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KASSA

The KASSA project is a Specific Support Action –SSA funded by the EC FP6 within the research priority *Global Change and Ecosystems*. It has mobilised 28 partners from 18 countries in Europe, North Africa, South-East Asia and Latin America.

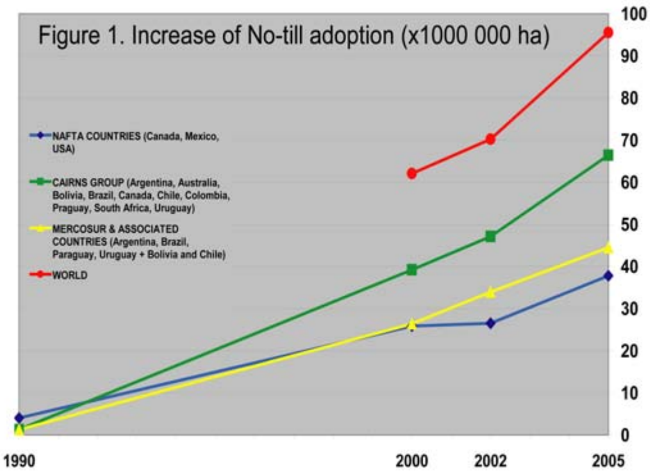
KASSA has mainly focused on conservation agriculture[1] and has been implemented simultaneously through four regional platforms: Asia, Europe, Latin America and the Mediterranean. This structure allowed comparison of conservation agriculture practices and experiences across agroecosystems within a large diversity of climates (Temperate, Mediterranean, Subtropical and Tropical); soils (from chernozem to tropical acid soils); farming and cropping systems (rainfed and irrigated systems, mono-cropping and multiple-cropping systems, mixed crop-livestock systems; annual and perennial crops, highly mechanised and less mechanised systems); and socio-economic conditions (small and large scale farms in developed and developing conditions).

Over an 18 months period, KASSA partners have conducted a knowledge assessment on conservation agriculture and shared the findings among the different platforms. This iterative process has resulted in a comprehensive knowledge base on practices, approaches, systems, conditions and challenges related to conservation agriculture. Conservation agriculture is spreading in Latin America and Asia but is hardly being adopted in Europe and North Africa. Its impacts on agricultural productivity and the quality of the natural resource base are not well understood. Lessons learned and knowledge gaps identified suggest that there is ample scope for collaboration to address the major research and policy questions related to agriculture and sustainable development.

Main lessons of KASSA

Conservation agriculture is spreading

Figures[2] show a steady increase world wide in adoption of conservation agriculture practices, mainly no-till. The main adopters are countries from the CAIRNS GROUP - coalition of agricultural



[1] Agriculture using reduced/minimum tillage or no-tillage (zero-tillage), crop residues for soil cover, direct sowing and crop rotations.
[2] Figures 1 and 2 according to data published by: Benites J.R. & Ashburner J.E., 2001 (proceedings of the Ist World Congress of Conservation Agriculture-WCCA, Madrid- Spain); Derpsch R., 2001 (proceedings of the Ist WCCA, Madrid- Spain); Derpsch R. & Benites J.R., 2003 (proceedings of the IInd WCCA, Foz do Iguaçu-Brazil); Derpsch R., 2005 (CDRom of the IIIrd WCCA, Nairobi-Kenya).

exporting countries -, those of the MERCOSUR –the common market of Latin America - and those of NAFTA - North American Free Trade Agreement.

The three Latin American countries participating in KASSA (Argentina, Bolivia and Brazil) cover together about 95% of the surface area under no-till in the MERCOSUR countries, and about 44% of the world area. In Bolivia no-till is used in soybean and related systems. In subtropical Brazil and Central temperate Argentina, no-till and soil cover are widely used in multiple-cropping systems; crop rotation is less frequent. In the Cerrados of Brazil, the crop-pasture systems rely on annual succession of 2 or 3 crops with direct seeding in crop residues.

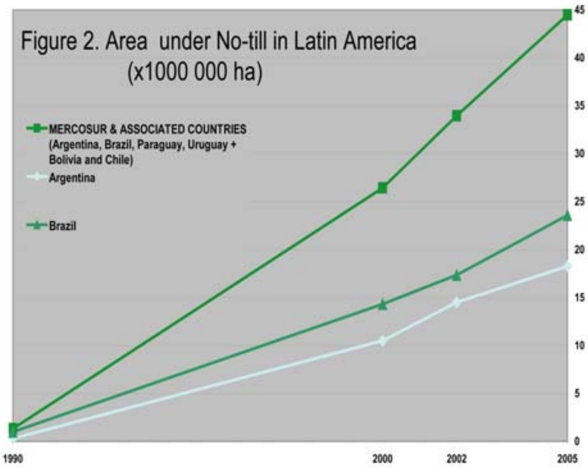


Figure 2. Area under No-till in Latin America (x1000 000 ha)

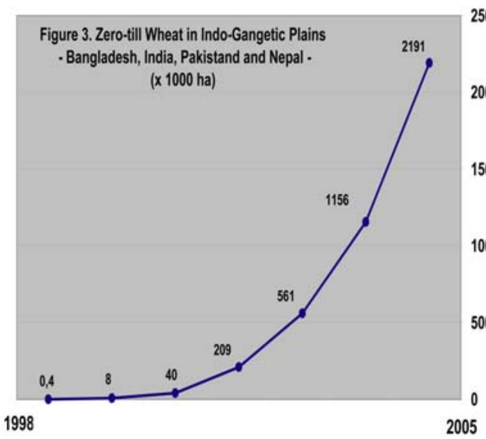


Figure 3. Zero-till Wheat in Indo-Gangetic Plains - Bangladesh, India, Pakistand and Nepal - (x 1000 ha)

Figure 3 provided by the Asian platform of KASSA shows a swift increase of the area under zero-tillage in the irrigated Indo-Gangetic Plains.

No-till and mulch are used on hillsides in northern Vietnam, while conservation agriculture is starting to be adopted in intensive rice based systems in river valley bottoms.

Data published by the third world congress on conservation agriculture (2005) show about 100 000 ha under no-till in China in 2004/05.

Around the Mediterranean, reduced tillage and no-tillage are used in Spain since the early 1980s, in rainfed winter cereals systems and between rows of perennial crops as olive, almonds and grapes. In Tunisia, no-till technology is being adopted in rainfed cereals systems since the early 2000s; area under no-till was about 2500 ha in 2003/2004[3].

According to data provided by the European platform (table 1), reduced tillage is more used in Europe than no-tillage and cover crops and, conservation agriculture is little adopted. In Czech Republic, Estonia and Ukraine, reduced tillage and no-tillage technologies are newly adopted.

Table 1. Expansion of conservation agriculture in European platform

Europe	Reduced tillage		No tillage	
	Area (ha) year	% of the agricultural used area	Area (ha) year	% of the agricultural used area
Czech Republic	750 000 2005	18%	150 000 2005	3.5%
Denmark	150 000 2004	6.8%	~ 0 2004	
Estonia	160 000	16%	10 000	1%
France	1 373 800 2001	4.6%	50 000 2001	0.2%
Germany	3 400 000 2004	20%	510 000 2004	3.0%
Norway	158 000 2004	15%	6 000 2004	0.6%
Ukraine	9 400 000 2005	24%	50 000 2005	0.1%
United Kingdom	1 416 000 2000	7.7%	24 000 2000	0.1%

Suitability of conservation agriculture, its drivers and constraints

Farmers in the four KASSA platforms generally cited reduction of costs in machinery and fuel and time-saving as major drivers for the introduction and adoption of conservation agriculture technologies. Cost savings, when not offset by an increase in herbicide costs are seen as the major driving force for the adoption of conservation agriculture even if in some cases a change to conservation agriculture is accompanied by a yield decline. Flexibility and improved timeliness of field operations, as well as the possibility to grow more than one crop a year are other factors favouring adoption of conservation agriculture. Soil erosion problems and the need to enhance water productivity in water-scarce regions are other factors contributing to farmers' decision to shift to conservation agriculture. In southern Brazil, erosion problems were at the origin of the development of conservation agriculture technologies.

Development and long lasting of conservation agriculture systems are highly site-specific and depend on the biophysical, social, cultural, technological, institutional, market and policy environments. One key element is a favourable institutional and policy environment that is conducive to the emergence of farmer

[3] M'Hedhbi K. and Ben Hamouda M., 2005 (CDRom of the III[rd] WCCA, Nairobi-Kenya).

leadership and dynamic and effective innovation systems, able to generate and share knowledge in order to correct, adapt and improve the systems.

Cover crops and crop rotations may be used to combat weeds, pests and diseases, but this is still hardly practiced due to climatic conditions, the general lack of adapted varieties, competition from livestock and general market conditions: farmers do not use cover crops and rotations when they do not generate a direct economic benefit. As a result, conservation agriculture is still relying mostly on the use of chemicals for the control of weed, pests and diseases; the fate of pesticides, heavy metals, and persistent organic pollutants and their impacts on the environment and the food chain are not well documented.

The drivers and constraints for the development and the dissemination of conservation agriculture emphasized by the four KASSA platforms are listed in table 2. They are not organised in a hierarchical order; most of drivers can become constraints and vice versa.

Table 2. Drivers/constraints for conservation agriculture

Farm and market conditions	Reduced/ increased production costs
	More/ less flexibility and improved timeliness of operations
	More/ less diversification and enterprise selection
	Use/ lack of cover crops
	Use/ lack of suitable rotations for integrated pest, weed, disease control
	Scarcity or excess/ suitable amounts of residues
	Strong/ weak crop-livestock interactions
	Reduced/ increased soil erosion and resource degradation
	Improved/ reduced water productivity (apply to water-scarce agroecosystems)
Biophysical conditions	Favourable/ unfavourable climate
	Favourable/ unfavourable soils
Social, cultural, technological, institutional, and policy environments	Presence/ absence of a crisis mentality
	Absence/ presence of socio-cultural barriers
	Leadership/ lack of leadership from farmers and farmer organisations
	Ready availability/ lack of conservation agriculture implements
	Presence/ absence of dynamic and effective innovation system
	Availability/ lack of knowledge regarding conservation agriculture
	Presence/ absence of policies for training, communication and support for farmers' initiatives
	Policies affecting farm size, agrarian structure and land tenure
	Appropriate/ inappropriate agricultural research policies
	Favourable/ unfavourable macroeconomic policies
	Favourable/ unfavourable agricultural sector policies
	Presence/ absence of suitable subsidies and credits to facilitate conservation agriculture
Impact of conservation agriculture on health and on the environment	Reduced/ increased pressure of weeds, pests and disease
	Reduced/ increased pollutions
	Impact of conservation agriculture on human health known/ not known

This list served to assess/anticipate the suitability of conservation agriculture and the opportunities and challenges to its development in the regions analysed by KASSA. Results make it clear that conservation agriculture is not equally appropriate for all agroecosystems. Indeed, it seems relatively difficult to introduce conservation agriculture when:

- The technology is less profitable for farmers. This is generally the case when the unit production costs are increased, when the use of cover crops and agronomically sound rotations increase costs but produce few benefits; and, when pest, disease or weed problems are increased. In the absence of an integrated management strategy, increased incidence of pest, diseases or weed calls for two possibilities: *i*-increased use of pesticides which impacts farm economics and harms the environment and the food chain, and may lead to the emergence of resistance issues; and *ii*-the use of conventional technologies such as soil tillage, residue burning…

- Knowledge is lacking. Conservation agriculture technologies cannot develop and spread when farmers and technicians have little knowledge about them, or have cultural barriers that discriminate against their use. This is generally the case where policy and governance conditions do not encourage the emergence of dynamic innovation systems for knowledge generation and sharing.
- Suitable implements are not available. Adapted and affordable implements are necessary for the success of conservation agriculture. The main countries adopting conservation agriculture have developed their own implements; it is often the result of a close collaboration between industry, farmers and research.
- Biophysical conditions are not favourable. In cold sandy and silty soils and in heavy clayey soils prone to waterlogging the use of soil cover and no-till result in cooler soil temperatures, delayed sowing, and depressed yields; this is the case in wet cold temperate regions. No-till is not suitable for soils prone to compaction. In dry lands and under rainfed conditions, shallow soils are not suitable due to their poor water holding capacity. Conservation agriculture technologies are generally unsuitable where soil cover from crop residues is either inadequate (dry lands conditions, livestock competition for biomass) or in excess (wheat straw in temperate climate, rice straw in rice-based systems).

Knowledge gaps and research needs

There are relatively few scientific data on conservation agriculture systems. Major gaps in knowledge and research needs are listed below:

- The impact of conservation agriculture technologies on soil processes and soil life and health (micro and macro biodiversity) and consequences for sustainable soil management are not yet well understood. Knowledge generation in this domain may help improving soil fertility and water management and help fine-tuning strategies for improved pest, disease and weed management; crop breeding; carbon sequestration and reduction of GHGs emissions and erosion mitigation
- The impact of agro-chemicals used in conservation agriculture on the natural resource base and human health needs more study as well, particularly the fate of heavy metals, pesticide and persistent organic pollutants in the environment and their risks for soil, water and the food chain quality.
- The impact of conservation agriculture on farm incomes and more generally on e.g. costs, employment, rural development, natural resource base quality and food prices… are not well known. More studies in this domain may help addressing the profitability and the economic viability of conservation agriculture in both small scale and large scale farming taking into account the conditions of market, policy and institutional change.

There are clear needs for better information and decision support tools on site specific suitability of conservation agriculture taking into account climate, soils and market conditions and for the development of adapted implements.

Challenges

Conservation agriculture technologies are spreading. The short term benefits they generally provide to farmers through the cost reduction for labour, machinery and fuel are likely to be sufficient to further boost their dissemination as attested by the current trends. Conservation agriculture undoubtedly affects poverty and malnutrition, food security and safety; the rural development; the basic natural resources and the environment; and, the climate change. However the magnitude and the long-term significance of these impacts in diverse contexts are not yet well established.

A substantial research effort is needed to understand these systems in order to anticipate positive and negative impacts and to enhance their efficiency.

The complexity of conservation agriculture requires a much more systematic, participatory and multi-disciplinary approach to research, involving all relevant stakeholders, and more emphasis on knowledge management, education, training, and dissemination strategies. Research and education remain fundamental to help ensure that conservation agriculture will contribute to objectives of sustainable development.