SMALLHOLDER FARMING

Limits of conservation agriculture in Africa

In the short term, conservation agriculture does not overcome problems of poor crop productivity and food insecurity of smallholder farmers in sub-Saharan Africa.

Katrien Descheemaeker

Achieving food security is critical for sub-Saharan Africa where an increasing population and rising welfare levels will be driving food demands for decades to come. With a large share of the African population dependent on small-scale farming, solutions for making smallholder agriculture more productive without environmental and social drawbacks are urgently needed. Conservation agriculture (CA), based on three agronomic management principles (that is, minimum soil disturbance, permanent soil cover by mulching with crop residues, and crop rotations or intercropping) has been promoted for sustainable intensification, but the claim that CA would improve crop yields remains controversial.

Now, reporting in *Nature Food*, Corbeels and colleagues offer a valuable contribution to the debate by presenting the first continent-wide meta-analysis of CA experiments in sub-Saharan Africa[1]. With the aim of understanding crop yield response to CA and unravelling the influence of environmental conditions, they analysed 79 studies across 16 countries that compared CA cropping systems with the conventional setting of crop residue removal and continuous cereal cropping. Compared with conventional cropping, CA slightly increased yields by an average of 3.7%. The increase was only significant for maize (at an overall 4%). As expected, the yield benefits were stronger under the combined application of all three CA principles, in drier conditions and when herbicides were applied.

The initial aim of CA of reversing soil degradation tackled an important issue in large-scale agricultural systems, leading to impressive adoption rates in North and South America, for example[2]. This success fuelled the belief that for Africa, CA could be a panacea; and the focus on soil degradation was widened with claims that CA could solve problems of high labour requirements and poor crop yields. Since the early 2000s, various research and development organizations, governments and even churches have been strongly advocating it, often based on contested evidence[3,4]. Indeed, whereas the evidence on CA in African contexts clearly indicates positive effects on soil and water conservation[5], the effects on crop yields are more complex to assess due to a number of reasons: CA is not a single technology but a package of practices whose actual implementation may vary per farmer; soil quality takes time to change, so effects on crop yields are often noticeable only over the long term; finally, crop yields increase only in drier environments, and depending on which principles are implemented, crop yields may decline[6].

Despite huge efforts to promote CA among smallholders, adoption rates in Africa have been modest at best[7], with farmers usually adapting the three principles to their own conditions. Looking into the reality of smallholder farmers helps to understand why certain constraints hinder the adoption of the CA principles. The first principle of reduced tillage leads to increased weed pressure. Yet, poor market access and affordability often preclude the use of herbicides, whereas manual weeding increases the demand for human labour (and, often seen as a woman's task, may aggravate gender inequality). Poor markets also limit the attractiveness of including legume crops in rotations or intercropping; combined with farmers' heavy reliance on energy-dense cereal crops for their family's food self-sufficiency, this hampers the implementation of the rotation principle. Finally, the mulching principle is hard to apply where crop residues are used as animal feed — especially in drier environments where biomass is scarce. Such prioritization of short-term opportunities is not surprising in low-resource contexts where food security is a daily struggle; this clashes with the longer-term benefits that CA may bring. Clearly, smallholder farmers would need serious enticement to adopt CA — and such enticement, as Corbeels and colleagues now show, will not come from considerable yield improvements.

The findings of Corbeels and colleagues refute the claims that CA would substantially improve food security of smallholders in an environmentally and socially sustainable way. Small yield increases are meaningless at the farm level in terms of improvements in food self-sufficiency and income, mostly because of small farm sizes. On top of the limited effect size, the long-term nature of the effects is likely to demotivate farmers. Whereas the application of all three principles is necessary for stronger effects, the adoption of the mulching and rotation principles are problematic in the smallholder context. Besides, herbicides are beyond the reach of most smallholders and would come with environmental and potentially health hazards; and unlike on large-scale farms, the elimination of ploughing on small farms would not lead to higher profitability (possibly aggravating gender inequality instead). All of this indicates that CA should not be promoted on the grounds of its potential to improve crop yields and food security, and that focus should be shifted to a wider range of options to enhance the livelihoods of African smallholder farmers. ❐

Katrien Descheemaeker ✉
Plant Production Systems, Wageningen University, Wageningen, the Netherlands.
✉*e-mail: katrien.descheemaeker@wur.nl*

Published online: 16 July 2020
https://doi.org/10.1038/s43016-020-0119-5

References

1. Corbeels, M., Naudin, K., Whitbread, A. M., Kühne, R. & Letourmy, P. *Nat. Food* https://doi.org/10.1038/s43016-020-0114-x (2020).
2. Triplett, G. B. & Warren, A. D. *Agron. J.* **100**, S-153–S-165 (2008).
3. Giller, K. E., Witter, E., Corbeels, M. & Tittonell, P. *Field Crops Res.* **114**, 23–34 (2009).
4. Andersson, J. A. & Giller, K. in *Contested Agronomy: Agricultural Research in a Changing World* (eds Sumberg, J. & Thompson, J.) 22–46 (Earthscan, 2012).
5. Thierfelder, C. et al. *Food Secur.* **9**, 537–560 (2017).
6. Pittelkow, C. M. et al. *Nature* **517**, 365–368 (2015).
7. Corbeels, M. et al. *Agric. Ecosyst. Environ.* **187**, 155–170 (2014).

Competing interests

The author declares no competing interests.