CA2AFRICA: Conservation Agriculture in AFRICA: Analysing and Foreseeing its Impact - Comprehending its Adoption

The project

The 2nd **CA2Africa** Global Workshop '**Reviewing progress and adjusting work plans'** was held in Tunis on 25-27 October 2011. The first day was devoted to presentations of projects results at each of the 5 platforms (East Africa, Southern Africa, North Africa, West Africa and Madagascar). Ivan Solomon (Afnet, CIAT, Kenya) presented the progress with the database and data entry. Given the difficulties with entering the data in the on-line database, simplified excel spreadsheets (at field and farm level) were developed for data-entry. At the end of the day, Eric Penot (CIRAD, Madagascar) gave an introduction to the Olympe modelling software (for an economic analysis and simulation of farming systems).

The second day we made a field trip to 2 medium-sized farms practicing Conservation Agriculture (at El Krib and at Oued Zarga). The first farmer whom we visited, Mr. Adnen Abdrabbou, is a pioneer CA farmer who is practicing CA since 11 years. The second farmer, Mr. Bechir Mestiri adopted CA on his farm 5 years ago. Their main reasons for adopting CA were savings in energy and labour together with larger crop yield stability and control of erosion. Mr. Mestiri made a presentation on his experience with CA and on the integration of his cropping-livestock activities.

The third day started with presentations on the results of the modelling activities so far in the project– at the 3 scales of analysis that were identified in the project: field (DSSAT model), farm (Olympe model) and region (QAToCA tool). For the planning of future project activities a spreadsheet with the main activities was developed and filled in by the different platforms. The planned activities were then presented and discussed in plenary. The discussions afterwards covered the organization of the remaining regional workshops and the project deliverables. The spreadsheets form the roadmap for each of the platforms. Hamisi Dulla (ACT, Kenya) gave a presentation on the dissemination and training activities of the project. The final global CA2Africa workshop will be held in December 2012. The location is still to be confirmed.

Participants at the 2nd global project workshop in Tunis

FACTS

The opportunities of conservation agriculture in Tunisia

Moncef Ben-Hammouda (ESAK) and Boubaker Thabet (INAT)

Conservation agriculture was introduced in Tunisia during the 1999/2000 growing season. CA practices seem to have had a favorable response from farmers operating in the northern part of Tunisia as covered areas, number of farmers and the number of direct drills that were purchased show an upward trend (see Figure 1).

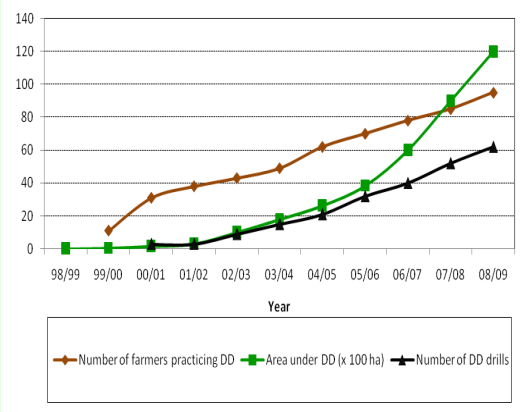


Figure 1: Adoption trends of CA in northern part of Tunisa

The main reasons for adopting CA are savings in energy and labour together with larger crop yield stability and control of erosion. In a Mediterranean climate characterized by erratic rainfall, CA has a positive effect on durum wheat grain yields (higher and more stable) mainly through water conservation (see Figure 2).

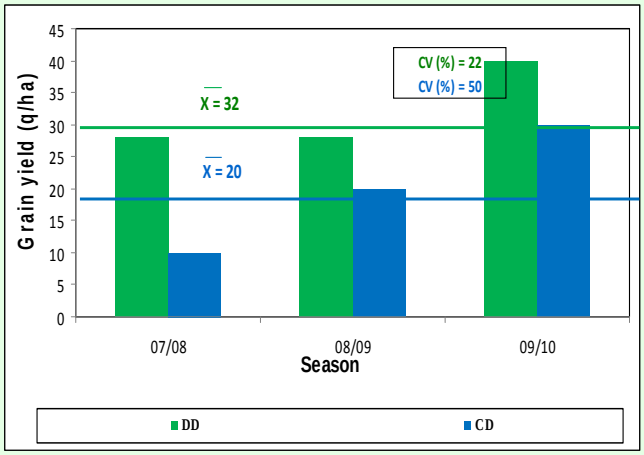


Figure 2: Durum wheat grain yield as affected by conventional drilling (CD) and conservation agriculture (DD, direct drilling) practice.

In this environment the challenge is to respond to the timing of the rainfall, its intensity and irregularity with an adequate cropping sequence. Presently, straw cereal production uses germplasms, characterized by a relatively long biological cycle (± 8 months). From the point of view of diversification, there is a need to develop physiologically season specific (fall, winter, spring) germplasms, giving the chance to farmers to insert more crops in their cropping sequences. Today, the most dominant cropping systems in Tunisia are a monoculture of barley or a rotation of durum wheat and barley with a limited scope of cover crops. CA crop sequence systems with barley and legumes turn out to be more productive in terms of total biomass production, with the results that the farmer acquires more grazing possibilities on his farm.

Comparative performance of conservation agriculture and current smallholder farming in semi-arid Zimbabwe

Frederic Baudron (CIMMYT)

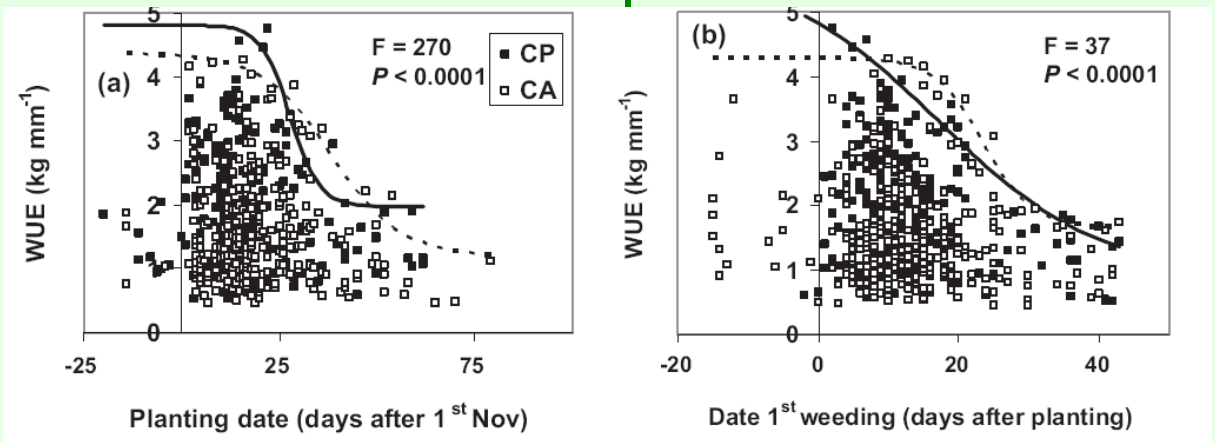
A study was conducted during three consecutive seasons in Mbire District - a semi-arid area of Zimbabwe – to compare the short-term performance of conservation agriculture (CA) and current farming practice (CP) in two multi-locational experiments: (1) unfertilised on-farm trials (n = 63) with a cotton-sorghum rotation, and (2) farmers' cotton fields (n = 541) receiving fertiliser provided on credit by cotton companies. In both cases, residues for mulching were produced *in situ*.

CA did not affect cotton productivity during the first two years of experiment, which received average or above average rainfall. During the drier 2009-10 season CA had a slightly negative effect both in the on-farm trials (average yield of 730 and 820 kg ha^{-1} under CA and CP, respectively) and in the farmers' cotton fields (average yield of 1220 and 1440 kg ha^{-1} under CA and CP, respectively). This was attributed to reduced rainfall infiltration in unploughed soils due to surface soil crusting, most soils in the study area being coarse-textured. Crusting may be avoided by the production of greater quantities of mulch than what was achieved in this study (average of 770 kg ha^{-1} in the on-farm trials). To achieve this, the inclusion of cover crops appear promising from initial results.

On-farm experiment during the 2007-08 season, with cotton in the foreground and sorghum in the background

Good agronomy, and in particular timely planting and weeding (see Figures), and adequate fertilisation and crop protection appeared central for obtaining high crop productivity rather than tillage and mulching. CA does not seem to overcome constraints on low-external-input systems.

Source: Baudron et al. (2011) Comparative performance of conservation agriculture and current smallholder farming in semi-arid Zimbabwe. *Field Crops Research* (in press).



Cotton rainwater use efficiency (WUE, kg DM seed-cotton mm^{-1}) in 2008-09 and 2009-10 under current farm practice (CP) and conservation agriculture (CA), as a function of (a) planting date, and (b) date of the first weeding operation. For each graph, a summary of the Fisher test comparing the two boundary curves is given.

Evaluating the impact of Conservation Agriculture with- OLYMPE - A modeling tool for farming systems

Guillaume Bruelle and Eric Penot (CIRAD, Madagascar)

CIRAD has developed together with INRA and IAMM a software tool called "Olympe" (http://www.olympe-project.net) that enables the technical and economic analysis of farming systems and the simulation of the functioning of one or more farms. Linked to the CA2Africa farm-level database, Olympe is a powerful tool for analyzing the impacts of conservation agriculture (CA) in smallholders farming systems.

Several types of analysis are possible:

- testing the economic impact of agro-technical management options (e.g. CA cropping systems) for different types of farms;
- comparing economic results of a agro-technical option in a variety of farming contexts
- identifying farmers' possible strategies with agro-technical alternatives;
- calculating externalities on the environment linked to the choice of a given set of agro-technical management options;
- testing the robustness of a agro-technical option in relation to climatic or economic uncertainties;
- assessing risks associated with the choice of a innovative cropping/management system

It is also possible to calculate impacts at the regional level on various groups of farms (using farm typologies).

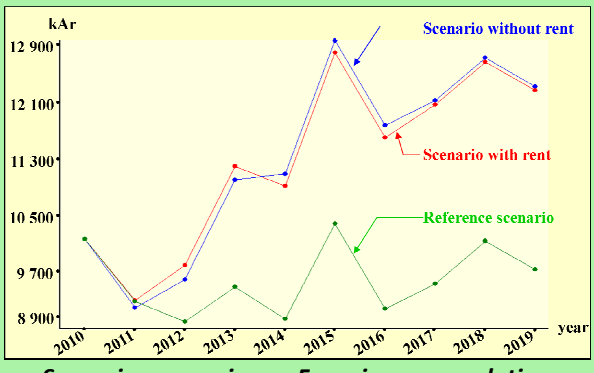
Example of application:

A scenario analysis was performed with Olympe for a farm at Lac Alaotra, Madagascar composed of 5 dairy cows and organized as described in the "reference scenario" (see Table below). Taking into account the herd evolution and its genetic improvement through the years, "Olympe" draws the farm income evolution of this scenario (green curve, see Figure below). In this case, the potential dairy production is not reached because of non-sufficient feeding rations.

Two scenarios are suggested with the introduction of CA cropping systems in order to produce on-farm forage to complement the rations; one without changing the farm plan, another by renting extra land. Olympe allows comparing the farm income evolution of each scenario along the years (blue and red curves, see Figure). Olympe can also compare the scenarios in terms dairy milk or crop production, labour productivity, gross margin, etc.

Table: Three scenarios with different farm plans

	REFERENCE SCENARIO	SCENARIO WITHOUT RENT	SCENARIO WITH RENT
Irrigated Paddy Field	*3 ha Rice: 5t/ha*	*3 ha Rice: 5t/ha*	*3 ha Rice: 5t/ha*
Poor Water Control Paddy Field	*0.75 ha Rice: 5t/ha*	*0.75 ha Rice: 5t/ha*	*0.75 ha Rice: 5t/ha*
Highland	*1 ha Rice 1t/ha Corn 1t/ha*	*1 ha Cassava+Stylosanthes 7t/ha Groundnut+Brachiaria 0.8t/ha*	*1 ha Corn 1.5t/h*
			1 ha Cassava+Stylosanthes 7t/ha
			1 ha Groundnut+Brachiaria 0.8t/ha



Scenario comparison – Farm income evolution

1 euro = 2850 ariary

QATOCA– A Qualitative Expert Assessment Tool for assessing the adoption potential of Conservation Agriculture in Africa

The QAToCA-team from the Leibniz-Centre for Agricultural Landscape Research (ZALF), Germany www.zalf.de (Johannes Schuler, Sandra Uthes, Peter Zander, Hycenth Tim Ndah; from left to right)

Background

Adoption rates of conservation agriculture in Africa are very low as compared to those in the Americas or Australia. A number of studies that aim at identifying the determining factors of CA adoption in Africa have become available in the literature. However, a comprehensive self-assessment tool is lacking that allows a systematic evaluation of the determinants in the CA adoption process from field, farm to regional scale and for use in a variety of regional contexts.

The QAToCA tool

This motivated us to develop a Qualitative expert Assessment Tool for the assessment of CA adoption - QAToCA- pronounced [ka:toka:].

Guided by existing diffusion theories and conceptual models of adoption, QAToCA is designed to assess in a semi-qualitative manner the socio-economic, institutional and cultural conditions that promote or hinder the adoption of CA in the heterogeneous farming contexts in Africa. QAToCA contains a systematic, expert-based list of adoption criteria with associated questions and possible scenarios for regional CA experts and practitioners to self-assess their CA diffusion activities.

The tool covers seven thematic areas, which are underpinned with a number of operational questions, indicators and statements, and the user of the tool has to assess in how far these statements apply to the conditions in a particular region.

These thematic areas are:

A: Object of Adoption (CA)
B: Capacity of the implementing organisation(s)
C: Attributes of Scaling up
D: Political/Institutional framework at regional level
E: Political/Institutional framework at village level
F: Economic conditions
G: Community's attitude towards CA

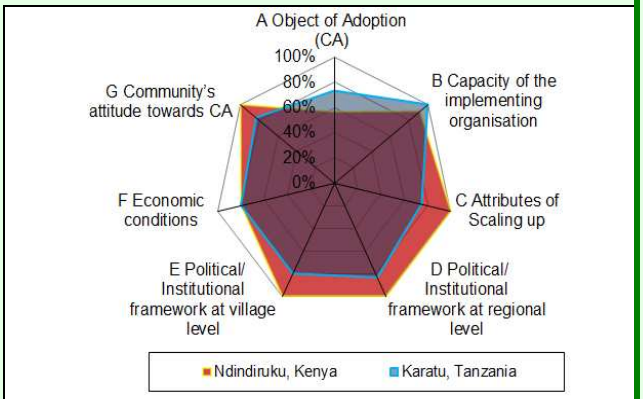
Expert evaluation of QAToCA and pretesting

A draft version of QAToCA was distributed among CA experts in a number of 'CA2Africa' partner institutions (e.g Bernard Triomphe from CIRAD France) for a very first expert evaluation.

Suggestions for improvement were then collected to develop a second version which was later pretested in Tanzania, Zimbabwe, Burkina Faso, Madagascar, and Tunisia during the 1st round of regional workshops organised by the 'CA2Africa' project in September 2010. Further feedback from CA experts in these countries has therefore been integrated to form the present and final version of the tool.

QAToCA results

QAToCA helps in a systematic way to identify supporting and hindering factors to successful CA adoption in Africa (see Figure). Its comparative analysis yields a better understanding of the specific regional socio-economic, cultural and institutional settings that determine adoption of CA. Its results further support regional development and research projects with regard to developing specific project strategies in order to improve the overall targeting of CA technologies within smallholder farms in Africa.



Thematic area	Indicator	Ndindiruku, Kenya	Karatu, Tanzania
A Object of Adoption (CA)	Cost of CA and liquidity issues	-	-
	Availability of CA knowledge	-	-
	Complexity of CA	-	-
	Labour requirements vs. endowments	-	-
	Availability of social networks/org.	-	-
	Residue and seeds requirements vs. availability	-	+
	Machinery + fuel requirement and availability	-	-
	Land requirement and availability	+	+
	Observability of CA	+	+
	CA yield response and time	-	-
	Relative economic risk	-	+
	Trialability	+	+
	Flexibility/adaptability	+	+
	CA and social status + prestige of farmers	-	+
	CA and conflict over resources	-	+

Legend: + Supporting factor; - Hindering factor to CA adoption

Figure: Exemplary results from the application of QAToCA in East-Africa (Kenya and Tanzania)

Outlook

QAToCA is currently used in ten African countries within the 'CA2Africa' project (WP2), each with a number of case studies, to evaluate the adoption potential of different CA practices in these cases.

Recent CA Publications

Baudron, F., Andersson J.A., Corbeels M. and Giller K.E. (2011) 'Failing to Yield? Ploughs, conservation agriculture and the problem of agricultural intensification An example from the Zambezi Valley, Zimbabwe', Journal of Development Studies (in press)

Baudron F., Tittonell P., Corbeels M., Letourmy P., Giller K.E. (2011) Comparative performance of conservation agriculture and current smallholder farming practices in semi-arid Zimbabwe. Field Crops Research (in press)

Lahmar R., Bationo B.A., Lamso N.D., Guéro Y., Tittonell P. (2011) Tailoring conservation agriculture technologies to West Africa semi-arid zones: Building on traditional local practices for soil restoration. Field Crops Research (in press)

Rusinamhodzi L., Corbeels M., Wijk van M., Rufino M.C., Nyamangara J. and Giller K.E. (2011) Long-term effects of conservation agriculture practices on maize yields under rain-fed conditions: lessons for southern Africa. Agronomy for Sustainable Development (in press)

Giller, K. E., Corbeels M., Nyamangara J., Triomphe B., Affholder F., Scopel E., Tittonell P. (2011) A research agenda to explore the role of conservation agriculture in African smallholder farming systems. Field Crops Research 124, 468–472.

Guto, S.N., Pypers P., Vanlauwe B., de Ridder N., Giller K.E. (2011) Socio-ecological niches for minimum tillage and crop-residue retention in continuous maize cropping systems in smallholder farms of Central Kenya. Agronomy Journal 103, 1-11.

Guto, S.N., Pypers P., Vanlauwe B., de Ridder N., Giller K.E. (2011) Tillage and vegetative barrier effects on soil conservation and short-term economic benefits in the Central Kenya highlands Field Crops Research 122 (2011) 85–94

Kihara J., Bationo A., Mugendi D.N., Martius C., Vlek P.L.G. (2011) Conservation tillage, local organic resources and nitrogen fertilizer combinations affect maize productivity, soil structure and nutrient balances in semi-arid Kenya. Nutr Cycl Agroecosyst (2011) 90:213–225

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Mrabet R. (2011) Effects of residue management and cropping systems on wheat yield stability in a semiarid Mediterranean clay soil. American Journal of Plant Sciences, 2011, 2, 202-216

Mupangwa W., Dimes J., Walker S., Twomlow S. (2011) Measuring and simulating maize (Zea mays L.) yield responses to reduced tillage and mulching under semi-arid conditions. Agricultural Science 2 (2011) 167-174.

Nkala P., Mango N., Corbeels M., Veldwisch G.J., Huising J. (2011) The conundrum of conservation agriculture and livelihoods in Southern Africa. African Journal of Agricultural Research 6: 5520-5528.

CA2Africa partners

Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France www.cirad.fr
Centro International de Agricultura Tropical, Colombia www.ciat.cgiar.org
Leibniz-Zentrum Fuer Agrarlandschaftsforschung, Germany www.zalf.de
African Conservation Tillage Network, Kenya www.act-africa.org/
International Centre for Agricultural Research in the Dry Areas, Syria www.icarda.org
Institut d'Etudes et de Recherches Agricoles, Burkina Faso www.inear.bf
Centro Internacional de Mejoramiento de Maiz Y Trigo, Mexico www.cimmyt.org
Institut National de la Recherche Agronomique, Morocco www.inra.org.ma
Consejo Superior De Investigaciones Científicas, Spain www.csic.es
Wageningen Universiteit, the Netherlands www.wur.nl

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