CIMMYT's Strategy for Catalyzing the Adoption of Conservation Agriculture in Southern Africa.

Brief history of Conservation Agriculture

Conservation Agriculture (CA) is a term that has been coined in the last 10 years to describe agricultural systems that include three major components: minimal soil movement, permanent cover of the soil surface generally with crops and crop residues, and crop rotation. The term has benefits in that it implies a system approach and takes the emphasis off the soil tillage component implicit in terms such as conservation tillage (which describes different although overlapping systems) and direct seeding, no-tillage or zero tillage (previous names for CA which focused on the tillage or lack of it). In CA systems major benefits accrue from all three major components and the interactions between them, and in many cases it has been shown that omitting one or more of the principles results in unsustainable systems.

Conservation Agriculture plot in Hwedza, Zimbabwe. Soybeans seeded after maize (crop rotation) without soil tillage and with good residue cover from maize residues and thatch grass.

Most of the early development of CA concentrated on large, mechanized commercial farms and was driven initially by the interests of agrochemical companies (ICI and later Monsanto), but then later by farmers and farmer associations as they realized the major economic and conservation benefits of CA.

In the 1980's and 1990's efforts began to extend the practice of CA to resource-poor smallholder farmers, notably in Brazil, Paraguay, Ghana, India and Pakistan. In the first three of these countries there is now extensive use of CA by small-scale farmers, while in India and Pakistan there are large areas of wheat in the rice-wheat system sown using CA principles, but then the rice crop is seeded using conventional agriculture.

In Southern and Eastern Africa there have been numerous efforts to adapt CA principles to smallholder farmer situations. The German GTZ has had projects in several countries in the region helping develop and extend CA systems, notably in Tanzania, Mozambique and Zimbabwe. FAO has more recently been involved in Kenya, Tanzania, Mozambique and Zimbabwe. Sasakawa Global 2000 initiated some efforts in Malawi. However, the biggest developments in CA have probably been in Zambia and more recently in Zimbabwe. The Zambian efforts originated with the experiences of a commercial Zimbabwean farmer, Brian Oldrieve. Based on his experiences with small-holder CA production systems in Zimbabwe, the Zambian National Farmers Union created a Conservation Farming Unit which developed and promoted the local system, largely

based on preparation during the dry season of planting basins into which the crops are sown each season. Basins only cover 5-15% of the land area and so tillage is markedly reduced. Haggeblade and Tembo (2002) estimated that there were about 40,000 farmers in Zambia practicing the system on at least part of their land. Together with the Golden Valley Agricultural Research Trust (GART), the CFU have developed and extended an animal traction CA system, although adoption of this system has been slight. Based on the success of the basin system in Zambia, the British DFID catalyzed the re-introduction of the system to Zimbabwe in 2004, funding a number of NGOs under an FAO-coordinated Conservation Farming Task Force. Under this Protracted Relief Project a very large number of farmer-managed plots have been installed over the last three seasons in Zimbabwe, concentrating on the "poorest of the poor" managing manual systems. Both the Zambia CFU and the DFID/FAO work in Zimbabwe have been development efforts, with some research to support it – especially the GART work in Zambia. The approach has tended to be prescriptive rather than adaptive, although farmers have been encouraged to adapt the system after they have learned how to manage it. Inputs were supplied to farmers for the CA plots in the first years.

It was in this context that CIMMYTs CA project for southern Africa began. The project had been in preparation for several years, but was funded and initiated in 2004. There were several conceptual pillars upon which the project was built apart from the three basic principles of CA. These concepts, a result of CIMMYTs close involvement with CA work in South Asia and Latin America, included the following:

- Mind-set and the culture of the plough are two of the major impediments to the expansion of CA
- CA is the most sustainable system we know of at the moment for field scale agriculture.
- While the three principles of CA are extremely widely applicable, the techniques and technologies to apply these principles are dependent on local biophysical conditions and farmer circumstances.
- Research and extension systems do not have the capacity to develop complex systems for all farmers
- Crop residue retention is vital for the success of CA. Although residue retention is difficult when farmers use all residues for animal feed, the alternative of declining soil organic mater levels is not sustainable.

Facilitating the Widespread Adoption of Conservation Agriculture in Southern Africa – CIMMYTs Projects.

History:

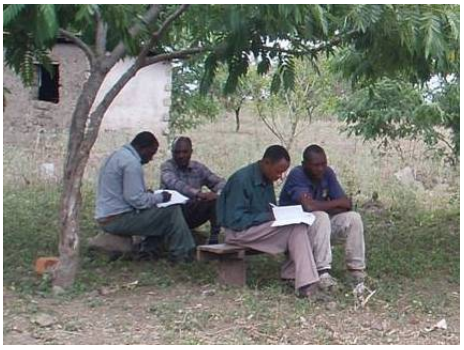
- July 2004. BMZ-funded project begins in Malawi, Tanzania, Zambia and Zimbabwe, with field activities initiated in all four countries in the 2004/2005 crop season.
- April 2006. CIAT-led project, in which CIMMYT plays a major role for field activities in CA, is approved by the Sub-Saharan Africa Challenge Program to work in the Zimbabwe-Malawi-Mozambique Pilot Learning Site.
- December 2006. Small grant received from German GTZ for a workshop on current status of CA in Mozambique. The workshop was held the same month.

- March 2007. CIAT-led project, in which CIMMYT plays a major role for field activities in CA, is approved by the Austrian Government for work in Manica and Sofala Provinces of Mozambique.
- June 2007. IFAD agrees to a grant to fund CIMMYT CA project in Malawi, Mozambique, Zambia and Zimbabwe, effectively carrying on from the BMZ project.

The following paragraphs describe the different interlinked activities carried out under the CA Projects in which CIMMYT is involved in Southern Africa and the rationale behind them.

Definition of pilot sites and "best bet" CA technologies with partners.

An initial workshop was held in the region with the main partners identified before the project began, including partners from Malawi, Mozambique, Tanzania, Zambia, Zimbabwe, FAO, DFID, GTZ and ACT (African Conservation Tillage Network). Based on this workshop a greater number of interested stakeholders/potential partners were identified in each of the project countries. A Stakeholder workshop was then held in each country to define the pilot sites where the project would work and the "best bet" CA technologies based on previous work on CA and associated technologies in each region of each country.



Conducting the baseline survey in Karatu, Tanzania

Baseline surveys

Baseline surveys were conducted in most of the initial communities where the project began field activities in the 2004/2005 crop season. Baseline surveys explored current farmer practices and problems, wealth endowment, and exposure to conservation agriculture techniques. Since then field activities have expanded into "new" communities, but baseline surveys have not been conducted in all of these communities.

Community Awareness and Farmer Discussion Groups.

Before field activities are initiated in each community, an awareness meeting is held with members of the community to a) find out from them what their agricultural production problems are; b) explain to them the principles of CA and link the benefits of CA to the problems that they have enunciated (normally there is a large degree of convergence); c) explain that we would like to help them manage some demonstration plots in the community; and d) ask them to decide on whose fields in the community the demonstration plots should be established.

Farmers observe and discuss signs of soil degradation in Shamva, Zimbabwe

Demonstration and Validation Plots.

Simple demonstration sites have been established in all of the pilot communities. These plots are established each year on the same site to assess the cumulative effects of CA over time. We aimed at 5-6 sites in a community, each comprising 3 plots: normal farmer practices and management and two different CA options (best bets). All plots receive the same level of fertilizer and are seeded to the same variety to take these two variables out of the equation. The actual CA options vary from country to country, from areas with manual systems to areas with animal traction systems, and also depending on soil type and rainfall pattern. We have had a problem convincing partners that the demonstration plots should be confined to one community and that they should be close to each other, a practice we feel is important as it allows participating farmers to visit all the plots easily and also for them to feel "group support". However, partners have often spaced the plots out more than we would have liked, given normal extension practices of widespread blanket recommendations.

A demonstration plot in Balaka, Malawi in the 2004/05 season with the farmer's check on the left and the "best bet" CA practice on the right.

While for the public and NGO partners with whom we work the plots are for demonstration to farmers, to the project they are "validation" trials of the best bet technologies (which may be modified somewhat from year to year based on observations and farmer perceptions) with 5-6 replications in the community. This allows us to analyze the results statistically and accrue valuable, scientifically relevant information on the performance of CA practices on farmers' fields.

Farmer group fertilizing their on-farm demonstration plot in Enyezini, Malawi.

Farmers are encouraged to work in groups in order to increase the exposure of farmers to the plots. Farmers receive all the inputs at the start of the season, but at the end of the season return enough grain to cover the costs of the inputs to a community project. In this way farmers do not participate just to get free inputs, the economic benefits of the technology are more evident, and (as they do not pay us for the inputs) we do not create the impression that the project is trying to make money out of their efforts.

A summary of the number of pilot communities in each of the countries over the past four seasons is shown in the following table.

Table 1. Numbers of pilot communities with CA demonstration activities in five countries over the period 2004-2008.

Country	2004/05	2005/06	2006/07	2007/08
Malawi	3	5	8	10 [a]
Mozambique [b]			4	26 [c]
Tanzania [d]	2	3	2	
Zambia	2	2	2	4
Zimbabwe	2	4	5	6
Total	**9**	**14**	**21**	**46**

[a] Includes two communities managed under the SSA Challenge Program project

[b] Mozambique was not included in the BMZ/GTZ project

[c] Includes 2 communities under the SSA-CP project and 20 communities under the CIAT-Austria project.

[d] Tanzania is not included in the IFAD-funded project.

Capacity building of partners

At the start of the project, many of the partners had little or no exposure to the principles and practice of CA. Conviction of the necessity and benefits of CA only comes with practical field experience, but it is important for partners to have a basic grounding in the principles and possibilities of CA. Therefore we conducted a series of short, 3-day courses for partners in each of the project countries. To date six courses have been conducted (one each in Malawi, Mozambique, Tanzania and Zambia, and two in Zimbabwe).

Partners learn to use, calibrate and maintain an animal traction seeder during the short CA training course in Zambia.

An on-farm research trial on weeding intensity and fertilizer/manure amounts in Monze, Zambia

Research on knowledge gaps.

Knowledge gaps for successful CA management were identified at the start of the project in some of the project countries, whereas in others (e.g. Zimbabwe) there was no consensus among stakeholders on CA knowledge gaps/researchable topics. Therefore, on-farm research to identify solutions to specific CA management problems was initiated in some countries in the first season, while in others these activities started later. Issues for research have since been

identified with partners in study tours of on-farm demonstration sites. These are discussed at Annual Evaluation and Planning Meetings (see below) and partners identified to manage the on-farm research activities. Occasionally it has been decided that on-station research is preferable or acceptable, and trials have then been conducted on public research stations.

Equipment testing, modification and manufacture

Adequate equipment has been a severe impediment to successful research, extension and adoption of CA in all types of traction systems: manual, animal and mechanical. For manual systems very basic equipment (e.g. pointed stick) can be used to successfully manage CA, whereas in animal or mechanical systems the equipment is more complicated and expensive. There has been relatively little development of adequate equipment for managing CA in manual or animal traction systems, but in Brazil there are now several successful companies manufacturing such equipment. Initially, therefore we imported both manual "jab planters" and animal traction direct seeders form Brazil to test in the region. We have also used a locally produced intermediate technology for animal traction systems – a ripper tine that is used to open a furrow into which seed and fertilizer are placed manually. As continued importation of equipment will be difficult and expensive we have endeavored to catalyze and promote local manufacture of adapted equipment, and have had jab planters made by two companies in Zimbabwe, as well as testing similar planters manufactured in Tanzania. One company in Zimbabwe has also manufactured an animal traction direct seeder. Field days have been held with participation of farmers and machinery manufacturers to test and discuss equipment. However, the local equipment manufactured to date suffers from marked quality problems, and while we will continue to support local manufacture we may continue to promote importation of robust equipment.

A farmer tries out a Zimplow seeder at a participatory (farmers and machinery manufacturers) field day organized by the CA project.

Farmer discussion groups.

Partners are encouraged to hold regular discussion with interested farmers (including the farmers and farmer groups in the community who manage the demonstration plots) to observe and discuss the development of the crops in the

A farmer discussion group hosted by Mr. Makwara in Zimuto, Zimbabwe.

demonstration plots and in any "farmer experiments" [1] and learn from these experiences. In many ways these discussion groups are similar to the concept of the Farmer Field School, especially where there may be some technical input on specific aspects.

After each season partners conduct a farmer discussion group meeting in each community to report back on the results of the demonstration plots in the community, and to discuss these with the farmers. Perceptions of farmers on CA and CA management are also discussed, and these points provide inputs into discussions at the Annual Evaluation and Planning Meetings.

Annual evaluation and planning meetings

These meetings are held in each country each year between crop seasons and attended by all the technical partners involved in the project. Farmers do not attend these meetings, but their suggestions and perceptions collected during the discussion groups in each community provide inputs for the discussions and decisions. Typically an annual meeting will comprise: presentations and discussions of field results from each community and from research trials; enunciation and analysis of the technological and logistical problems that occurred during the previous season; analysis and definition of solutions to the problems defined; definitions of roles and responsibilities, taking into account the agreements on functional solutions to problems; definition of budgets for the next season for each community and each research partner and/or activity; definition of demonstration plot management, sites and communities for the coming season; definition of on-farm and on-station research trials; and, finally, preparation of trial and demonstration plot protocols that incorporate all the decisions made. Partners are furnished with these protocols and data sheets for each site.

Participants in the 2008 study tour in Zambia pose in a demonstration plot in Kabwe.

Partner Study Tours

Each season we tour field sites with all of the technical project partners in each country, observing trials and demonstration plots, meeting and discussing CA issues with farmers, and identifying issues that need to be resolved or that offer opportunities for research in the future. These tours serve also to stimulate project partners, and provide valuable inputs into the evaluation and planning process. Initially we were able to visit all sites in each country, but as the project has expanded, for budgetary reasons we are now unable to do so. However, each year we visit at least one geographical area in each country.

[1] We term any field or part of a field where a farmer is trying/testing CA practices under his/her own initiative a farmer experiment. We believe that these farmer experiments precede technology adoption.

Monitoring of farmer experimentation

On the development side of the project, the main aim of the demonstration plots is to stimulate farmer interest, experimentation and adoption of CA technologies. At the same time it is common for farmers to modify and adapt technologies to better fit their particular circumstances. This gives an opportunity to researchers and extension agents to observe and learn from these farmer modifications, and possibly incorporate them into the research and extension programs. Therefore, together with partners, we try to identify, georeference and monitor these farmer experiments.

Mrs. and Mr. Tafireyi of Zimuto, Zimbabwe, stand proudly in their conservation agriculture experiment plot.

Farmer study visits

As noted earlier, the project works in a few pilot sites in each country. Scaling out of the technologies to other sites and communities is being stimulated through farmer study visits. Starting in 2007, groups of farmers from four communities (two in Malawi and two in Zimbabwe) were taken on a 2-day visit to the project communities. The principal interaction was between the farmers themselves, with technical staff present for part of the time to help answer technical issues. However, the extension agent with responsibility for the community of the visiting farmers also visited the extension agents of the pilot community to discuss and learn about CA.

In Malawi, at the insistence of local partners, we have agreed to help establish demonstration plots in both of the "visiting" communities, although we plan to have less involvement there in the future so that we can monitor the effectiveness of the study visit in stimulating farmer experimentation with CA. In Zimbabwe however, we have initiated demonstration plots in only one of the two communities, which will allow us to monitor differences in farmer experimentation. Although the sample is very small, we hope to get some insights on the effectiveness of the study visits and demonstration plots that will help design future activities.

Case studies/Innovation histories

It is unlikely that in the life of relatively short-term 3-year projects there will be considerable adoption of CA, even in the target communities. It is clear from experiences in other parts of the world that the initial stages of adoption and consolidation of CA systems in a community or region takes many years, after which growth can be exponential. Therefore, we do not plan farmer surveys within the life of the present project, but rather case studies of experimenting farmers to obtain information on their and their family's perceptions of CA, any impacts they have observed to date on their food security, income and/or livelihoods, and their views on the potential impacts of CA

on these. Some initial case studies and innovation histories of the farm families have been conducted in 2007.

Researcher-managed medium-term trials

It is important to be able to observe and understand the longer-term effects of CA on crop productivity and soil quality. This information provides inputs for scaling out activities in that it helps predict the impacts of widespread CA adoption. These predictions can be made simply on an area basis taking into account different recommendation domains and/or geographically and climatically similar areas, or through incorporation of the data into crop/soil simulation models also linked to geographic information systems. While these data could in theory be obtained from the demonstration plots in farmers fields in the region there are many issues of less-than-optimum management, farmer decisions on land allocation changing over time (impacting on the continuity of the demonstration plots), and damage or loss of scientific equipment due to marauding animals or theft. Therefore, we established two "long-term" trials [2] at the start of the BMZ project in 2004: one in Choma, Zambia, and one at Henderson Research Station, Zimbabwe. After the first season we suspended the Zambian trial due to some problems of soil variability and trial management, and started a new trial in Monze, Zambia. Under the CIAT-Austria project we initiated a similar trial in Chimoio, Mozambique, in the 2006/2007 season, and at Chitedze Research Station, Malawi, under the IFAD project in the present crop season.

Taking soil moisture data on the conventionally tilled plot of the long-term trial at Henderson Research Station, Zimbabwe. The run-off and erosion plot can be seen in the background.

Ph.D., M.Sc. and undergraduate thesis studies.

Under the previous BMZ-funded project, two Ph.D. scholarships were awarded to students from the southern Africa region to study at German universities, with their field work conducted in southern Africa in association with the CA project. The disciplines for these scholarships were selected given their expected importance in determining the expansion of CA and the availability (or lack of availability) of expertise in the region, and therefore one scholarship was given for socio-economic studies and one on soil ecology. The soil ecology Ph.D. student successfully defended his thesis in December 2007, and the socio-economic student defended his thesis in late January 2008.

Although full-time scholarships are not included in the IFAD project, we help and encourage undergraduate and post-graduate students to conduct their thesis work on CA project activities. At the moment in Zimbabwe we are working with one M.Sc. student

[2] Long-term reflects optimism that these trials will continue until the cumulative effects of CA on soil quality and crop productivity are clear and documented. However, short-term project funding and the limited budgets of national programs in the region mean that we can only guarantee that these trials continue until the end of the presently funded projects.

and one undergraduate student from the University of Zimbabwe, while in Mozambique, one Ph.D student and one M.Sc. student are conducting their fieldwork on the long-term trial and a Ph.D. student is working on the economics of smallholder CA, all under the CIAT-Austria project.