Impact and adoption of conservation agriculture in Africa: a multi-scale and multi-stakeholder analysis

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Introduction

Conservation Agriculture (CA) is increasingly promoted in Africa as an alternative for coping with the need to increase food production on the basis of more sustainable farming practices. CA is specifically seen as a way to address the problems of soil degradation resulting from agricultural practices that deplete the organic matter and nutrient content of the soil. It aims at higher crop yields and lower production costs. Yet, success with adopting CA on farms in Africa has been limited (Kassam et al., 2009).
The European Commission has recently funded a collaborative project, CA2Africa (www.CA2Africa.eu), that seeks to better understand the reasons for the limited adoption of CA in Africa by analysing past and on-going CA experiences, in order to assess under which conditions and to what extent CA can strengthen the socio-economic position of smallholder farmers in Africa. A better comprehension of where, when and for whom CA works best, and how CA should be configured in different settings will enable the identification of knowledge gaps for future research, development and promotion of CA in Africa.

Methods

The project brings together the major research players involved with CA in Africa to share, assess and learn together with multiple stakeholders from a number of case studies on CA. These experiences will be shared during a series of workshops in the five project regions in West, North, East and Southern Africa and Madagascar. CA is analysed and understood using a conceptual framework that distinguishes three scales of analysis: field, farm and regional scales (Figure 1). Each scale has its own analytical tools and/or models. The performance of CA at field scale may be assessed with conventional experimentation and using crop/soil models such as APSIM or DSSAT. At farm and village scales, trade-offs in the allocation of resources (e.g. cash, labour, land, nutrients) become important in determining how CA may fit into a given farm. Trade-off analysis can be done using bio-economic farm or household models or with biophysical dynamic simulation models coupled with optimisation algorithms and objective functions representing farmers' priorities (Affholder et al., 2010). Land-use problems and competing uses for crop residues among different types of farmers also require analysis at the village scale, at which negotiations for land use and resource allocation take place. At a regional scale, i.e. the context or external environment, factors such as the marketing infrastructure and the institutional dimensions become important (Ehui and Pender 2005). The project examines all three scales and their interactions, with emphasis on the most relevant linkages to explain CA adoption or refusal.

Major constraints for adoption/challenges for research and development

Some reasons for limited CA adoption that were preliminarily identified from the case studies include: 1) crop yield benefits from CA usually occur in the long term, while associated costs are immediate; 2) there are strong trade-offs with other activities at the farm level and above; 3) the poor functioning and access to (input) markets and credit facilities; 4) the knowledge-intensive nature of implementing CA; and 5) the promotion of CA as a package with little consideration for the diversity of farmers and local practices.

CA is undoubtedly an option that can result in substantial benefits for certain types of farmers in certain locations (Giller et al., 2009). However, benefits from CA at field level do not necessarily overcome the (economic) constraints at farm scale, and many of these benefits are only realized in the longer term (Rusinamhodzi et al., 2010). CA profoundly alters the flow of resources (nutrients, labour and cash) at the scale of the farm and above, and hence strong trade-offs exist when implementing CA. For example, the retention of crop residues on the soil surface as mulch competes with their use as fodder. Indeed, animal feed is often in critically short supply and takes precedence in many smallholder farming situations. The promotion of mulching in CA systems has therefore to be done concurrently to the promotion of fodder production and improved methods of crop residue harvesting, storage and feeding. Protecting the crop residues from free grazing through e.g. fencing of the plots, requires renegotiation of the traditional rules or local by-laws.

The increased amount of labour required for weeding with CA may outweigh the labour-saving gained by not ploughing the soil unless herbicides are used to control weeds. The reallocation of labour, especially to weeding, often is implying more work for women. Weeding is labour intensive and farmers may find the use of herbicides attractive, but often lack the cash to invest in them. In many regions, development of better markets is needed before farmers can invest in herbicides, seeds, fertilizer and no-till equipment. In general, there is in many parts of Africa a need for (market) support for smallholders in order to create economic incentives to invest in agriculture.

Overall, the ex-ante identification of opportune situations for implementing CA is a challenge that demands active research and development from a multi-scale, multi-stakeholder and interdisciplinary perspective. It must consider the multiple scales at stake as represented in Figure 1, in which technical performance (i.e., the field scale) is but one of the determinants of adoption. At each scale, difficulties might emerge that impede, slow down or even reverse the process of CA adoption.

CA-related innovation and adoption processes

Given the complexity and knowledge-intensive nature of CA systems and the need to tailor CA practices to local conditions, a strong capacity in problem-solving around CA among farmers, development agents and researchers is required. Development and adoption of CA is a dynamic iterative innovation process, involving interacting agronomic, socio-economic and cultural factors that are specific for the local conditions and institutions. Production objectives and constraints, and risk attitudes of farmers on the one hand, and the expected benefits and costs of implementing CA on the other hand are two important aspects that influence adoption. Smallholder farmers often attribute a substantially higher value to immediate costs and benefits than those incurred or realised in the future, due to the immediate constraints of production and food security that they face. Yet, many of the benefits of employing CA are only realised in the longer term. Farmers adapt and implement CA technologies with their own understanding of the principles, their aspiration and possibilities to integrate it into their farming systems, and their actual access to knowledge, advice and resources. Most CA projects, however, tend to focus heavily on agronomic, field-scale matters, often to the detriment of dealing properly with issues arising at other scales or being of a different nature. Priority is often given to "demonstrating" CA rather than to reinventing or adapting it in a participatory manner to the local context, even though the use of local group-based learning approaches such as 'farmer field schools' is increasing. Also, interventions tend to place little attention on the need of support system to make the necessary inputs and small equipment available to farmers e.g. in village shops. Overall, the experiences with CA development in Africa teach us that no blueprint or silver bullet exists, and no dogmas or rigid prescriptions will do.

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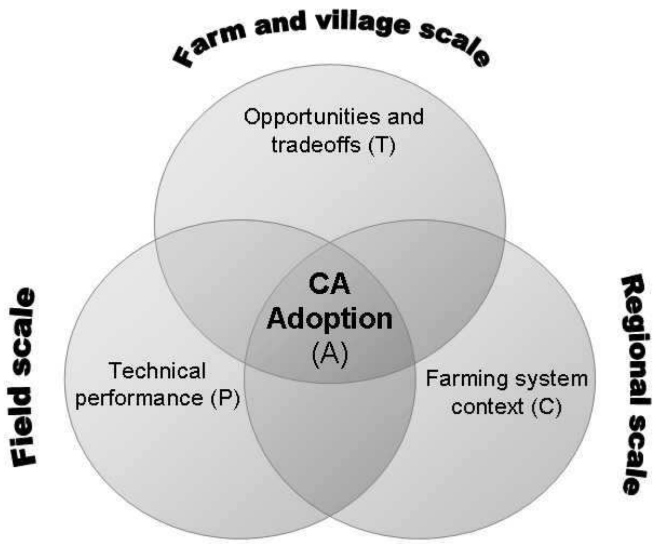
Figure



Adoption = Performance + Tradeoffs + Context + (P x T x C)$_{interactions}$

Figure 1. Conceptual representation of the determinants of adoption of conservation agriculture. Adoption (A) is conditioned by its technical performance (P), subject to the opportunities and tradeoffs (T) that operate at farm and village scales and constrained by different aspects of the context (C) in which the farming system operates including market, socio-economic, institutional and policy conditions defining the innovation system and the variability inherent to the physical environment (e.g. climate change).