the CA basin planting system were US$44/ha against US$19/ha under CD tillage in Zambia, and US$213/ha against US$61/ha under CD tillage in Zimbabwe. Although the cost of producing maize was higher under the CA basin system for both countries, the higher yield gains achieved with this technology resulted in significantly better returns in production compared to the CD tillage system. The CA ripper system has been demonstrated to be more efficient in producing maize, costing US$0.13/kg in Zimbabwe compared to US$0.18/kg using the CD tillage system. In terms of returns per labour, again the ripper system has been shown to give the highest returns to labour invested in maize production for both countries. Commercial farmers who are using CA have reported significant increases in farm productivity and profits compared to the period they were practising conventional tillage.

Appropriate tools for land preparation are available, such as the chaka hoe, in Zambia and Zimbabwe. Although the implement has worked well for some communities in Zambia, it has been suggested that it is too heavy for women and weaker male farmers. Manufacturers of farm implements in southern Africa make different weights of hoes, including lighter ones that are better suited to women farmers. It is necessary for farmers to be exposed to the wide range of existing tools so they can choose appropriate implements for their situation. Further, farmers' adaptations of existing tools should be promoted while new ones are developed where appropriate.

Although CA benefits vulnerable households, future programmes can enhance the impact of CA at community, national and regional levels by including resource-endowed households in the promotion of CA. Future CA scaling out and expansion initiatives could consider the use of herbicides to reduce labour requirements associated with weeding, but farmers would need to be fully trained in their use and application while the environmental impacts of the herbicides also need to studied. If herbicides are promoted, the farmers' access to them (especially by smallholders) and prevailing soil and crop conditions need to be considered. Encouraging the use of multiple-use cover crops and other mulch sources can also assist in weed suppression. Labour-saving jab planters can be alternatives for vulnerable farmers. Resource-endowed farmers can also benefit from rippers and direct-seeding equipment, particularly if the linkages to both input and output markets are secured. In Zimbabwe, NGOs have been instrumental in introducing and promoting CA. However, for long-term sustainability, the national extension service must be fully engaged in the process because communal by-laws regarding grazing make it difficult for CA farmers to maintain permanent soil cover, as neighbours' livestock feed on their mulch.

In conclusion, the study sought data to analyse CA impacts at both household and community level in Zambia, Zimbabwe and South Africa. In general, data was available in Zambia and Zimbabwe for the stated terms of reference. However, there was limited documented information available on CA development in South Africa, and limited time for research work. For a comprehensive assessment of CA socio-economic impacts in South Africa, there is a further need to carry out formal surveys on both large-scale and small-scale farmers adopting the technology. This will be essential to help bridge the knowledge gap that exists in CA practices in the region.

1 Introduction

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1.1 Background

More than four decades after the start of the Green Revolution, agricultural scientists continue to face the challenge of increasing food production to meet the demands of a growing population, particularly in developing countries. Of most concern to scientists is that the sources of agricultural productivity growth (improved varieties, fertilizer and water) have been in use for the last two to three decades, but with no significant yield gains, particularly in sub-Saharan Africa. As the demand for food continues to increase, there are now added requirements, not only to provide food security for a growing population, but also to provide more nutritious food to make protein, vitamins and some essential minerals more available, particularly for the most vulnerable communities such as households affected by HIV/AIDS. However, the land available to produce this extra food is shrinking because of urbanization and the use of agricultural land for other purposes. Expansion is possible in some parts of southern Africa, but the quality of this new land might be inferior to that already in agricultural use.

Future sources of agricultural productivity growth are proving to be more complex and harder to find, especially with increasing competition for water resources. Furthermore, climatic models suggest that the southern African region will be strongly affected by future climatic changes, with predicted increases in frequency and severity of drought which will prejudice crop production if there is no adaptation or change to existing cropping systems. This predicted lower rainfall increases the need for more water-efficient cropping systems to mitigate the effects of climate change. Researchers, extension workers, policy/decision makers, farmers and development actors have a growing interest in CA, a farming technology which is helping to meet some of the farming challenges. With its ability to increase efficient use of rainfall, promote higher infiltration, and reduce runoff and evaporation, CA will help to extend soil water availability to support crop growth.

The actual definition of CA tends to vary with authors, but the most generic definition is provided by the Food and Agriculture Organization of the United Nations (FAO).

> CA is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment. CA is based on enhancing natural biological processes above and below the ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and the use of external inputs such as agrochemicals and nutrients of mineral or organic origin are applied at an optimum level and in a way and quantity that does not interfere with, or disrupt, the biological processes. CA is characterized by three principles which are linked to each other, namely:
> 1. Continuous minimum mechanical soil disturbance.
> 2. Permanent organic soil cover.
> 3. Diversification of crop species grown in sequence or associations.

(Source: http://www.fao.org/ag/ca/1a.html)

This report looks at CA evolution and development in Zambia, Zimbabwe and South Africa and provides a socio-economic analysis of adoption and viability of different options of CA practices. It is based on study visits to Zambia, Zimbabwe and South Africa.

1.2 Benefits of CA practices

The benefits of practising CA will be looked at in relation to its three principles, minimal soil disturbance, permanent ground cover and rotation, since they interact to provide the basis for improved crop productivity. Traditionally, farmers practise conventional tillage with ploughs, discs and harrows; these are referred to as the conventional draft tillage (CD tillage) system in this report. It is believed that in order to obtain a uniform and loose seedbed that is weed-free, it is necessary to till the soil. However, ploughing, the mixing of crop residues and other biomass into soil surface, and the burning of residues all contribute to the deterioration of the physical quality of the soil. In particular, soil structure becomes coarse, massive and platy; soil bulk density increases, and water infiltration, retention and availability all decrease. Routine tillage with its associated soil degradation also has a strong potential to increase the impact of droughts as the soil becomes less fertile, less responsive to fertilizer and less able to infiltrate rainfall or irrigation water. The long-term result of routine tillage is that more energy (i.e. more tillage, fertilizer, chemical and organic amendments, and water – particularly irrigation water) is needed to restore the soil ecosystem before it becomes healthy again and can supply the necessary nutrients and soil physical conditions for plant growth.

The use of mulch helps to promote more stable soil aggregates as a result of increased microbial activity and better protection of the soil surface. Increased soil cover results in reduced soil erosion. Soil erosion and land degradation processes occur when rainfall fails to infiltrate the soil and instead starts to flow over the soil surface and is lost as runoff. Practices that reduce the impact of raindrops on the soil surface and maintain soil pores intact will reduce soil loss through erosion and improve water infiltration. Soil cover will also protect the loss of water through evaporation and protect the soil from the heating effect of the sun. Soil temperature influences the absorption of water and nutrients by the plants, seed germination and root development, as well as soil microbial activity and crusting and hardening of the soil. In CA, soil emphasis is not on the consistent use of nutrients in the soil, but optimization of access of plant roots to soil nutrients. The obvious benefits of rotating cereals and legumes still stand, i.e. mainly aiding in pest and disease control, exploration of different soil layers by crops of different types, and improving soil fertility through nitrogen fixation by legumes.

1.3 The context of CA in southern Africa

Interest in applying the principles of CA to the conditions of southern Africa goes back several decades, but the issues and problems that sparked this interest and the ways in which CA innovation systems have evolved vary across different countries. Even within a country, variability in production environments leads to the need for a corresponding diversity of CA practices. Smallholder agro-ecosystems in southern Africa are affected by a multitude of problems. Soils often are sandy, thin and of low fertility. When these soils are farmed under the conditions of low and variable rainfall that is typical of the region, a common outcome is moisture stress in crops and seasonal shortages of fodder for livestock. Many experts feel that CA can help overcome these problems, despite complications that arise in implementing CA in areas where livestock is an important component of agro-ecosystems.

Most people live in rural areas of southern Africa and depend primarily on agriculture for their livelihoods. Small-scale women farmers represent the majority of the rural poor population and it is conceivable that for the greatest impact, agriculture development strategies must target these populations. Information available from gender analysis studies has shown that women face significant barriers in agriculture, especially inequalities in access to and control over crucial resources and inputs such as land, labour, fertilizer and credit access. In some instances women face barriers to membership of rural organizations, agricultural inputs and technology.

The poor performance of agriculture has affected the access to food by many rural households in southern Africa and ultimately constrained the capacity of poor people to respond to livelihood vulnerabilities, including the impact of HIV/AIDS. There is also evidence to show that HIV/AIDS-related illnesses and deaths are evidently affecting more women than men (ECA, 2006). Furthermore, older women and grandmothers are increasingly burdened by the care and support they render to the increasing number of orphans. In Zimbabwe, the impact of HIV/AIDS, coupled with the deterioration of the macro-economic environment of the past decade, recurrent droughts and weak government policies are some of the vulnerability factors that have caused the performance of agriculture to decline (ECA, 2006). Donors have responded by promoting the more sustainable improved crop production technology of CA, and relief agencies have purposely selected resource-poor households and those affected by HIV/AIDS for training and input support to implement this improved and more sustainable farming practice.

2 Approach and Methodology

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This study discusses how promotion and adoption of CA by farmers should be considered as one avenue to pursue to meet the challenges of increased food production requirements and stagnant crop productivity gains. It also assesses the socio-economic impact of this technology. The study, commissioned by FAO, is based on data collected from three southern African countries, Zambia, Zimbabwe and South Africa. The terms of reference which guided the study are described below.

2.1 Terms of reference

The following terms of reference guided the study on socio-economic analysis of CA technology in southern Africa:

1. Review, analyse and synthesize existing (and collect where necessary) CA data, information, knowledge and experiences in selected three countries (South Africa, Zambia and Zimbabwe) where significant CA activities exist regarding:

- CA quantitative and qualitative benefits and impacts (private and community) in relation to associated costs/investments (benefit: cost analysis) in implementing CA under different biophysical, climatic and socio-economic environments focusing on the following CA techniques:
  » Zambia: Planting basins and tractor-drawn CA systems
  » South Africa: Tractor-drawn CA systems
  » Zimbabwe: Planting basins
- Conservation Agriculture and HIV/AIDS:
  » Analyse the relationships or linkages between CA, and gender and HIV/AIDS.
  » Appropriateness and impact of CA technological practices in addressing HIV/AIDS impacts and gender inequalities, and vice versa.
  » Coping mechanisms by HIV/AIDS-affected households and related gender dynamics in addressing or dealing with issues such as labour and other bottlenecks under CA.

- CA innovations in different socio-economic and biophysical contexts.

2. Identify gaps in knowledge and information that need to be addressed in order to better understand CA economic, social and environmental benefits and impacts.

2.2 Study implementation

The study implementation process was guided by the terms of reference above and the FAO Regional Emergency Office for Southern Africa in conjunction with the FAO Sub-Regional Office for Southern Africa. The FAO offices in the three study countries facilitated appointments with key informants and provided information on CA in their respective countries as well as logistical support. Visits were made to Zambia, Zimbabwe and South Africa to collect data through key informant interviews, farmer group discussions and secondary data collection from existing project reports. Annex 1 shows the list of institutions visited and their interests in supporting CA practices in the respective countries. The study was carried out during April and May 2010.

2.3 Study sites

In Zambia, group discussions with CA farmers were conducted in Chongwe district in the agro-ecological Region II which is semi-arid with rainfall between 600–100 mm per annum (Baudron et al., 2007). In Zimbabwe, discussions were held with farmers in Nkayi district, Matabeleland north province, lying in Natural Region IV with a mean annual rainfall of less than 800 mm (Vincent and Thomas, 1960). In the third country, South Africa, the discussions were with farmers in the Willowvale area of Eastern Cape province. Agro-ecological regions play a significant role in adoption of CA. High rainfall areas, by virtue of high biomass production and limited competition for crop residues with livestock, are areas where CA is likely to be adopted. However, Haggblade and Tembo (2003) reported high adoption rates in low rainfall areas where it is reported that benefits of CA are realized from moisture conservation. Adoption of CA is therefore not only a factor of the agro-ecological region but of socio-economic factors too. Issues discussed focused on the impact of CA practices on gender and HIV/AIDS. Social issues related to the practice of CA were also discussed, including its impact on livelihood options, and perceptions on returns to investments in CA practices.

2.4 Methodological challenges

Available reports and documents on CA practices were collected and in some instances follow-up interviews with key persons involved were carried out. There was limited documented information available on CA development in South Africa, including research work.

3 Evolution of CA Practices in Southern Africa

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Devastating recurrent droughts during the 1930s converted America's breadbasket into a dust bowl. Its dust storms served as a wake-up call to man about how his interventions in soil management and ploughing could lead to unsustainable agricultural systems (Hobbs, 2007; Haggblade and Tembo, 2003). These events resulted in massive emigration out of the farming heartland of America. The Soil Conservation Corps was formed in response, as well as an ongoing programme of research into alternative methods of combating soil erosion.

During the 1950s in Africa, spurred on by the American experience and the memory of the South African drought of the 1920s, British colonial authorities imposed a set of mechanical soil conservation interventions – soil bunds, ridging and contour ploughing – across much of British Africa (Reij, Scoones and Toulmin, 2001).

By the 1960s, US researchers and farm equipment manufacturers had produced a successful package of mechanized low-tillage equipment and agronomic practices (Hudson, 1981).

Successive price shocks during the 1970s which saw a six-fold increase in oil significantly boosted farmer interest in minimum tillage techniques globally. In addition to diminished compaction, soil erosion and improved water infiltration, the minimum tillage techniques succeeded in cutting fuel costs by between 50 and 80 percent (Witmuss, Olson and Lane, 1975; Epplin et al., 1982; Baker and Rouppet, 1996).

Minimum tillage agriculture expanded rapidly in the USA during the 1970s and 1980s, reaching over 35 percent of the total area and up to 80 percent for crops such as soybeans (ECAF, 2001; Doane, 2001). United States farmers, researchers and farm equipment manufacturers invested heavily in minimum tillage farming techniques. As a result, the USA has become a major research centre and exporter of minimum tillage technology and equipment.

In southern Africa, as in South America, commercial farmers and associated national and international agricultural research institutes caught the second wave of global interest in conservation agriculture during the 1970s, encouraged by advances in the USA and the breathtaking increases in world oil prices. Brazil quickly became a leader in South America, establishing conservation agriculture research programmes in Parana, called "direct seeding in straw", and by the late 1990s Brazilian farmers cultivated one-third of their cropped area under conservation agriculture (Derpsch, 1998; Alonso, 2001).

During the 1970s and 1980s, South African and Zimbabwean commercial farmers visited the USA and also launched research programmes on minimum tillage (Ellwell, 1995). Zimbabwe's Agricultural Research Trust (ART) proved particularly influential among Zambian commercial farmers, who also sent farm delegations to the USA for study and established commercial contacts during the mid-1980s. The predominantly hand-hoe CA package in Zambia and Zimbabwe represents a local variant of traditional minimum tillage technologies adopted in many parts of Africa (Critchley et al., 1994; Reij, 2001; Haggblade and Tembo, 2003). This involves the use of planting basins (shallow holes where the seed and fertilizers are placed). In Zambia, the planting basin size is 30 cm long, 15 cm wide and between 15 and 20 cm deep (Baudron et al., 2007), whilst in Zimbabwe the planting basins are 15 cm long, 15 cm wide and 15 cm deep, a modification of the Zambian basins (Twomlow et. al., 2006b) The degree of mechanization and access to markets will play a significant role in farmers' decisions to adopt the technology. In Brazil, for example, adoption was associated with reduced costs, reduced soil erosion and higher yields (Gowing and Palmer, 2007).

3.1 Emergence of CA in Zambia

High fuel costs of the early 1990s stimulated interest in low-tillage systems in Zambia. Farmers discovered that low-till cultivation could enable them to reduce fuel consumption from 120 to 30 litres per hectare, dramatically improving profitability of mechanized maize production. Parallel benefits of reduced soil compaction and improved soil structure became apparent to early CA adopters (Hudson, 1995; The Farmer, 1995). The Zambia National Farmers Union (ZNFU) created two institutions to spearhead development and extension of minimum tillage technologies for smallholder farmers – the Conservation Farming Unit (CFU) of the ZNFU and the Golden Valley Agricultural Research Trust (GART). A consultant from Zimbabwe was brought into the ZNFU to help set up low-tillage farm trials at the newly established GART. The consultant also introduced the hand-hoe analogue of minimum tillage systems to Zambia in 1995.

3.1.1 Zambia National Farmers Union (ZNFU)

The ZNFU initiated the formation of the CFU to lobby government and donor support for CA in the country. Meetings are held periodically with all stakeholders, including traditional and local leadership, to influence policies favourable to the up scaling of CA in Zambia (ZNFU, 2000). The ZNFU is also involved in funding or facilitating credit access for farmers to acquire inputs from markets. For example, the Lima Credit Scheme provides for between 1 and 5 ha of CA inputs through credit guarantee for 50 percent of the cost of inputs. Another example is the Emergent Farmers Support Programme which supports middle level farmers (tractor farmers with adequate collateral), by recommending them to banks for input purchase loans. Product market intelligence is also used to source the best commodity markets; it includes the use of cellphone text messages.

For CA to be sustainable in Zambia, the ZNFU is working on incorporating lead farmers, an extension approach initiated in 2003, in other leadership training programmes, but it discourages the concept of paying these farmers as an incentive. The union is aware of the fact that the majority of people working on the land, and CA practitioners, are women. As a result, ZNFU is advocating for gender sensitive approaches to CA technology transfers. For example, there is a concern on the recent promotion of herbicide use, as male farmers believe it will be cheaper to continue practising hand-weeding using family labour. Women are the primary source of family labour in Zambia. Basin digging is also done mostly by women; the chaka hoe is known to be heavier than the traditional hand hoe commonly used by smallholder farmers in southern Africa and might be inappropriate for certain farmer categories. ZNFU is also sensitive to some cultural implications associated with CA practices. For example, promotion of animal-drawn rippers can be a problem for some regions in Zambia where, culturally, women are not supposed to handle a plough or ripper. To help address some of these gender-related cultural beliefs, the ZNFU has included gender issues in their CA training programmes. The ZNFU also engages the government in lobbying for appropriate gender policies, and the discussions include issues related to CA technology practices.

3.1.2 Conservation Farming Unit (CFU)

Following consultations among donors, the Ministry of Agriculture and Cooperatives, the ZNFU and GART in late 1995, there was general agreement on the need to establish a cost effective and proactive unit to coordinate and promote the adoption of CA among smallholders. Initially, CA promotion was in the more drought prone regions of Zambia. In November 1995, with interim support from the World Bank and the EU, a Conservation Farming Unit (CFU) and Conservation Farming Liaison Committee was established under the ZNFU. The committee meets every two months and has the following responsibilities:

- Ensure standardization of CA technical messages, methods and approach.
- Act as a forum for exchange of CA ideas and experiences.
- Recommend priorities for CA research and seasonal demonstration programmes.
- Maintain liaison with all local and international research organizations involved in CA and summarize latest findings for end-users.
- Publicize and promote the conservation effort through the media.
- Identify potential sources of finance to support the CA effort.

The committee is chaired by the CFU coordinator. The CFU also works with private sector out-grower companies (e.g. Lonrho) and with NGOs to train staff and demonstrate CA practices to farmers. Such agencies provide the necessary services (extension, input supply and marketing) that enable farmers to exploit new CA technologies.

The CFU started with modest early funding from a variety of donors to support CA demonstrations and uptake. Donors include the World Bank, European Union (EU), Canadian International Development Agency (CIDA), and the governments of Norway and Finland. Lonrho Cotton Company supported developments of CA guidelines and farm trials with maize and cotton farmers in central and southern provinces. CFU has also conducted training and farm trials for Dunavant Cotton farmer distributors and worked with a coalition of NGOs including Cooperative League of the USA (CLUSA), Development Aid from People to People (DAPP), World Vision and the Catholic Dioceses of Monze. During their early years, the CFU focused largely on a CA system for Zambia's hand-hoe smallholders living in arid and moderate rainfall zones of Zambia (agro-ecological regions I and IIa).

The CFU has been working closely with GART on research experiments and demonstrations for CA alternative technologies. Furthermore, a lead-farmer approach was initiated around 2003, and now has 5 500 lead farmers that have trained 157 000 farmers. Lead farmers have been linked up to agrodealers with an electronic voucher system to access such inputs as herbicides, sprayers and the Magoye ripper. In 2010, CFU plans to issue vouchers worth US$680 000 to lead farmers and these will be redeemed at 27 agrodealers across the country. Mobile Transactions Zambia Ltd produced the vouchers and the rural agro-dealers will then credit an established CFU account to access their payments. This voucher system is believed to be 90 percent secure. Another four-year programme being supported by the Norwegian government at a total cost of US$27 million started in 2007, with part of the funding going to GART research efforts in CA technology. Additional Norwegian funding will be accessed by CFU through the Common Market for Eastern and Southern Africa (COMESA), with a strong emphasis on climate-change adaptation and mitigation.

This new funding to CFU specifically targets smallholder farmers, particularly women farmers, though it is unclear how these projects will deal with issues of gender and HIV/AIDS within the project areas. The issues of gender and the effects of HIV/AIDS are only included as part of the CA curricula where emphasis is placed on staggering land preparation (digging planting basins) and encouraging the use of herbicides. Training is being done on appropriate use of herbicides, although there is concern by some advocates of organic farming who oppose the practice. But CFU have evidence to show that where use of herbicides has been adopted, farmers have planted an additional Lima (0.25 ha) of other crops due to less labour required for weed control.

CFU has also targeted commercial farmers by demonstrating available machinery that can be used on CA. Commercial farmers are not supported with any material by CFU. The impact of the demonstrations could not be evaluated since this initiative has just been started. However, some farmers tried out what was demonstrated in their farms.

3.1.3 Golden Valley Agricultural Research Trust (GART)

GART, with support from the Emergency Coordination and Rehabilitation Unit (IMAG) Project, has been working on improving animal draft-powered rippers. In more recent years, the CFU and GART have both worked with hand hoe and ADP variants of CA research and extension. In the mid and late nineties, researchers at the GART introduced the Magoye ripper to Zambian farmers, as part of efforts to develop, adapt and promote CA and minimum-tillage practices. The Magoye ripper is an implement meant to be pulled by a pair of oxen in the same way as a common plough, but is used in the dry season and disturbs a limited area of topsoil. In the early period, GART staff set up on-station and on-farm trials to ascertain the benefits and constraints of the technology. They identified a key benefit: with the Magoye ripper: farmers can finish land preparation in good time prior to the onset of rains to take advantage of the first rains. As a minimum tillage method, it reduces disturbance of the soil and helps prevent erosion. It may also provide income opportunities through the provision of the ripping services to neighbours, reducing the overall labour constraint for land preparation.

To scale up farmer adoption of the technology, in 2001/2, GART worked with partners to distribute about 2 000 rippers in the Central, Copperbelt, Eastern and Southern Provinces (500 rippers to each province). There has, however, been concern regarding the lack of partnership between GART and potential industrial companies that can manufacture the rippers to facilitate farmer access to spare parts.

3.1.4 Ministry of Agriculture and Cooperatives (MACO)

Following the adoption of CA by the Ministry of Agriculture and Cooperatives (MACO) as the strategy for increasing farm productivity and production in 1999, two major projects are now being implemented in partnership with the Food and Agriculture Organization of the United Nations (FAO) and the Conservation Farming Unit (CFU), with support from the Royal Norwegian Government and the EU. The Conservation Agriculture Scaling up Projects (CASP) and the Farmer Input Support Response Initiative (FISRI), each of two-year duration, are being implemented by the MACO's Department of Agriculture in 12 districts.

3.1.4.1 Conservation Agriculture Scaling up Projects (CASPP)

The Royal Norwegian Embassy requested FAO to develop and implement the CA scaling Up for Increased Productivity and Production Project(CASPP). This project was designed to harness the experience of the CFU in implementing CA activities. The overall project objective is to complement the already existing project – Conservation Agriculture Programme (CAP) – being implemented by the CFU with the support of the Royal Norwegian Government. The project will expand CA to 140 agricultural camps in 12 districts of Zambia. The aim of the project is to build capacity of the staff of the MACO in the Department of Agriculture and of 3 920 lead farmers to enable the successful expansion of CA in Zambia. The districts concerned are Kalomo, Choma, Monze, Mazabuka, Chongwe, Chibombo, Kapiri Mposhi, Mumbwa, Chipata, Katete, Petauke and Kaoma. The project officially began operations on 31 December 2008 and is due to end on 30 December 2010. The project involves 140 camp extension officers and 3 920 lead farmers receiving inputs and CA tools to the value of K500 000 as incentive. Training of agriculture staff and farmers was contracted to GART and CFU. In addition to the inputs provided under the voucher scheme, the project also directly procured 8 500 seedlings of *Faidherbia albida* trees, 1.5 tonnes of sunnhemp seed, 1.5 tonnes of velvet bean seed, 20.3 tonnes of sugar bean seed and 20 tones of cowpea seed for inclusion in legume rotations. *Faidherbia albida* trees are used for nitrogen fixation, erosion control for crops, food, drink and medicine. Unlike most other trees, *F.albida* sheds its leaves in the rainy season; for this reason, it is highly valued in agroforestry as it can grow among field crops without shading them. In Chongwe, although evaluation is still in progress, the general crop appearance shows that crops grown under *F.albida* perform better than the ones further from the tree.

3.1.4.2 Farmer Input Support Response Initiative (FISRI)

The FISRI project was formulated from an original fertilizer support programme that was initiated by the government of Zambia in response to rising prices of agricultural commodities and inputs. The EU provides financial support while FAO provides technical support to the programme. FISRI now aims to complement existing efforts of up scaling CA among smallholder farmers in Zambia, such as those of the CASPP and CAP. The project jointly implemented by FAO and MACO will run for two years and will strengthen efforts that seek to lay the groundwork for building the capacity of MACO's Department of Agriculture and Own Farmer Facilitators (OFF) – lead farmers in the CAP model – in anticipation of longer-term investment in CA expansion throughout the country. The focus of the intervention is the training of 45 district staff on CA concepts, and the training of 3 920 OFFs on CA topics. The project will target 58 800 farmers, and will be implemented in the same districts as CASPP is operating, but targeting different agricultural camps. The project has so far carried out a baseline survey, and some of the results are used for the analysis of the socio-economic impact of CA in this report.

As an incentive to the lead farmers and the local government extension staff, the two projects are providing a redeemable input voucher worth ZK500 000 (US$100) per lead farmer, motor bikes to extension staff, and four vehicles (two from CASPP and two from FISRI) for use in both projects. The projects aim to train an equal number of beneficiary farmers: 58 800 for CASPP and 58 800 for FISRI.

It should be noted that although the MACO formally adopted CA principles in Zambia in 1999, the government policy is not specific about this new farming practice. The policy as stated in the Fifth Development Plan emphasizes crop diversification, and in the latest sixth National Development Plan the emphasis is on crop production and productivity – which can infer CA practices. There is, however, a new thrust by MACO to engage politicians in buying into the CA concept. The first attempts included a national tour to CA sites with the Zambian first lady in 2010.

3.1.5 CA adoption trends in Zambia

Extension of the CA technology has attracted strong support from not only the CFU, but also the privately held Dunavant Cotton Company (the successor to Lonrho and the largest cotton company in Zambia). CA is also supported by the Cooperative League of the USA (CLUSA), the Land Management and Conservation Farming (LMCF) Project, together with their partners and the extension service of the MACO and other NGOs such as the Catholic Archdiocese of Monze, Development Aid from People to People (DAPP), CARE and Africare. The partnership that includes the LMCF has stepped up promotional efforts for both CA rippers and hand-hoe basins. Consequently, both MACO and LMCF have devoted increasing attention to extending CA technologies across the country. Following recent restructuring in 1998, Dunavant Cotton Company expanded its commitment to CA in its farmer training and support programmes. Similarly, since 1998 CLUSA operations in Central and Southern Provinces has required all its farmers to plant in CA basins as a condition for receiving input credit and marketing support.

The frequent droughts of the early 2000s stimulated a surge of interest in the water-conserving CA technologies – the hand-hoe basins and rippers – developed for erratic rainfall zones of southern and central Zambia. Donors such as SIDA, Norwegian Agency for Development Cooperation (NORAD), FAO and World Food Programme (WFP) have funded a major expansion of CA by funding food-for-work digging of CA basins coupled with the financing of 60 000 input packs – one Lima (0.25ha) of maize and one Lima of a legume – distributed to CA farmers by CARE, CFU, CLUSA, LMCF, the Programme Against Malnutrition (PAM) and World Vision.

Despite all the efforts in Zambia to upscale CA, particularly among the smallholder farmers, there are still questions to be answered on adoption rates and the seemingly lack of evidence of spontaneous adoption in areas that have been exposed to the technology for a long time. For example, some contact farmers interviewed clearly articulated benefits of CA but only allocated less than 20 percent of their cropping land to CA. Lead farmers commanding an annual cropping area of between 3 and 7 hectares mainly under maize, legumes and cotton were only putting less than a hectare under CA practices. The ZNFU quantitative report shows no significant increase in area under CA between 2005 and 2008 (ZNFU, 2009). During ground discussions, farmers were asked why they are not putting more of their land to CA practices given the benefits that they described. The main reason cited by farmers for not expanding their area under CA practices was labour demand for weeding and basin digging. Under conventionally ploughed land, farmers reported they were able to cope with weed pressure on as much as 7 ha. Although farmers had been trained in the use of herbicides to reduce weed pressure, this practice is not widely adopted among smallholder farmers in Zambia.

3.2 Emergence of CA in Zimbabwe

The following CA techniques have been evaluated and actively promoted in Zimbabwe since the 1980s: no-till tied ridging; mulch ripping; no-till strip cropping; clean ripping; hand-hoeing or zero till; tied furrows (for semi-arid regions); and open-plough furrow planting followed by mid-season tied ridging (Nyagumbo, 1998; Mupangwa et al., 2006; Twomlow et al., 2006).

3.2.1 Promotion of CA through humanitarian relief programmes

This is by far the largest initiative in Zimbabwe and is focused on vulnerable households, building on the earlier seed and fertilizer relief programmes in Zimbabwe (Rohrbach et al., 2005; Twomlow et al., 2007) funded by the United Kingdom's Department for International Development (DFID) and the European Commission Humanitarian Aid Office (ECHO). All these households have been classified as vulnerable and are in receipt of seed and fertilizer relief investments distributed through a range of NGOs operating within Zimbabwe.

The most common CA package being promoted is a hand hoe-based system that focuses on the creation of planting basins in the dry season, locally referred to as conservation farming (CF) (PRP, 2005; Hove and Twomlow, 2007). In 2004, the International Crops Research Institute for the Semi Arid Tropics (ICRISAT) began providing technical assistance to more than ten NGOs under the United Kingdom's Department for International Development (DFID) Programme Against Malnutrition (PAM). The aim was to promote CF across 13 districts in the semi-arid areas of Zimbabwe (www.prpzim.info/). As a result, farmers are showing a growing interest in CA and reporting yield gains ranging from between 10 and more than 200 percent as compared to the traditional practice of overall spring ploughing and planting (Hove and Twomlow, 2007; Twomlow et al., 2008a). Despite the fact that these yield increases depend on the level of experience of the farm household and seasonal rainfall, a growing number of farmers have been voluntarily taking up various parts of the CA practices.

3.2.2 River of Life (RoL) Church: Operation Joseph

The oldest CA initiative in Zimbabwe is Operation Joseph (OJ) which is run by the River of Life Church – now known as the Foundation for Farming (FFF). Operation Joseph builds on the Hinton Estates Out Reach Programme initiated by Brian Oldreive in the 1990s. The programme focuses on the promotion of either basin tillage or shallow-planting furrows in conjunction with a set package of inputs (seed and fertilizer) for a cereal-legume rotation.

Outside of the initiatives at Hinton Estate, during the early stages of the programme, beneficiaries were closely associated with the RoL Church and were encouraged to follow a strict set of agronomic guidelines that were periodically assessed over two to three cropping seasons. The programme enforces a three-strike rule meaning that households that fail to adhere to the strict protocols are given three chances before being ejected from the programme. The River of Life's Operation Joseph ended in 2008 but the promotion continues through other initiatives. OJ benefited from the first phase of the Protracted Relief Programme

(PRP), which started off solely funded by DFID UK but which is now in phase II and is a multi-donor funded programme. RoL has moved into new districts in PRPII to continue with the promotion of basins.

3.2.3 Promotion of CA in smallholder maize-based systems

A second initiative is run by the International Maize and Wheat Improvement Centre (CIMMYT). The initiative was originally funded through the German Federal Ministry for Economic Cooperation and Development (BMZ) and is now supported by the International Fund for Agricultural Development (IFAD). Its objective is to facilitate widespread adoption of CA in the maize-based systems of Malawi, Tanzania and Zimbabwe. In Zimbabwe, the target population for this initiative is the emerging commercial maize farmers who have the financial and draft power resources to invest in animal drawn no-till equipment such as direct seeders. The project partners have imported and are evaluating a range of equipment developed in South America, and are now working with Zimbabwean industries to produce locally adapted animal drawn no-till equipment. Ripper tines are among the implements which are locally available and promoted.

3.2.4 Commercialization of smallholder farming

A third initiative was established in 2004 and 2005 by the FAO Emergency Coordination and Rehabilitation Unit (ERCU) and the three Farmers' Unions of Zimbabwe (ZFU: Zimbabwe Farmers Union; ZCFU: Zimbabwe Commercial Farmers Union; and CFU: Commercial Farmers Union). The project attempts to pass on the experiences of commercial farmers to communal farmers, with the objectives of improving food security and commercializing communal farming in natural regions II and III. The project is site specific, and with the support of resident extension staff, planning is based on local conditions and farmers' experience.

3.2.5 CA adoption trends in Zimbabwe

In Zimbabwe, the decision to start CA practices was not, in most cases, voluntary. Smallholder farmers who first participated in CA promotion were selected by NGOs as vulnerable households facing production constraints. Vulnerable households are defined as families that face difficulties in meeting their basic livelihood needs. This definition has been extended by relief agencies in Zimbabwe to include households affected by the HIV/AIDS epidemic. These households were provided with agricultural inputs and appropriate extension support as incentives to adopt the CA technology (Twomlow et al., 2008a). After a period of learning the new CA technology, vulnerable households (including some spontaneous adopters) experience variations in the level of use of the new farming practice.

There is mounting evidence that less vulnerable households are also taking up aspects of the package with no external incentives (Mazvimavi et al., 2008). There has been some spontaneous adoption, mostly from farmers learning the technology from their neighbours. Figure 1 demonstrates the increase in number of practising CA in Zimbabwe as reported by the National CA Taskforce for the period 2004 to 2010.

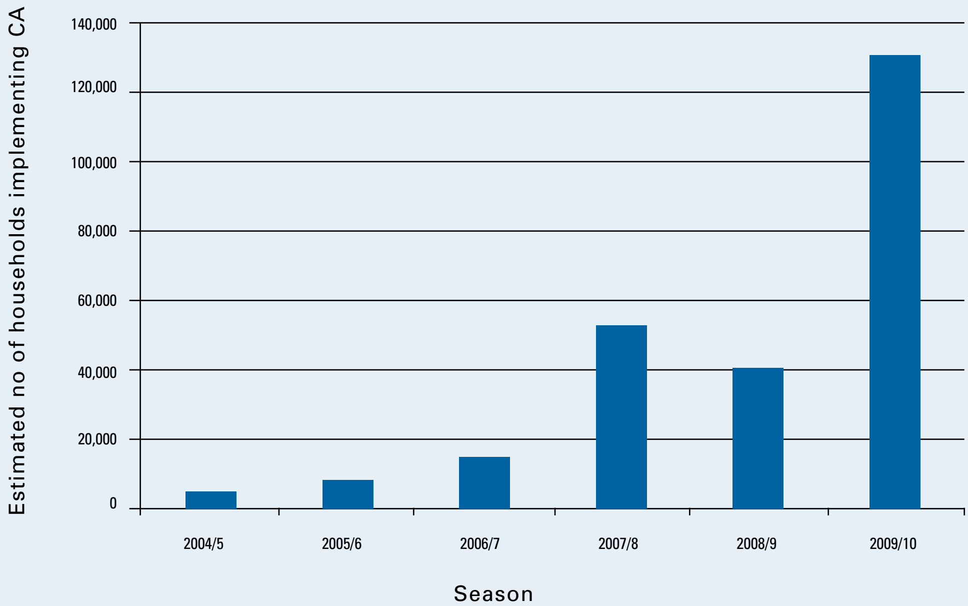
At the same time, however, there has been some dis-adoption by farmers who originally participated in the CA promotions but subsequently opted out due to various reasons. Among the farmers who continue to practice CA, many have modified the package and generally adopted some components of the technology like digging planting basins while leaving out other recommended practices. Crop rotation, mulching and winter weeding are some principles that have hardly been adopted. The choice of staple cereals over legumes has limited crop rotations, and the input package provided more cereal than legume seed thus making it difficult for farmers to achieve a full rotation. The multiple uses of crop residues, e.g. for livestock feeding, fuel wood and construction, have also limited their use for mulching. Winter weeding has been considered to be labour intensive and coincides with other off-season activities.

Findings in Zimbabwe are in agreement with reports on adoption of CA in other parts of Africa: despite nearly two decades of development and promotion of CA by the national extension programme and numerous other projects, adoption has been extremely low in the smallholder sector compared to other continents such as South and North America and Australia (Hobbs, 2007; Derpsch, 2008; Gowing and Palmer, 2008). Constraints to CA adoption include: a low degree of mechanization within the smallholder system; a lack of appropriate implements;

a lack of appropriate soil fertility management options; problems of weed control under no-till systems; limited or poor access to credit; a lack of appropriate technical information for change agents and farmers; blanket recommendations that ignore the resource status of rural households; competition for crop residues in mixed crop-livestock systems; and the availability of labour (Twomlow et al., 2006a).

There is a need to adapt technology to local situations. Improving input-output markets for legumes could improve their production. Farmers should be encouraged to use forms of mulch other than crop residues like the use of leaf litter and grass. Using cover crops could also be another option. Winter weeding is a challenge that can be addressed by using herbicides or slashing to prevent weed seed.

Figure 1. Changes in the number of households practising CA in Zimbabwe, 2004-2010



3.3 Emergence of CA in South Africa

Considerable research and development of conservation tillage techniques has been conducted in South Africa, especially during the past 25 years. Most of this knowledge has still to be effectively digested and presented to potential practitioners, especially small-scale farmers. Extensive work, especially on animal traction, crop rotation and acidification, still needs to be done.

3.3.1 Smallholder CA promotion and demonstrations in Limpopo Province

The South African CA task force has identified demonstration sites for various CA techniques across the country. The Limpopo, Fetakgomo district municipality site will be part of the Limpopo eco-technology project and be implemented by the Agricultural Research Council – Institute for Soil, Climate and Water (ARC-ISCW). It is funded by the Limpopo Department of Agriculture. The main trials established in 2009 demonstrate variations in CA practices by smallholder farmers and will include crops, implements and rainwater-harvesting techniques. The demonstrations will use animal-drawn rippers, planters and some cereal and legume crops for rotation.

3.3.2 Conservation Agriculture Thrust (CAT), University of Fort Hare

The CAT is an initiative of the Eastern Cape Department of Agriculture and Rural Development (ECDARD) in association with the University of

Fort Hare. The department is the sole funder of the project, while the university provides infrastructure and project administration. The goal of CAT is to reduce poverty, increase food security (especially in HIV/AIDS-affected households), reduce environmental degradation and improve the quality of life of vulnerable communities of Eastern Cape province. CAT's priority is the urgent and immediate adoption and adaptation of the principles and practices of CA by the majority of farmers in the Eastern Cape province. To achieve this, CAT focuses on two main strategies: a) to raise awareness of CA in the province; and b) to practically implement CA in smallholdings. Training of local extension officers is a critical factor to be supported by the local government.

Since 2007, the CAT has trained 40 extension officers and 15 of their direct supervisors from the department; this has resulted in the establishment of about 60 CA demonstrations by smallholder farmers in the province. Of these demonstrations, about 120 emerging farmers are now involved in improved crop production using CA methods. In view of the general awareness of CA, demonstration sites have been planted along the national highway N2, and are now referred to as the N2 Lima Project. The N2 Lima Project has resulted in increased awareness of CA in the province and has exposed senior government officials and other stakeholders to the initiative.

3.3.3 Roodeplaat experimental station, Pretoria

The Agricultural Research Council – Institute for Soil, Climate and Water (ARC-ISCW) with funding from the Maize Trust will be conducting on-station research experiments on CA. The experiments are aimed at developing research methods to quantify various soil-crop relationships, as well as in-depth understanding of the expected impact of climate change, and how CA will mitigate these effects. The research will take advantage of being done on-station to enable better control and apply new and innovative basic research on CA techniques. The experiments will also investigate the effects of CA on carbon sequestration and greenhouse gas emissions in view of the contribution of agricultural practices to climate change.

3.3.4 CA initiatives by large-scale commercial farmers

The Summer Grain Centre of the South African Agricultural Research Council Grain Crops Institute (ARC-GCI) commenced CA trial research in KwaZulu-Natal in 1976. However, adoption suffered a major setback in 1986/87 due to conditions particularly favourable to *diplodia* cob-rot and severe infestations in susceptible maize hybrids. A switch to more tolerant hybrids, soaring production costs and declining grain prices have resulted in farmers choosing CA as a means of increasing net returns. On-farm CA trials based on tractor, animal draft and manual means are being conducted by the KwaZulu-Natal Department of Agriculture. CA crops like maize, cotton, and possible rotation crops such as soya beans, cowpeas and dry beans are being tried with a plan to establish about 200 on-farm CA demonstrations. Other constraints include deficiencies or gaps in the information available to CA farmers. This has been attributed to poor communication between farmers, extension advisers and researchers.

There have been reports of unsuitability of CA in regions with sandy soil in South Africa's large-scale commercial farms (Berry, 1998). However, according to Fowler (1999) this has been attributed to conservatism of advisers and practitioners, resulting in CA having extremely limited acceptance. Reduced tillage is however practised by many large-scale commercial farmers, especially those cultivating sandy soils. CA for vegetables and cotton producers is virtually non-existent, with the only adopters of any significance being some sugar farmers in KwaZulu-Natal. This is also the case for wheat, medic, lucerne and canola farmers in the Western Cape, and maize, wheat and soya farmers in KwaZulu-Natal. In both these cases, only between 2 and 3 percent of the area is reported to be under CA (Fowler, 1999). The growing enthusiasm and commitment of the newly formed No-Till Club in KwaZulu-Natal aims to make a difference to the CA practices of large-scale commercial farmers in South Africa. Senior officials and researchers in the KwaZulu-Natal Department of Agriculture and researchers in the ARC, as well as individuals in the universities and other departments in South Africa are among its members. The club is lobbying for funding of CA in the country.

4 Socio-economic Profile of CA Farmers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4.1 Characterization of current CA households in Zambia

Household characteristics affect adoption decisions by farmers, particularly smallholder rural farmers. CA requires careful advance planning as well as meticulous, timely execution of key tasks. This requires a change in mindset and farm management style of farmers: a dry season can no longer be considered as a time reserved for resting and socializing because the off season in CA is regarded as the prime time for serious land preparation.

Farmers who are well educated and at ease with new farming techniques are more likely to become innovative farmers. According to Haggblade and Tembo (2003), cotton farmers whose cash crop demands careful attention (planting date, regular weeding, constant spraying and insect monitoring) have the necessary management traits that make good CA farmers. In Zambia, cotton farmers are among the largest group of CA spontaneous adopters as they possess the perseverance and planning, management and agronomic skills necessary to excel in this new farming practice. These farmers have also developed skills to deal with the issues around labour division on gender lines and with the constraints associated with the effects of HIV/AIDS on vulnerable households.

4.1.1 Gender and household dynamics in Zambia

Results from the Kalinda and Kapunda (2009) study on CA farmers show that 79 percent of households are male headed, with variations across districts (See Figure 2 and Table 2). Monze district has the highest proportion of male-headed households (92 percent) and Choma has the lowest (65 percent) practising CA. Men tend to be primary decision makers, but the male head-ship does not necessarily translate to men taking the lead in agricultural work. Age has an impact on productive capacity and influence on CA practices. The estimated mean age of rural households in Zambia is 44 years (Kalinda and Kapunda, 2009), with variations at district level. Chibombo has the oldest CA household heads at 49 years, and Chipata the youngest at 40 years. The generally young to midlife households show greater potential among Zambian farmers to being innovative and adopting new farming practices, such as CA techniques.

Figure 2. Map of Zambia showing 12 districts covered by CASPP and FISRI projects baseline studies in 2009

Source: CASPP Annual Report, 2010

Zambian farmers are the most unlikely to face problems understanding basic principles of CA, given their levels of literacy. The literacy rate in Zambia's rural areas is quite high, with 94 percent of household heads having attained some formal education. The Kalinda and Kapunda (2009) report shows that 48 percent of household heads had primary education and 46 percent had at least secondary education. Farmers with limited education have greater difficulty in following up some of the recommended CA practices, such as those in Katete and Chongwe districts where illiteracy rates are 13 percent and 15 percent respectively. Rural household sizes in Zambia are relatively high at 9 persons per household, compared to Zimbabwe where it is 6 persons per household (Tables 1 and 3). At district level, average household sizes do not vary much, with Katete having the smallest mean of 7 persons, and Kalomo the largest at 10 persons. It can be inferred that the high number of people per household can be translated to better access to family labour, a critical requirement for hand-hoe based CA practices. However, it should also be noted that the actual labour available depends primarily on the economic dependence ratio[1] which estimates the size of the more active persons in the household. Based on the economic dependence ratio, most households in rural Zambia are composed of young people or economically less active persons. This pool of non-productive population can slow down the pace of CA technology transfer in situations where the adult household members have to spend more time looking after the young and elderly family members.

1. Economic dependence ratio is calculated by dividing the total number of children (0-17 years) plus the elderly (above 60 years) by the total population.

Table 1. CA household characteristics by agro-ecological regions and districts in Zambia, 2009

Agro-ecological zones	District	Number of respond-ents	Proportion of female-headed households (%)	Mean age of house-hold head (years)	Mean education level of household head (%)			Labour access	Mean current household size (persons)
					Never been to school	Primary	Secondary and tertiary	Mean number of adults (18-59 years)	
IIb	Kaoma	77	20.8	44.7	6.5	48.1	44.4	2.7	8.0
IIa	Mumbwa	79	16.5	44.0	2.5	39.2	58.3	3.6	9.3
IIa	Mazabuka	75	25.3	44.4	4.0	52.0	44.0	3.0	9.3
IIa	Monze	75	8.0	42.5	0	44.6	55.4	3.4	9.8
IIa	Choma	75	34.7	43.7	1.3	46.7	52.0	2.8	9.0
IIa	Kalomo	76	23.7	46.0	8.0	57.3	34.7	3.4	9.9
IIa	Chipata	78	23.1	39.7	5.1	44.9	50.0	2.9	7.9
IIa	Katete	75	14.7	42.9	13.3	56.0	30.7	2.8	7.2
I/IIa	Petauke	78	29.5	42.1	5.1	70.5	24.4	3.1	8.6
I/IIa	Chongwe	75	22.7	44.4	14.7	40.0	45.3	2.7	7.4
IIa	Chibombo	75	25.3	48.5	9.3	28.0	62.7	3.2	9.5
IIa/III	Kapiri Mposhi	77	11.7	42.2	1.3	44.2	54.5	2.9	8.5
	Total	915	21.3	43.7	5.8	47.8	46.4	3.0	8.7

Source: Kalinda and Kapunda (2009)

Note: In Zambia, agro-ecological zone 1 receives less than 800 mm/year; agro-ecological zone 2 receives 800-1 000 mm/year; and agro-ecological zone III receives more than 1 200 mm/year. (Source: http://www.pavidia.org.zm/e-zambiaagri4.html)

4.1.2 The effects of HIV/AIDS on the Zambian rural population

Though difficult to quantify the effects of HIV/AIDS in rural areas, a proxy is generally used, i.e. the presence of orphans and recent deaths within the household. Although the incidences vary across districts, available data show that 17 percent of the population in the study districts were orphans, with 8 percent being chronically ill, and 2 percent having died in the past 12 months (Table 2). The results show that 8 percent of the sample households have a member receiving ARV drugs and 12 percent of the households are involved in an HIV/AIDS support group. The incidences of chronically ill and deaths seem to correlate with members on HIV/AIDS support groups or ARV treatment in Kaoma, Mazabuka and Chipata districts.

To some extent, these estimates confirm the negative impact of HIV/AIDS on labour-force availability and productive capacity of the households. With CA practices, staggering some operations stretches labour demands; for the sick or those caring for HIV/AIDS patients, this approach provides the opportunity to spread labour for such households. On a positive note, the high level of involvement of household members in ARV treatment and support groups is indicative of increased awareness of the HIV/AIDS pandemic. Box 1[2] presents a case of a CA farmer, living with HIV/AIDS, who has been selected as a lead farmer responsible for encouraging the adoption of CA in Mazabuka district.

2. Name of the farmer has been changed to respect confidentiality of the individuals mentioned.

Box 1. Dealing with HIV/AIDS by a CA Farmer in Zambia

John Baison is a farmer living with HIV/AIDS in Mazabuka district and practising CA. He retired in 2007 from his employment in the mines of the Copperbelt because of ill health. John has been on antiretroviral therapy (ART) for the past two years now, and has shown remarkable recovery and decided to start a new life as a CA farmer.

He was selected to be a lead farmer under the CASPP project in 2009 and oversees training of 15 farmers in his camp. Mr Baison says most farmers infected with HIV/AIDS were not being directly supported by the Network of Zambia People Living Positively with AIDS (NZP+) or any other organization that receives inputs through cooperatives. Mr Baison says stigmatization lingers as many Zambians still have the perception that a person infected with HIV had minimal chances of survival. He has taken the initiative to encourage infected farmers and wishes government and non-governmental organizations would implement programmes to assist farmers and curtail stigma.

"I have personally tried to convince infected farmers that one can live a longer life by taking the ARVs and the response has been very good and now government should come out with a good policy to build on this exercise," he said.

Some farmers have to travel long distances from rural areas to ART and medical health centres because of inadequate facilities in areas they live. To correct this, government must set up health centres as close as possible to farmers so they can get help quickly and be healthy and productive. This is particularly important for CA farmers who need to closely monitor their operations throughout the year. Mr Baison gives the example of miners who he says have continued to be productive because they have facilities such as the New Start Centre right at their doorstep.

Mr Baison would prefer to see the different institutions promoting CA to include ART in their programmes. Since there is a diversity of crops produced by the CA programme, the sick farmers have access to a more healthy diet that can help to sustain ART. However, Mr Baison is critical of the chaka hoe for basin digging which he says is too heavy, especially on the days when he is not feeling too well. Otherwise he manages the remainder of the work required by CA by staggering some of the operations throughout the year.

Table 2. Presence of orphans and chronic illness, deaths and involvement in HIV/AIDS programmes, among CA practising households in Zambia, 2009

Agro-eco-logical zones	District	Number of household respondents	Total number of people in the sample households	Number of orphans as proportion of total (%)	Persons chronically ill in the sample households (%)	Persons who died in the sample households (%)	Involvement in HIV/AIDS-related activities (%)	
							Person on ARVs	HIV support group
IIb	Kaoma	77	616	17.0	8.0	2.1	11.7	18.2
IIa	Mumbwa	79	735	11.2	4.2	1.5	5.1	16.5
IIa	Mazabuka	75	698	11.9	7.7	3.2	20.0	20.0
IIa	Monze	75	735	6.3	1.2	0.8	6.7	9.3
IIa	Choma	75	675	10.2	3.3	0.3	1.3	6.8
IIa	Kalomo	76	752	11.3	4.3	1.1	5.3	10.5
IIa	Chipata	78	616	14.4	3.2	2.1	6.4	14.1
IIa	Katete	75	540	4.4	0.2	0.4	12.0	13.3
I/IIa	Petauke	78	671	5.8	2.1	0.6	7.7	9.0
I/IIa	Chongwe	75	555	13.5	2.0	0.9	8.0	13.3
IIa	Chibombo	75	713	14.6	3.5	2.0	4.0	9.3
IIa/III	Kapiri Mposhi	77	655	11.9	1.7	0.8	3.9	5.2
	Total	915	7 960	17.0	8.0	2.1	7.7	12.1

Source: Kalinda and Kapunda (2009)

4.2 Characterization of current CA households in Zimbabwe

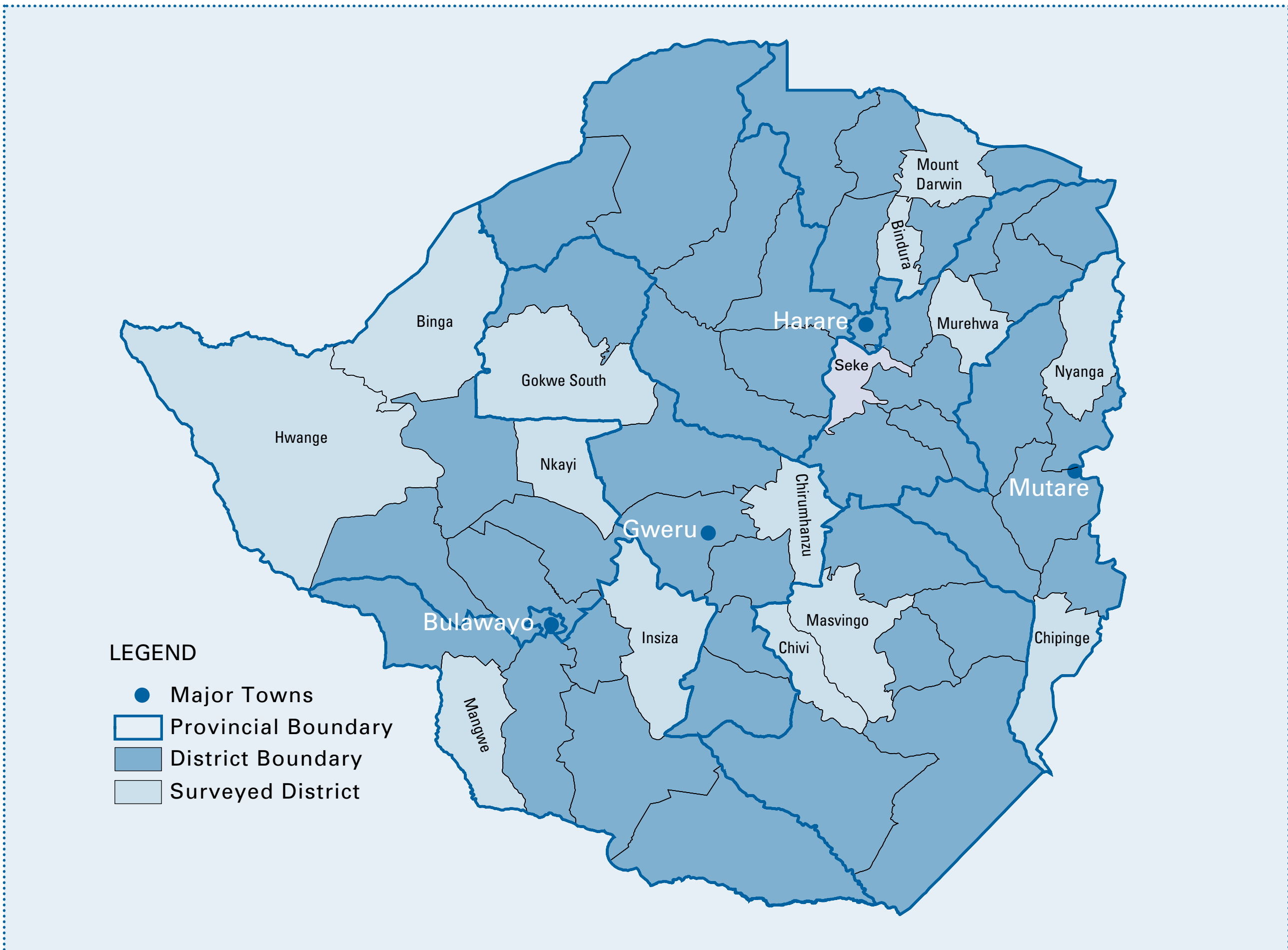
In Zimbabwe, CA promotions in the context of NGO support have essentially targeted vulnerable farmers. These farmers are not necessarily of the same resource and social endowment status. Different household characteristics influence technology adoption differently. NGOs targeted farmers perceived to be vulnerable to food production shortfalls, and provided them with training on CA and free inputs as incentives to try out the new technology, and also as a more efficient way of using relief inputs. The variations in household socio-economic status will influence the intensity of adopting specific CA components. For Zimbabwe, good availability of data enabled a more detailed assessment of socio-economic factors influencing farmer practice of specific CA techniques.

4.2.1 Gender and CA household dynamics in Zimbabwe

Data available from ICRISAT studies using 232 households in 15 districts (Mazvimavi, et. al., 2009), Figure 3 shows that there was no significant difference in the numbers of male and female-headed households targeted by NGOs across the districts (Figure 3 and Table 3). This is despite the fact that NGOs deliberately target female-headed households for relief assistance. The sex of the household head is equally shared with 49.9 percent being male-headed and 50.1 percent being female-headed households. The average age of the household head is above 50 years, with the exception of Mount Darwin, Nyanga, Chipinge and Binga where it ranges from 44 to 48 years. There does not appear to be any significant age difference across the 15 districts. This can be attributed to the targeting process of households by the NGOs, which includes the elderly as part of the vulnerable households. On average, farmers had 6.4 years of formal education. This means that household heads across the surveyed districts had attained up to primary level of education and were generally literate. The education level had nothing to do with the targeting procedure of NGOs but is vital in assessing the ability of farmers to appreciate and grasp new principles or concepts such as CA.

In general, all the household heads have farming experience with farmers in Binga having the least farming experience (19 years) and Gokwe South the most (38 years). This information helps to characterize the farmers participating in CA. These farmers have experience with their environment and natural resources. They are thus more likely to appreciate a new technology that has potential for better crop yields. Over time, farmers are expected to realize greater yields from CA as they gained experience with the technology. Households interviewed by ICRISAT had some experience with CA, with the majority of farmers having at least a minimum of three years of practice with the technology (Mazvimavi et. al., 2009). The most experienced farmers were in Bindura district, with more than six years of CA practice. This is where River of Life pioneered CA, with some farmers claiming to have started in the late 1980s. Districts such as Binga, Chipinge and Chirumhanzu had relatively less experienced farmers, averaging less than three years because CA promotions by NGOs in these areas have only recently been introduced. Farmers in areas such as Masvingo, Murehwa and Insiza were in their fourth season of CA practice.

Figure 3. Districts covered by the ICRISAT CA panel study, 2009, Zimbabwe



Source: Mazvimavi et al., 2010

4.2.2 Dealing with HIV/AIDS-affected households in Zimbabwe

Table 3 shows that the majority of the farmers in Zimbabwe started practising CA after being selected by NGOs. In all the districts there is some evidence of chronic illness which directly limits CA labour availability in the household. On average, about 20 percent of the households have chronically ill people. Seke, Bindura and Chivi had the highest number of chronically ill household members. In Seke, NGO targeting was based primarily on HIV/AIDS indicators. The average household size across the survey sample is six, with fewer contributing to full-time labour on the farm (3.7 persons per household). Binga had the largest average household size of nine individuals. Marriage arrangements in that area are typically polygamous resulting in the larger household sizes (Manyena et al.,2008).

Table 3. Characteristics of households involved in CA by agro-ecological regions and districts, Zimbabwe, 2008

Natural region	District	Female headed households (%)	Mean age of household head (years)	Mean education level of household head (years)	Mean farming experience (years)	Mean conservation agriculture experience (years)	Proportion initially selected by NGO for input support (%)	Proportion of chronically ill persons (%)	Mean labour access (adult equivalent)	Mean current household size (persons)
NR II	Murehwa	66.7	59.1	6.4	37.3	4.1	62.5	20.7	3.6	6.3
	Bindura	61.1	59.5	4.7	34.8	6.0	81.8	26.7	2.9	4.7
	Seke	68.0	56.2	6.6	31.4	3.4	79.4	41.4	3.3	5.8
	Average	65.5	58.0	6.0	34.0	4.4	74.7	29.5	3.3	5.6
NR III	Mount Darwin	38.1	47.9	6.0	26.6	3.6	74.2	13.8	4.1	6.1
	Chirumhanzu	58.3	50.7	7.2	26.8	2.8	43.8	20.0	3.5	5.8
	Masvingo	50.0	58.9	6.2	34.8	4.3	68.3	16.1	3.5	6.0
	Average	47.3	52.9	6.3	29.9	3.7	62.5	16.7	3.7	6.0
NR IV	Nyanga	71.4	46.2	7.1	23.4	3.9	100.0	16.7	3.1	5.4
	Gokwe South	27.3	55.2	6.2	38.0	3.2	93.1	10.7	3.3	6.3
	Nkayi	25.0	61.5	7.1	36.8	3.3	64.0	20.0	4.6	8.3
	Insiza	46.2	53.4	6.2	23.6	3.8	76.9	17.4	3.3	6.4
	Average	43.1	53.7	6.7	30.9	3.5	85.2	16.0	3.6	6.6
NR V	Chivi	46.7	53.3	7.2	28.3	3.7	94.7	23.3	3.8	6.7
	Hwange	28.6	52.9	5.0	25.9	3.4	72.7	17.9	4.1	6.2
	Mangwe	77.8	53.6	6.7	22.3	3.9	95.7	13.6	2.8	5.5
	Chipinge	55.0	47.9	6.9	24.5	2.8	100.0	19.4	4.0	6.5
	Binga	0	44.1	6.4	19.5	2.6	93.1	8.7	5.2	9.0
	Average	44.4	50.4	6.5	24.1	3.3	91.2	17.2	4.0	6.8
NR II –V	*50.1*	*53.8*	*6.4*	*29.7*	*3.7*	*78.4*	*19.9*	*3.7*	*6.3*	

Source: Mazvimavi, et. al., 2010

Zimbabwe is divided into five agro-ecological regions also known as natural regions I to V. Natural regions I and II receive the highest rainfall (at least 750 mm per annum) and are suitable for intensive farming. Natural region III receives moderate rainfall (650–800 mm per annum) and natural regions IV and V have fairly low annual rainfall (450–650 mm per annum) and are suitable for extensive farming (Vincent and Thomas, 1960).

4.2.3 CA adoption intensity in Zimbabwe

Table 5 shows household characteristics that were used in a study by Mazvimavi and Twomlow (2009) as determinants to the extent of CA practice. Characteristics of the household head, such as age and farming experience, were hypothesized to imply farming knowledge gained over time and to be important in evaluating technology information (Feder et al., 1985; Belknap and Saupe, 1988). Older farmers are expected to use their many years of farming experience to decide to adopt the new technology (Table 4).

It was also hypothesized that family labour availability may influence adoption of most CA components. Farmers who have recent experience with HIV/AIDS are more likely to reduce the intensity of CA practices they adopt based on their access to labour access and resources.

Table 4. Hypothesized determinants of adoption of CA techniques by vulnerable households in 15 districts of Zimbabwe, 2007

Independent variables	Measure	H_0 sign	Rationale
Gender	1 = Male 0 = Female	+	Female farmers tend to have labour constraints and will miss some of the components of CA
Age	Years	+	Older farmers with better farm experience are more likely to practise all CA techniques
Farming experience	Years	+	Farmers' experience increases the likelihood of understanding the benefits of CA
Labour availability	Number of full-time family labour	+	Availability of labour increases the ability to adhere to all components of CA practices
Draft access	1 = Yes 0 = No	–	Farmers with draft-power access are likely to use conventional farm-plough tillage practice
Illness or death	1 = Yes 0 = No	–	HIV/AIDS impact negatively on the intensity of CA adoption
Extension access	Number of meetings	+	Extension services increase information on improved performance of CA
NGO promoting CA	1 = Promoted by NGO 0 = No NGO promotion	+	Spontaneous adopters lacked some technical information and inputs to practice of components of CA
CA plot size	m^2	+	Farmers realising significant benefits from CA have increased CA plot sizes and tend to practise most CA techniques
Experience with CA	1 = 2^{nd} + year 0 = 1^{st} year	+	Farmers that have practised CA in the past have a better understanding of benefits of the technology
Rainfall region	1 = High rainfall 0 = Low rainfall	+	Farmers in high rainfall regions practice most components of CA

Table 5 summarizes the results of the Tobit Model analysis and shows that the male-headed households (GENDER) were more likely to adopt most of the eight components of the CA package. However, the significance levels of the results are low and this could be attributed to the fact that the majority of farmers are women. Age (AGE) and farming experience (FARMEXP) were not important factors in deciding which CA practices to adopt. In this analysis, age effect could have been influenced by the changing life cycle of the farmer with time, and the effect on adoption of CA practices.

As farmers grow older, they become more skilful through learning by doing. But this trend attenuates as they reach middle age and their physical strength begins to decline. Furthermore, with age farmers become more risk averse and less willing to adopt new farming technologies. There was a positive relationship between experience (CFEXPER) with CA practice and the intensity of adopting different components of the technology. The regression results suggest that the longer a household practices CA, the more likely it is to take up all eight components of the CA package.

Table 5. Estimation Tobit Model for factors influencing adoption intensity of CA for 232 households surveyed across 12 districts in Zimbabwe, 2007

Variable	Coefficient estimate	Standard error	Asymptotic t-ratio
Constant	0.095	0.065	1.470
GENDER	0.046	0.029	1.641*
AGE	0.0003	0.001	0.244
FARMEXP	0.00001	0.0001	0.083
LABOUR	0.032	0.033	0.991
ILLDEATH	-0.007	0.028	-0.240
DRAFT	0.037	0.028	1.373
EXTN	0.018	0.004	4.831***
NGO	0.259	0.034	7.437***
PLOTSIZ	0.065	0.020	3.202***
CFEXPER	0.044	0.028	1.567*
RAINFAL	0.152	0.029	5.209***

Log likelihood function = -18.987

*Level of significance: ***0.01; **0.05 * 0.10*

Source: Mazvimavi and Twomlow (2009)

Household labour availability (LABOUR) and the impact of HIV/AIDS (ILLDEATH) do not appear to limit the uptake of the CA package. In some districts NGOs purposely targeted HIV/AIDS for CA promotion, and with good training and staggering some of the required operations, the implied negative effect of the epidemic is reduced. This justifies current NGO initiatives to promote CA to the more vulnerable households in a community as a means of combating food insecurity. In some instances there are other social arrangements, e.g. grouping to work on an ill person's field as a social service or assistance by more able community members, thereby reducing the labour constraints faced by farmers affected by HIV/AIDS.

Another explanation for the lack of significant effects of labour on CA adoption is that vulnerable households in most of the districts work as groups when undertaking the labour intensive tasks such as basin digging.

As expected, extension access (EXTN) and NGO support (NGO) significantly influenced adoption of different components of CA. Where government extension officers have been working closely with NGO staff in promoting the technology, they have become an important source of backup technical support. CA adopters with larger plot sizes (PLOTSIZ) were also likely to practise more components of CA. As plot size increased, the likelihood of implementing more of the package increased, as farmers responded positively to yield gains. In this study there was no assessment of the impact engaging lead farmers who would be useful in filling the extension gap to some extent at the local level.

The rainfall pattern was included in the study to capture spatial variability in CA adoption. Farmers in high rainfall areas (RAINFAL) implemented more CA components than those in low rainfall areas. A portion of the interviewed farmers in the high rainfall areas had longer experience with CA, which is by itself a contributing factor to the intensity of adopting different CA components. The adoption patterns by agro-ecological regions seem to contrast results from a study in Zambia where Haggblade and Tembo (2003) concluded that the highest adoption rates of CA using hand-hoe basins occurred in low and scattered rainfall regions. In Zimbabwe, farmers in high rainfall areas had more years of experience in CA practice, where a church-based organization had initially promoted the technology (Mazvimavi et al., 2008), and these farmers tended to increase adoption intensity of the recommended CA components. This might help to explain the contrast with findings from Zambia. Also results are more likely to change with more CA experience in drier areas where the technology has greater impact on water harvesting and moisture retention during the drought periods.

4.2.4 Impacts of CA on crop production in Zimbabwe

In Zimbabwe, yields from CA plots are generally higher than those from CD tillage plots (Table 6). Maize, the main crop grown in all the districts, yielded on average 1 546 kg/ha on CA and 970 kg/ha on CD tillage plots in the 2008/2009 cropping season (Mazvimavi et al., 2010). The maize yields were much lower for the 2007/2008 year, when the rainfall was less favourable. Larger yield gains are realized in CA than CD tillage plots because the technology promotes improved management and targeted application of fertilizers, timeliness of operations like planting, frequent weed control, and timely fertilizer application.

Table 6. Maize yield (kg/ha) from CA plots and non-CA plots for three cropping seasons, Zimbabwe

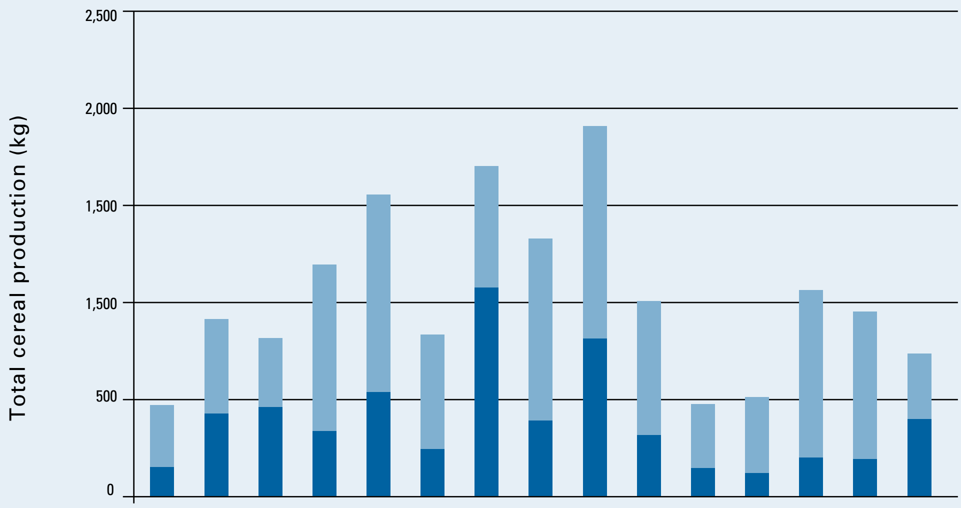
Natural region	District	2006/2007		2007/2008		2008/2009	
		CA	CD Tillage	CA	CD Tillage	CA	CD Tillage
NR II	Bindura	1 950	920	1 109	510	1 490	1 208
	Murehwa			2 266	897	2 132	1 412
	Seke					1 635	962
NR III	Chirumhanzu	1 162	789	1 207	340	1 428	914
	Masvingo	1 735	725	3 060	557	2 439	1 355
	Mount Darwin	1 105	701	1 011	368	1 190	877
NR IV	Gokwe South	2 056	421	766	285	1 433	713
	Insiza			800	247	1 646	1 105
	Nkayi	1 244	789	1 175	398	1 579	792
	Nyanga	1 917	1250	1 247	787	1 308	874
NR V	Binga			500	250	1 384	868
	Chipinge			222	79	1 262	1 105
	Chivi	1 500	910	1 061	270	1 658	874
	Hwange	1 464	385	561	424	1 563	713
	Mangwe			614	283	1 048	792
Total Average Yield		*1 570*	*765*	*1 114*	*407*	*1 546*	*970*

Source: Mazvimavi et al. 2010

Assuming that an average household of six people requires 900 kg of cereal in one consumption year, farmers in 9 of the 15 districts in Zimbabwe were likely to meet their full year cereal requirements from the CA plots. These requirements can be produced from an area of about 0.6 ha. Conversion to CA will thus enable farmers to produce more surplus food which they could market and generate income for family needs. Alternatively, they could use most of the arable land for growing cash crops or other purposes such as rotational woodlots, with, e.g. leguminous tree species which help to restore the fertility of the soil, and produce their own timber and fuel wood. However, in making these estimations, it should be noted that as the area under CA per household increases, the average yields might decrease due to inadequate management, e.g. more weeding time might become necessary because of the increased area.

Information presented on Figure 4 also supports the fact that most household food is still being produced through conventional tillage methods in the 15 study districts of Zimbabwe. The data show that CA contributed more than 50% of the food production in only three of the districts, Bindura, Masvingo and Seke. These data and the data in Table 6 demonstrate the need for households to increase the proportion of their land that they farm using CA.

Figure 4. Contribution of CA to household food security (total cereal production in kg), 2008/2009 cropping season



Source: Mazvimavi et. al. 2010

4.3 Large-scale CA adopters in South Africa

CA practice in South Africa's large-scale commercial sector has been widespread in the past two decades. Though with some variations, commercial farmers commonly refer to the practice as 'non-till' but implementing basically all three principles of CA. It was reported that by 2002, more than 300 000 ha of arable commercial land was under CA, and the latest figures are even higher (Farmers Weekly, 2007). It has been difficult to obtain the latest statistics for CA practice in South Africa given the short time frame of the study tour. However, during the study a visit was made to two large-scale commercial farms in Limpopo and Gauteng provinces, both practising CA at different levels. For the purpose of this analysis, a study case adapted from the Farmers Weekly is presented in Box 2 illustrating successes in CA practice by a farmer in the Northern Cape province. Of note is that the farmer has made significant savings on farm operational costs and improved farm workers welfare, including their medical expenses.

An increasing number of commercial farmers in South Africa practising CA have gone for study tours to Australia, Brazil and the USA. Based on such experiences, these farmers have played the 'lead farmer' position in an otherwise sceptical neighbourhood which did not believe in CA. Even the farm equipment industry in South Africa was less supportive as they wanted to maintain the traditional business of selling conventional tillage implements. One farmer summed up the situation: "Farmers with the infrastructure required for conventional tillage are loath to change, and some farmers prefer to keep doing what their forefathers did."

Box 2. The case of CA success in the Orange River

Jaco van Niekerk plays a leading role in the local research into CA practices, which includes soya production and alternative crops such as paprika from his farm in the Northern Cape province. Jaco farms on 1 139 ha, including 440 ha of irrigated crops, 3 ha of pecan nuts and about 4 ha under lucerne, planted between the irrigation centre pivots. On sandy loam soils with a clay content of between 10 percent and 12 percent, Jaco's soya, maize and wheat respectively yielded 4,3 tonnes/ha, 14,9 tonnes/ha and 7,3 tonnes/ha during the 2006/2007 cropping season. Jaco's interest in soil structure and the damage done by conventional tillage, inorganic fertilisers and harmful chemical applications was nurtured by his father and reinforced at university. Seeking alternatives, he went on a farmer's tour to the United States in 1995, where he first learnt about CA principles such as minimal soil disturbance through no-till or direct seeding, permanent soil cover, the use of crop residue and/or green manure cover crops, multi-cropping and crop rotation.

Jaco realized South Africa needed CA to become globally competitive. CA not only reduced costs but enhanced soil structure, increased humus content, nurtured microbial life, prevented erosion and increased moisture absorption. Crop residue mulch captures rain and irrigation water, letting him use up to 30 percent less water and cutting down on pumping costs. The crop residue also forms a blanket that regulates temperatures and helps control weeds. Thanks to the build-up of humus, Jaco also needs less fertiliser, while microorganisms and earthworms flourish in the wetter soil.

Jaco blames the slow adoption of CA practices by large-scale farmers on the lack of knowledge and dearth of information on CA available in South Africa. "I wanted to save and enhance my soils for myself and future generations. But local farm machinery companies weren't importing no-till equipment. Alongside other input companies, they were actively discouraging no-till for fear it would hurt their sales. For example, I use only 6 litres/ha of diesel to no-till plant, and only about 20 litres/ha to plant, spray, combine and deliver the crop to my on-farm silos. In 2003, I managed to buy a Brazilian no-till Tatu planter for my maize and soya, and a no-till John Deere 1570 drill for my wheat. I've never looked back."

Jaco approaches his farming operations holistically. Jaco has found that weed populations have declined, allowing him to spray less pre- and post-emergent glyphosate to control them. Jaco also provides for his workers and their dependants. He and his wife Mary sent their domestic worker on a training course so she could teach at a nursery school for workers' children. Jaco provides school transport, sponsors fees, clothing and a soccer team. The farm has a medical facility for visiting doctors and farm workers affected by HIV/AIDS have ready access to ART programme. Workers receive bonuses based on the season's profits.

Adapted from Farmers Weekly, 23 October 2007

5 Profitability Analysis of CA in Zambia and Zimbabwe

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The following profitability analysis is based on smallholder CA animal-drawn rippers and hand-hoe basins in Zambia and Zimbabwe. Due to time limitations, data was not accessed to make a profitability analysis of the tractor-drawn CA system for Zambia and South Africa. This is one knowledge gap identified and recommended for a separate formal study, particularly in South Africa where there is limited published material on CA farm enterprise analysis.

5.1 Input use under CA and CD systems

Levels of input use in the CA maize system depended on the type of input as illustrated in Tables 7 and 8. In physical terms, higher seed rates of maize were used in CA at 25 kg/ha in Zambia and Zimbabwe compared to 20 kg/ha respectively for the two countries under the CD system. It has been argued that the CD tillage system is less efficient in seeding rate; the study estimates that the maize seed rate is 20 kg/ha. However, it is easier to maintain a consistent seeding rate in the CA system, particularly with the planting basin compared to planting in furrows made out of conventional draft ploughing. The analysis looks at a typical situation in rural Zimbabwe, where most farmers do not have access to fertilizer, hence the lower application rates. Overall, CA results in more efficient use of fertilizer and lower rates are used compared to CD.

The analysis shows that the CA basin technique required 69 percent more labour in Zambia and 58 percent more in Zimbabwe compared to the CD tillage system. Although not yet proven, the higher labour requirements in Zambia might be attributed to the larger basin sizes that are dug compared to Zimbabwe. The high labour demand in the CA system is more a consequence of the digging of planting basins and weeding practices. It is hypothesized that with more years of practising CA, the labour demand is reduced as it becomes easier to dig from the same basin and as weed pressure decreases.

However, farmers are finding it difficult to return to the same basins as they are destroyed by livestock, and farmers are also interested in ensuring that fertilizer is applied to all sections of the fields by opening up new basins. Most farmers frequently neglect to weed before weeds develop seeds, which has made it difficult to reduce the weed seed bank. Where farmers are practising the CA ripper system in Zambia, labour requirements are lowest at 63 days/ha for the entire cropping cycle compared to 70 days/ha and

148 days/ha for CD tillage and planting basins respectively (Table 7a).

The study does not distinguish the value of labour from the type of work done. In the context of surplus labour available in the rural areas, the use of more labour may even be an advantage to CA farmers. However, saving on labour through the adoption of herbicide use and rippers has the potential to increase the economic viability of CA systems.

This would help lower production costs and give participants more time to engage in other livelihood activities. It would also lighten the burden of women so they have time for other duties such as caring for children, the sick and elderly while also allow them some time to rest.

5.2 Yield improvement through CA

The maize grain yield under the CA system was 3 000 kg/ha and 1 780 kg/ha in Zambia and Zimbabwe respectively for the 2008/2009 cropping season. The yield gains are significantly higher than CD tillage with 2 119 kg/ha and 868 kg/ha for Zambia and Zimbabwe respectively. Thus, the grain yield under the CA technology was increased by 42 and 105 percent in Zambia and Zimbabwe respectively. The yield of by-product is more or less the same under these two systems of planting.

5.3 Impacts of CA on the cost of food production

Due to higher input use (seed, fertilizer and labour) under the CA system, particularly the planting basin technology, overall cost of production also increased. Cost of production per hectare under the CA basin system was US$376 per hectare compared to US$295 per ha under CD tillage system in Zambia. In Zimbabwe, the total cost of maize production was US$232 per hectare under the CA basin system compared to US$156 per hectare under the CD tillage system (Table 7b). However, the introduction of rippers is showing evidence of reduced production costs and these costs are likely to decline with the adoption of herbicides by CA farmers.

Table 7a. Farm enterprise budget analyses for conservation agriculture (CA) and conventional draft (CD) tillage practices for Zambia

			CA planting basins		CA Magoye ripper		CD tillage	
Item	Unit	Price/ Unit ($USD)	Quantity	Cost ($USD)	Quantity	Cost ($USD)	Quantity	Cost ($USD)
A. Revenue								
Maize grain	kg	0.14	3 000.00	420.00	3 000.00	420.00	2 119.12	296.68
Total revenue				*420.00*		*420.00*		*296.68*
B. Input costs								
Maize seed	kg	2.02	25.00	50.50	25.00	50.50	20.00	40.40
Basal fertilizer	kg	0.72	125.00	90.00	125.00	90.00	100.00	72.00
Topdressing	kg	0.70	125.00	87.50	125.00	87.50	100.00	70.00
Ripping services	ha	25.00			1.00	25.00		
Ploughing services	ha	25.00					1.00	25.00
Total input costs				*228.00*		*253.00*		*207.40*
Total labour	*day*	*1.00*	*148.00*	*148.00*	*63.00*	*63.00*	*70.00*	*70.00*
Total variable costs			*376.00*		*316.00*		*277.40*	
C. Returns								
Gross margin	US$/ha			44.00		104.00		19.28
Cost per kg	US$/kg			0.13		0.11		0.13
Returns to labour	US$/day			1.32		2.65		1.28
Labour productivity	kg/day			20.27		47.61		30.27

Sources: Haggblade, Tembo and Donovan (2004); Haggblade and Plerhoples (2010)

Table 7b. Farm enterprise budget analyses for conservation agriculture (CA) and conventional draft (CD) tillage practices for Zimbabwe

				CA planting Basins		CD tillage	
Item	Unit	Price/Unit ($USD)	Price/Unit ($USD)	Quantity	Cost ($USD)	Quantity	Cost ($USD)
A. Revenue							
Maize grain	kg	0.14	0.25	1 780.00	445.00	868.00	217.00
Total revenue					*445.00*		*217*
B. Input costs							
Maize seed	kg	2.02	2.00	25.00	50.00	20.00	40.00
Basal fertilizer	kg	0.72	0.33	92.50	30.53	0.00	0.00
Topdressing	kg	0.70	0.35	83.30	29.16	47.00	16.45
Ripping services	ha	25.00					
Ploughing services	ha	25.00	22.00			1.00	22.00
Total input costs					*109.69*		*78.45*
Total labour	*day*	*1.00*	*1.00*	*122.23*	*122.23*	*77.33*	*77.33*
Total variable costs				*231.92*		*155.78*	
C. Returns							
Gross margin	US$/ha				213.08		61.22
Cost per kg	US$/kg				0.13		0.18
Returns to labour	US$/day				2.74		1.80
Labour productivity	kg/day				14.56		11.22

Source: Mazvimavi and Twomlow (2009)

5.4 Net economic gain

The yield of CA maize averaged 3 000 kg/ha and 1 780 kg/ha in Zambia and Zimbabwe respectively, as compared to 2 119 kg/ha and 868 kg/ha for the CD tillage system Table 7. The gross revenue for maize was higher for Zimbabwe as compared to Zambia mainly due to higher maize prices in the former country.

The gross margins were higher in the CA basin system, being US$44/ha compared to US$19/ha under CD tillage in Zambia, and US$213/ha compared to US$61/ha under CD tillage in Zimbabwe. Although the cost of producing maize is high under the CA basin system for both countries, the higher yield gains achieved with this technology result in significantly better returns to production compared to CD tillage system. It is even cheaper to produce a kilogramme of maize under the CA system compared to the CD tillage system.

CA ripper system is the most efficient way of producing maize in the smallholder sector for the two countries, costing US$0.11/kg in Zambia compared to US$0.13/kg with the CD tillage system. In terms of returns per labour, again the ripper system has the highest returns to labour invested in producing maize in both countries. Alternatively, for each labour day invested in producing maize by these smallholder farmers, they are more likely to obtain increased grain with the CA technology using rippers, having approximately 48 kg per day invested. This shows a better prospect for a CA ripper system in the smallholder sector (including in Zimbabwe) for farmers with draft-power access.

6 Dealing With Increased Labour Demands in CA

6.1 Land preparation

CA with animal-drawn rippers, for example Magoye rippers in Zambia, aims to benefit from area expansion while at the same time avoid plough-induced damage to soil structure and soil organic matter. Rather than completely inverting the soil, rippers chisel only a furrow in the soil, resulting in less energy being used than in CD tillage. Ripping is also possible during the dry season, and for poorer farmers, off-season ripper rentals are likely to be cheaper and enable on-time planting and area expansion due to use of animal traction.

6.2 Weeding

Weeding seems to take a large proportion of crop production activities, particularly in CA practices. Different technologies are being tried to suppress the labour effort in weeding through cover crops and the use of herbicides. Also the weed wiper or weed broom (developed by the CFU) is being presented as a solution for the high costs of labour for weeding estimated at US$20/ha. Using data available from GART, hand weeding costs US$29/ha, and therefore herbicide, applied through the weed wiper, is cheaper compared to the cost of manual weeding using the hand hoe; it might also be more attractive to women farmers who face the additional labour demand in hand-hoe weeding practices (GART Yearbook, 2009).

Despite the potential labour savings in adopting the weed wiper, smallholder farmers in Zambia do not seem to prefer the use of this new weeding technology. For example, GART reported making available 2 000 wipers, and hardly any farmers were interested in buying the equipment at ZWK100 000. But all 3 000 ULV-sprayers were sold at a cost of ZWK150 000 each. The farmers response was due to the efficiency of the two-herbicide application equipment. The weed wiper requires 3-4 hr/ha and 120-160 litres of water for spraying herbicides, compared to the use of the ULV sprayer that can do the same job in 1hr/ha with only 10 litres of water. In some countries such as Somalia, slashing is done before making the basins or after harvest to prevent weeds from seeding. This method is preferred because it does not disturb the soil (Steiner et. al., 2003)

6.3 CA labour demands and gender

CA is promoted as one of the technologies with the potential to save labour demands for women farmers. Frequently the roles of men and women in farming are well defined: for southern Africa, men are generally responsible for land clearing, preparation and ploughing, whilst women are responsible for planting, weeding, harvesting and post-harvest activities. Labour saving techniques within the CA system could help reduce the labour burden for women. For example, tractor and animal-drawn rippers are used by men, and if herbicides were promoted this would significantly reduce the labour burden for women.

Appropriate tools for land preparation are available, such as the chaka hoe which is being distributed in Zambia and Zimbabwe. Although the hoes have been used successfully in parts of Zambia, it is argued that they are too heavy for women and weaker farmers. Some have also argued that weeding with short-handled hoes is the most punishing and time-consuming activity, causing fatigue and backache. Where long-handled hoes are available they can reduce the strain of squatting, but these are often rejected for use by women for cultural reasons. Manufacturers of farm implements in southern Africa make different weights of hoes, including lighter ones that are better suited to women farmers. However, women may continue to use the heavier ones because they do not make the decisions on the types of hoes to purchase, or they are simply unaware of the full range of available tools.

It would also be useful for different CA projects to link up with organizations with a gender focus to help highlight the specific needs or concerns of women in the smallholder production systems. Furthermore, it would be valuable to dedicate future studies to land and labour productivity under different CA systems and their implications to women and children.

6.4 Changing farming practices

CA is a relatively new farming practice which encourages the spread of labour use, particularly in land preparation, in order to overcome critical labour peaks, as well as encourage the use of herbicides to save hand-weeding labour demands. It is also argued that CA practices can increase labour use for women dealing with harvest and post-harvest activities resulting from increased yield gained by adopting the practice. Whilst greater yields are an incentive to the adoption of CA, it faces some challenges in communities where farming systems keep crop residues as soil cover, and the practice of minimum tillage or no-till is perceived as a sign of laziness.

The need to purchase such inputs as improved seed, fertilizers and herbicides affects women to a greater degree since additional household cash is invested in agricultural production instead of meeting other household needs, such as school fees, health care and laundry costs. If CA practice can lead to labour saving among farm communities in southern Africa, this will be of economic importance, particularly to women; it will enable them to divert time from subsistence farming activities and domestic chores to more productive income-generating enterprises.

7 HIV/AIDS Strategy and Implications for CA Adoption and Practice

Agriculture is the main source of livelihood for rural people in southern Africa, providing food through subsistence production and incomes, as well as offering employment. To this end, agriculture reduces the vulnerability of communities to the impact of HIV and AIDS. The loss of labour, income and managerial skills associated with the HIV/AIDS pandemic threatens the sustainability of rural agricultural production.

CA is viewed as one strategy that leads to intensification of agricultural systems, livelihood diversification and promotion of lifeskill transfers to help vulnerable farmers grow more food, (and often of a wider variety) on smaller areas, with lower costs and eventually with less labour when use of herbicides is adopted.

Linkages to utilize other synergies include education and health-sector partners, private-sector partners, research institutions and government, to better secure continuation of the support and to make possible a transformation into recovery strategies at the appropriate times.

7.1. Responses to HIV/AIDS in Zambia's CA programmes

The government of Zambia recognises how HIV/AIDS undermines the viability of the agriculture sector, and has since developed a commendable HIV/AIDS plan; it has also been criticized as targeting the civil servants. The MACO has designated HIV/AIDS focal-point personnel to coordinate HIV/AIDS activities among staff and implement the HIV/AIDS workplace policy. However, the policy is not specific to HIV/AIDS strategies related to farmers. The MACO facilitates access to ART and the treatment of opportunistic infections to all employees to motivate and ensure that they continue to perform their duties without discrimination. The MACO continues to work closely with different donor agencies involved in agricultural development and with emphasise on streamlining HIV/AIDS in their programme. This includes such programme as CASSP and FISRI among whose beneficiaries are households affected by HIV/AIDS. Their participation in CA practices helps them to overcome such problems as access to better nutrition and some labour-saving techniques encouraged by the CA practice (Box 2).

7.2 CA programmes and HIV/AIDS responses in Zimbabwe

In Zimbabwe, through its strategy on HIV/AIDS, FAO has assisted the Ministry of Agriculture in developing an HIV/AIDS strategy for the agriculture sector and assisted in implementing priority areas of the strategy. In the past, FAO has encouraged improved practices to diversify household agricultural production and these have been promoted through FAO's coordination mechanisms (seminars on gardens and presentations to the coordination meetings). The use of labour and time-saving technologies in addition to small irrigation projects for HIV-affected households have also been promoted through drip irrigation, treadle pumps and now in CA practices. To demonstrate this, model programmes were carried out with FAO partners to improve productivity of homestead-based production by increasing access to appropriate inputs and productive assets (diversified cereal and vegetable seed packs, herb and virus-free sweet potato cuttings, small livestock, agroforestry and micro-irrigation).

Good nutrition practices were also promoted through the dissemination of information, education and communication, and training materials. The Health Harvest training manual and pamphlets on good nutrition for people living with HIV and AIDS is highlighted. The take-home messages for extension were the links between HIV and AIDS,and good nutrition, and how agricultural production and diversity can support this. A practical guide for secondary school children with components on nutrition and good farming was developed. This guide contains advice on how to teach school children about food production, as well as information on improved farming practices and nutrition, and other lifeskills. In some instances, the development agencies are being encouraged to train orphans and vulnerable children in various survival skills including basic practical agriculture, CA practices, and income generating activities.

7.3 South Africa's strategies on HIV/AIDS within the CA programme

South Africa has a national strategic plan for HIV/AIDS which was recently revised for 2007-2011, but with no specific mention of the practice of CA for both large-scale and small-scale farmers (Ingelozi Management Solutions, 2008).

The national plan is clearly intended as the basis for the mainstreaming of HIV/AIDS throughout all government departments, and as the basis for all sectoral HIV/AIDS strategies. The South African Department of Agriculture has been engaged in an HIV/AIDS strategy development process. The National Department of Agriculture and all the provincial departments of agriculture, have a person or persons responsible for the coordination of HIV/AIDS.

There has been concern in the agricultural sector regarding the absence of HIV/AIDS policies. Reasons for the lack of such policies have been attributed to the following:

- HIV/AIDS is not regarded as a priority issue.
- No statistics are available that would raise the profile of HIV/AIDS as a business risk which must be responded to.
- Agricultural associations have to concentrate their energy on more pressing issues, such as the land claims process.
- At large-scale commercial farms, there is little or no evidence of the use of workplace policies around HIV/AIDS, although at some farms there are policy templates developed through discussions with farm owners and workers. Farmers tend to adapt the policy in ways that suit their individual requirements, with no specific reference to CA practices.

8 Recommendations and Gaps in CA Knowledge

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The promotion of CA technology has thus far been characterized by a mix of positive experiences and some apparent challenges. It therefore becomes critical to strategize on the best ways to address the challenges and sustain efforts to enhance the potential benefits that have been realized this far. The following section is a discussion of some issues that have arisen in the transfer of CA to both smallholder and large-scale farmers in southern Africa. The section also highlights areas of limited information and knowledge gaps for consideration for future socio-economic studies in the region.

8.1 Targeting farmers for CA promotion

In Zimbabwe, the promotion of CA has primarily targeted vulnerable households as a way of mitigating the effects of food insecurity and chronic poverty, although training was open to all categories of farmers willing to participate. There is some concern, however, about the extent to which these vulnerable groups can maximize input and technology support.

In some instances, vulnerable farmers face severe labour constraints and chronic illnesses, such as women farmers and those affected by HIV/AIDS. This limits productivity particularly due to high labour demands associated with digging basins and timely weeding. The practice of planting basins requires that farmers dig basins soon after harvest to spread demands on labour, but most farmers are not doing this due to other commitments and lack of fencing of their CF plots. In areas of sandy soil, farmers have had to re-dig basins at the onset of the season as they get destroyed by wind and livestock thereby increasing labour demands.

For Zimbabwe, there are knowledge gaps on the performance of CA by resource-endowed farmers. Input provision has often excluded resource-endowed farmers, who could be better positioned to maximize on CA practices. Such exclusion has limited the technology transfer to diverse resource groups within the communities. It is therefore important to include both resource endowed and vulnerable households in the promotion of CA for increased impact at the household and community level.

8.2 Weeding practices

Farmers can derive considerable yield benefits from increased weeding frequency. Off-season CA activities, such as winter weeding, have been implemented with some difficulty. There has also been limited emphasis in training on the appropriate time to start winter weeding, and farmers often do this activity just before digging the basins in August/September. Winter weeding is also a challenge because of conflicting demands for off-season labour because farmers tend to concentrate more on their own gardens and other off-farm activities and are less willing to continue weeding their CA plots. The traditionally held view is that it is strange and uncommon for farmers to tend to rain-fed fields during the off-season, so farmers tend to be reluctant to continue tending to their fields during the off-season to avoid embarrassment. There is a need for cultural transformation or a change in mindset by individual households and at community level.

Future CA scaling-out initiatives emphasize the introduction of herbicides where appropriate to reduce labour requirements associated with weeding. Encouraging the use of cover crops and other mulch sources can also assist in weed suppression. More information needs to be provided to farmers on the actual benefits of winter weeding and long-term benefits of maintaining weed-free CA plots. In cases where herbicide use is not possible due to cost, farmers should be encouraged to weed early, i.e. when the weeds have not developed seed to reduce weed seed bank.

8.3 Fertilizer use

Inorganic fertilizer has consistently proved to be an important factor in yield improvement, even in low rainfall areas. Availability and accessibility of fertilizer remains a challenge in Zimbabwe and farmers largely depend on NGO input packs and government subsidies. Farmers usually substitute basal fertilizer with organic fertilizers such as manure and compost when the basal fertilizer is unavailable. Top dressing is still critical because of the lack of substitute organic soil amendments. Farmers' perceptions regarding fertilizer use are shifting and many farmers now appreciate their benefits. Alternative soil amendments such as termitaria, compost and manure should also be promoted. Farmers should be trained on treatment and preparation of these alternative soil fertility amendments to ensure they obtain maximum benefits from their use.

8.4 Labour demands

Labour demand has been a limiting factor in the expansion for CA. This labour constraint becomes even more problematic if targeted households have limited labour due to HIV/AIDS, chronic illness, and is female or child headed. NGO targeting criteria for CA support has often focused on such households for CA promotions, leading to overwhelming labour demands. Some labour demanding components such as weeding can be reduced through the introduction of herbicides. In assessing labour requirements in CA, care should be taken to consider not only the labour requirements but also labour productivity since increased labour input also translates to increased production. Thus, any comparisons between CA and CD tillage benefits should focus on labour productivity, i.e. the returns per unit labour invested. Adequate training on the use of herbicides will be required and their full impact on the environment and ecosystems considered before wide-scale promotion among the smallholder farmers.

8.5 Mechanization of some operations in CA

There is need for mechanization of some of the CA operations such as basin preparation and weed control as innovative ways to address the high labour requirements associated with the technology. The use of jab planters that are also labour saving can be alternatives for vulnerable farmers. On the other hand, for resource-endowed farmers, the use of rippers and direct seeding equipment could be good options, particularly if the linkages to both input and output markets are secured. Lack of draft power was observed to be a challenge that would take time to gain response. However, some key informants were of the view that initiatives such as the cattle restocking programme and many other projects involved in passing on the livestock to farmers could be tailored to focus on farmers with interest in animal-drawn CA systems. In South Africa, increased research and extension effort is required to promote CA among both smallholder and large-scale commercial farmers. There is greater need for documented evidence on the viability of mechanized CA with the commercial sector. Also a positive mindset towards CA needs to be cultivated among all stakeholders.

8.6 The role of extension services

Extension provides an important link between the technology and farmers, and it ultimately sustains CA adoption. However, this role has so far been limited due to resource constraints in the national extension service. In Zambia, MACO had the most appropriate structure for the implementation of CA, but still some agricultural camps have not been manned by extension staff for extended periods. In addition, resource constraints have greatly undermined MACO efforts to provide effective and regular extension services to the farmers. Transport for staff and availability of operational funds are the basic inputs required to kick-start the extensive dissemination process of CA. MACO is better placed to monitor the performances of CA practices. In Zimbabwe, NGO promotions of CA are not permanent; therefore this practice can only be sustained through involvement of the national extension service. Institutionalization of the technology promotions through AGRITEX will significantly contribute to sustained CA adoption in Zimbabwe. In South Africa, there is need to train more local extension staff on the CA curricula. If resources permit, study visits to CA practitioners in Zambia and Zimbabwe will be strongly recommended.

8.7 Social and cultural issues

Generally farmers' attitudes towards CA are not positive yet, probably because this concept discourages farmers from conducting farming business as usual. This is the case for both large-scale commercial farmers in South Africa and smallholder farmers in the three study countries. However, farmers will continue to resist change until the benefits are fully confirmed. Although change in mindset is a gradual process, progress is more likely to improve in future with education and generation interface. Some farmers who are not practising CA are of the view that it is a farming practice for the poor. Such social and cultural undertones have also undermined uptake and adherence to CA practices. The preference of staple foods to legumes (which is a sign of food insecurity) has hampered adoption of crop rotation in CA. Creating input and output markets for legumes could be a step forward, and training farmers on the importance of diversification is essential.

The lack of legal titles to land and effective by-laws to regulate communal resources, as well as resource constraints among farmers have partly made it difficult to practice CA effectively. Communal by-laws regarding grazing make it difficult for CA farmers who want to maintain permanent soil cover as neighbours livestock feed on the crop residues. Unless this cultural behaviour changes and local by-laws are amended to protect CA farmers, it will be difficult for smallholder farmers in southern Africa to effectively implement this new farming practice. Incorporating agroforestry systems into CA could be a long-term strategy to addressing the problem.

8.8 Market access

Poor access to input and output markets discourage farmers making meaningful investments in CA practices. Farmers will only accept CA if the benefits become apparent. In Zambia, the limited supply of no-till planters, jap planters, chaka hoes and rippers, has resulted in a reduced number of potential CA adopters. Some of this equipment has to be imported from Zimbabwe. It is recommended that local wholesalers and agro-dealers stock such equipment in the CA project sites through the contact farmers or Own Farmer Facilitators (OFFs) for easier access to the communities. Furthermore, industries in South Africa need to be encouraged to manufacture CA farm implements, including rippers for tractors. In

Zimbabwe, current economic development efforts to open up markets will likely lead to improvements in the function of the commercial sector, including rural agro-dealers This will include the use of vouchers to purchase seed and fertilizers that have generally been distributed freely to vulnerable farmers. Access to fertilizer needs to be improved through markets and credit facilities to ensure its continued use among smallholder farmers.

In Zambia, the supply and demand of legume seed, especially non-edible legumes such as sun hemp, velvet beans and leguminous tree crops, is unstable. It is recommended that velvet beans and sun hemp are ploughed in at a tender stage of growth, which farmers tend to do leaving nothing for future use. For farmers who have attempted seed multiplication, consistency has been compromised by unstable demand because the seed is not traced through the formal market system. MACO could probably focus on promoting local seed multiplication and sell through local informal markets.

8.9 Harmonized approached in CA promotion

The lack of harmonized approaches to the promotion of CA has been highlighted in different discussions across the three countries visited as a problem that has hindered the dissemination process. The argument is that sometimes the CA promoters do not speak the same language. Firstly, it was noted that the technical recommendations for some technologies are not uniform, for example the planting basin dimension in Zimbabwe. Secondly, each CA promoter has a different way of enticing farmers to practise CA. This development has undermined the efforts of national extension services (such as AGRITEX and MACO) to promote CA. Where CA is promoted through relief programmes, farmers have developed a dependency attitude to the extent that they will pay limited attention to any promoter who does not offer them inputs. In some situations, CA promoters tend to work with the same specific farmers year after year consequently denying others an opportunity to participate. It is being suggested that the national extension services should regulate CA promotion strategies and aim to harmonize these approaches.

Conclusions

- CA has had positive results for both smallholder and commercial farmers. Farmers have realized higher yields than with CD tillage. For commercialized systems, reduction in the cost of production has also been a net benefit.
- Whilst greater yields are an incentive to the adoption of CA, it faces some challenges in communities where farming systems keep crop residues for livestock feeding, and the practice of minimum tillage or no-till is perceived as a sign of laziness.
- Although CA increases labour productivity, the labour demands in basin preparation and weed control limits adoption. It tends to increase labour demands on women who are mainly involved in these tasks. The labour demand in CA also limits area expansion. Farmers working together in groups have improved social networks in rural communities, especially where farmers share labour for digging and planting basins and weeding.
- The impact of CA on food security will be realized when millions of farmers in the region are practising the technology. To facilitate CA scaling up, there is a need to develop more appropriate and labour-saving implements, as well as improve market access.
- CA has the potential to improve livelihoods of the poor and achieve food security but it has to be tailor-made to fit current farming systems. If CA practice leads to labour savings for farm communities in southern Africa, this will be of economic importance particularly to women, since they could them divert time from subsistence farming activities and domestic chores to more productive income-generating enterprises. However, the need remains to continue raising awareness among development agencies and policy makers to support the countries in the region to formulate improved agriculture plans, programmes and strategies in line with the HIV/AIDS strategy for the agriculture sector. These practices will aid in mitigation against the impact of HIV/AIDS, and in the process support capacity building of stakeholders.

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