

Conservation agriculture and micro-dosing in Zimbabwe

Key fact

By adopting conservation agriculture practices and/or micro-dosing of fertiliser, more than 300,000 smallscale farming households in Zimbabwe have improved and stabilised yields and conserved moisture and built soil health.

Summary

Over the last ten years, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has been promoting conservation agriculture (CA). The number of smallholders practising some form of CA in Zimbabwe increased from 5,000 in 2005 to more than 150,000 in 2011, with cereal yields rising 15 to 100 per cent across different regions.



ICRISAT spearheaded the development of planting basins
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CA consists of three principles:

minimum soil disturbance, legume-based cropping and use of organic mulch. This improves infiltration, reduces evaporation and soil erosion, and builds organic soil content. CA tillage methods reduce labour requirements by more than 50 per cent, greatly assisting households affected by HIV/AIDS, where children or the elderly have responsibility for farm labour. Micro-dosing involves precision use of small quantities of fertiliser, a method that smallholders are more likely to afford. By adopting CA and micro-dosing practices, farmers in Zimbabwe have significantly improved household food security.

Facts & figures

- Between 75 and 90% of Zimbabwe's cropped lands are unfertilised during any cropping season.
- The use of fertiliser in smallholder areas of Zimbabwe is low and variable, due to lack of knowledge about appropriate usage, availability and affordability, and reasons embedded in cultural and traditional beliefs, such as the myth that fertilisers 'burn' the crops.
- The average application rates of nitrogen fertiliser by smallholder farmers in drier areas of Zimbabwe is only 3 kg/ha, compared to rates of 9 kg/ha in sub-Saharan Africa, and 206 kg/ha in industrialised countries.
- ICRISAT promoted micro-dosing which smallholders are more likely to afford and adopt. Despite low average rainfall, micro-dosing increased grain yields by 30-50%. Over 170,000 households have increased cereal production levels by an estimated 40,000 tonnes. Micro-dosing significantly improved household food security.
- Research and development investment to the CA and micro-dosing programme for the period 2004 to 2012 has been £2.5 million. Close to 300,000 farmers are now practising the technologies and have achieved productivity gains of up to 100%. This intervention has improved household food security, and saved US\$7 million in food imports annually.

European funding

ICRISAT's work on CA and micro-dosing in Zimbabwe was funded by the UK's Department for International Development (DFID) under the Protracted Relief Programme (PRP) in Zimbabwe. Total funding received was £2.5 million between 2004 and 2012.

Project milestones

Conservation agriculture

- 2004-5: ICRISAT participates in a series of initiatives to promote soil fertility and water management options to improve crop production among vulnerable smallholder farmers.
- 2004-11: ICRISAT trains more than 650 lead farmers, 241 government extension officers and 119 extension officers from 16 local and international NGOs.
- 2004-11: Each year, CA plots achieve higher yields than the conventionally ploughed plots irrespective of the agro-ecological zone and rainfall patterns.
- 2004-11: The yield gain from CA plots is attributed to the technology's ability to concentrate water and fertility within the basin thus minimising the danger of crop failure even in drought conditions.
- 2006-07: A panel study to assess the impact and adoption trends of the CA technology shows a progressive increase in maize yields from CA plots since the 2006/07 cropping season.
- 2010-11: Training continues; several NGOs outside the PRP consortium request and receive training from ICRISAT.

Micro-dosing

- 2003-04: Wide scale testing of the micro-dosing concept is initiated across multiple locations in southern Zimbabwe through relief and recovery programmes.
- 2003-04: A series of simple paired-plot demonstrations, with or without fertiliser, hosted by farmers selected by the community, are established where training is carried out and detailed labour and crop records are kept.
- 2003-07: Each year more than 160,000 low resourced households receive at least 25kg of nitrogen fertiliser and a simple flyer in vernacular languages explaining how to apply the fertiliser to a cereal crop.
- 2003-07: More than 2,000 paired-plot trials are established and quality data collected from more than 1,200 of these paired plots.
- 2004-11: ICRISAT trains more than 650 lead farmers, 241 government extension officers and 119 extension officers from 16 local and international NGOs.
- 2012: The training is ongoing; several NGOs outside the PRP consortium request and receive training from ICRISAT.

Costs and benefits

Research and development investment to the CA and micro-dosing programme for the period 2004 to 2012 has been £2.5 million. Close to 300,000 farmers are now practising the technologies and have achieved productivity gains of up to 100 per cent. This intervention has improved household food security, and saved US\$7 million in food imports annually.

More information

International Crops Research Institute for the Semi-Arid Tropics - www.icrisat.org

Conservation agriculture and micro-dosing in Zimbabwe



Philip Tshuma and his family proudly show extension agents their sorghum and pearl millet fields

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Crop yields in the semi-arid areas of Zimbabwe have been declining steadily over the years, mainly due to a decline in soil fertility. Research results show that between 75-90 per cent of cropped land in Zimbabwe is unfertilised each season, and average application rates for nitrogen by smallholder farmers is only 3kg per hectare. The situation has been exacerbated by pressure from an increasing population, forcing farmers to cultivate marginal lands, leading to further land degradation.

Since 2004, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has participated in the

UK Department for International Development's (DFID) Protracted Relief Programme (PRP) in Zimbabwe, in partnership with NGOs and the national extension service, AGRITEX, to promote conservation agriculture (CA) to smallholder farmers, in order to improve and stabilise yields while protecting the soil from degradation and conserving moisture.

CA consists of three principles: minimum soil disturbance, legume-based cropping and application of organic soil surface mulch. This improves infiltration, reduces evaporation and soil erosion, and ultimately builds up soil organic matter. CA also eliminates labour-intensive soil tillage, reducing

"Conservation agriculture is not easy, but the benefits we have seen in terms of food security encourage us to expand our areas under basins. We feel CA is one of the most suitable options for our dry areas, with unpredictable rainfall."

Philip Tshuma, farmer, Jambezi Village, Hwange District, Zimbabwe

the labour required for crop production by more than 50 per cent for smallholder farmers. This is especially important for households affected by HIV/AIDS, where children or the elderly have responsibility for farm labour.

ICRISAT has been actively involved in CA research and development to ensure that the technology

is adapted for smallscale farmers. ICRISAT spearheaded the development of planting basins that enable resource-constrained farmers without access to draught power to plant on time and therefore increase their yield potential. This technology emphasises the water capture benefits of basins, and encourages precise placement of fertiliser and controlled plot densities.

ICRISAT has also been working to encourage smallholder farmers to use inorganic fertiliser and progressively increase their investments in agriculture. Next to drought, poor soil fertility is the single biggest cause of hunger in Africa, but smallholders use very little manure and even less inorganic fertiliser. Poor smallholder farmers are unwilling to risk using expensive fertiliser in environments when rainfall is scarce and unpredictable.



Application of soil surface mulch is one of three CA principles
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Since 2003, ICRISAT has promoted micro-dosing - targeted application of small

quantities of fertiliser (a bottle capful of ammonium nitrate (AN) fertiliser per three plants) - which smallholders are more likely to afford and adopt. Although higher rates are known to give higher yields, the marginal returns to investment when using lower fertiliser rates are much better.

Micro-dosing is equal to about 8-10kg of nitrogen per hectare, approximately a fifth of the recommended application rates. Farmers are advised to apply the fertiliser three to four weeks after planting or at the five to six leaf stage, and to apply the fertiliser just once a season.



Farmers practising CA have seen yields increase by 15-100%
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With 25kg AN fertiliser, technical assistance from ICRISAT, and a simple fertiliser pamphlet, NGOs began establishing on-farm trials across the country in 2004 to demonstrate the micro-dosing approach. In each trial, the farmer selected a cereal crop, and compared results with and without fertiliser. Despite poorer than average rains during the 2005/06 season, grain yield increases of between 30-50 per cent were recorded in areas with widespread adoption of micro-dosing, and almost every farmer achieved a significant yield gain. During this same season, over 170,000 households increased cereal production levels by an estimated 40,000 tonnes, significantly improving household food security, and saving about US\$7 million in food imports.

ICRISAT established a panel study in 2007 to track the adoption and impacts of CA in 15 districts. The results show that in some districts, CA was contributing more than 50 per cent of household cereal requirements, despite limited area allocation. A significant improvement in soil quality (structure, organic matter, water infiltration and retention) has been found in farmers' fields under CA, compared to those under conventional tillage.

Of the two principles of CA not always practised by all smallholder farmers (soil cover and rotation), the study showed that surface mulching had the greatest impact on cereal grain yield compared to crop rotation in fields under minimum tillage. However practising both techniques increased cereal grain yield by 58-69 per cent compared to minimum tillage only.

The 2007 study has also highlighted the challenges in CA adoption, particularly labour associated with basin preparation and weeding. To address this, extension workers, researchers and NGOs developed and promoted mechanised CA and herbicide use.

Weed control and management of crop residues remain a challenge but despite these setbacks, CA is a more viable option compared to the conventional draught animal tillage system, and the benefits of adopting conservation tillage practices are evident in years with severe drought.

To support farmers in using seed, fertiliser and agro-chemical inputs, ICRISAT was contracted by PRP to build the capacity of farmers and extension officers in the principles of CA, integrated soil fertility



Micro-dosing uses a bottle capful of fertiliser per three plants
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management and seed multiplication. Since 2004, ICRISAT has trained more than 650 lead farmers, 241 government extension officers and 119 extension officers from 16 local and international NGOs. Several NGOs outside the PRP consortium have requested and received training from ICRISAT.

Trained farmers and extension officers have, with support from ICRISAT, conducted training sessions in their local areas, using training material developed by ICRISAT during the capacity building process. Over 5,000 copies of CA and micro-dosing fact sheets were distributed to farmers in the 2009/10 season and about the same number of copies in the 2010/11 season.



A micro-dosed maize field in Nkayi District, Zimbabwe
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In 2011, a study published in the *International Journal of Agricultural Sustainability* estimated that the number of smallholder farmers practising some form of CA in Zimbabwe increased from 5,000 in 2005 to more than 150,000 in 2011, with recorded cereal yield gains of between 15 and 100 per cent across different agro-ecological regions.

Despite greater interest in using fertiliser, access remains a constraint. The programme is therefore working with fertiliser companies to trial smaller packs of fertiliser (e.g. 5-20kg) suitable for micro-dosing. This illustrates the importance of considering strategies from the perspective of smallscale farmers. For a long time, researchers have been aiming for optimum yields and suggesting how much fertiliser is needed to achieve this output. ICRISAT instead has focused on how much

fertiliser farmers can afford and how best they can use this.

“Initially we were sceptical of what ICRISAT was pioneering, especially in our dry area, where the belief was that fertiliser use burns the crops. We also had reservations because of past experiences with ‘outsiders’ coming into the community, doing what they wanted to do, then going away, leaving the community without any tangible results. However, since 2004, ICRISAT, working closely with our local AGRITEX extension worker, has made farming look easy. We now trust them as a partner to help us achieve food security in our community.”

Dalarex Ncube, farmers’ chairperson, Ward 7, Hwange District, Zimbabwe

Giving farmers a basket of options, including different ways of improving soil fertility with limited resources, is ideal. A few may adopt high investment, optimum fertiliser rates, but most prefer to make smaller, incremental changes in their crop management. Correspondingly, extension recommendations should promote broader experimentation with a wider array of practices, rather than simply targeting an ideal solution.

The impact of CA needs to be improved and promoted so that more vulnerable households can build their resilience in the face of a variable climate. Relief programmes could promote widespread adoption of these technologies, although better targeting and impact monitoring are needed to maximise the benefits of the seed, fertiliser and agrochemical inputs given to farmers as aid.

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