Is Conservation Agriculture an Option for Vulnerable Households?

Briefing Note No. 4 September 2006

Steve Twomlow and Lewis Hove

Background

To improve crop production in marginal rainfall regions of southern Africa, cultural practices that conserve fragile soils (or at least prevent irreversible damage to soil structure and characteristics) and extend the period of water availability to the crop must be developed. Governments, non-governmental organizations (NGOs) and others have tried to develop improved genotypes, tillage/soil management systems and integrated pest/disease management packages. Unfortunately, many of the outputs, although technically sound, failed to perform well in the field. They were developed and tested in researcher-managed trials, with only limited consideration to the problems and priorities of smallholder farmers – the targets of these technologies.

Conservation agriculture may sound like old hat, but it is breathing new life into African smallholder farming. Basically, conservation agriculture is a suite of land, water and crop management practices to improve productivity, profitability and sustainability. The primary principles promoted for hand-based and draft animal powered cropping systems include:

- disturbing the soil as little as possible,
- performing operations, particularly planting and weeding, on time,
- keeping the soil covered with crop residues or other organic materials as much as possible, and
- mixing and rotating crops.

Working with NGO partners and the Food and Agriculture Organization (FAO), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has been promoting an easy-to-implement conservation agriculture package – known as basin tillage – which is ideally suited to vulnerable smallholder farmers in drought-prone areas of southern Zimbabwe with limited to no draft animal power. This initiative builds upon the seed and fertilizer relief programs in Zimbabwe and is supported by the United Kingdom's Department for International Development (DFID) Protracted Relief Program and the European Commission Humanitarian Aid Office (ECHO).

Basin Tillage in Southern Zimbabwe

The central component of the basin tillage package is the planting basin. Seeds are sown not along furrows, but in small basins or simple pits. These basins can be dug with hand hoes without having to plow the field which is important given that the majority of smallholder farmers in southern Africa struggle to cultivate their fields in a timely manner due to a lack of draft animals. The initial basin tillage concept was developed by Oldrieve in Zimbabwe in the late 1980s. It was subsequently modified and promoted in Zambia by the Zambian Farmers Union Conservation Farming Unit and also modified by the Zimbabwean Conservation Agriculture Task Force convened by FAO for southern Zimbabwe.

In southern Zimbabwe it is recommended that the planting basins be dug each year from early August through October in the same positions. The recommended dimension of each basin is 15 cm (length) × 15 cm (width) × 15 cm (depth) and the basins are spaced at 90 cm × 60 cm. Available soil fertility amendments (organic and/or inorganic fertilizers) are then added to each basin which is then lightly covered with soil in September/October. Rain water is collected in the basins during the early season rainfall events (October and November). Planting follows in November/December after the basins have

ICRISAT – Bulawayo

DFID Department for International Development

This work has been generously supported by
the UK Department for International Development
under the Protracted Relief Program for Zimbabwe

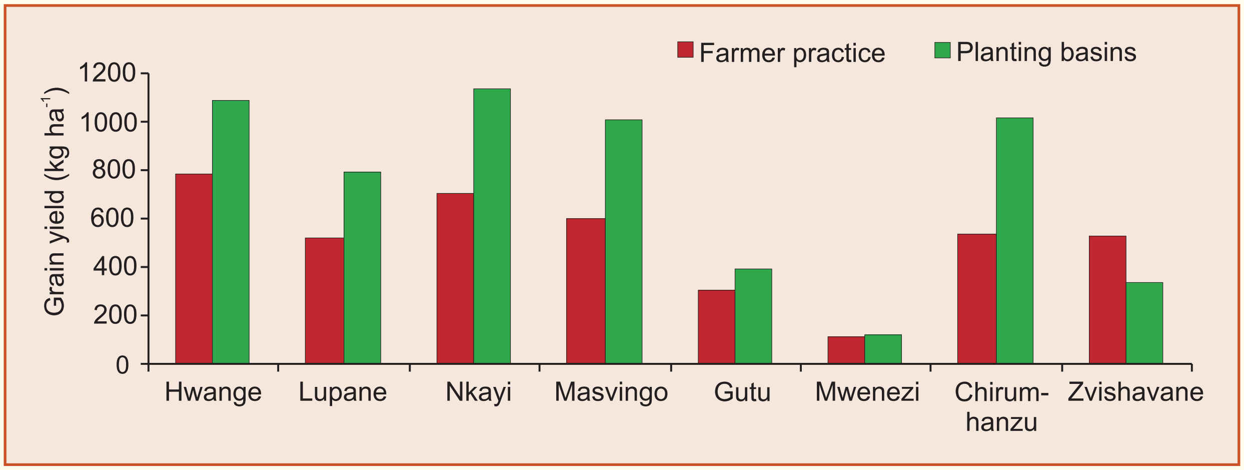

Figure 1. Maize yield responses to basin tillage compared to conventional farmer practice across eight districts in southern Zimbabwe in 2004/05.

captured rain water at least once. Smallholder farmers without draft power can plant at the right time in terms of days after an effective rainfall event (30 mm for sandy soils and more than 50 mm for heavier soils), rather than waiting for draft animals to become available several weeks into the season. In addition, farmers are encouraged to spread any crop residues that might be available as a surface mulch to protect against soil losses early in the season, conserve moisture later in the season, and enrich the soil with nutrients and organic matter as the residues decompose.

Gains to Vulnerable Households

The basin tillage technology was field tested in the 2004/05 and 2005/06 seasons, and despite initial concerns as to whether or not farmers would invest in the labor needed, first for basin preparation and then for the additional weed control (an essential part of the package) associated with reduced tillage systems, the results were extremely positive (Figures 1 and 2). Although making the basins requires time and effort, once prepared, the same planting position can be used repeatedly. With each successive season preparing the basins and weeding should become easier.

It is particularly remarkable that basin tillage benefits accrued to almost all the farmers applying this technology. Usually there are leaders and laggards in technology adoption. Often technologies are initially applied by only a subset of better-than-average farmers. It is well known that crop response to basin tillage depends on the timely application of complementary practices such as planting, weeding, fertilizer

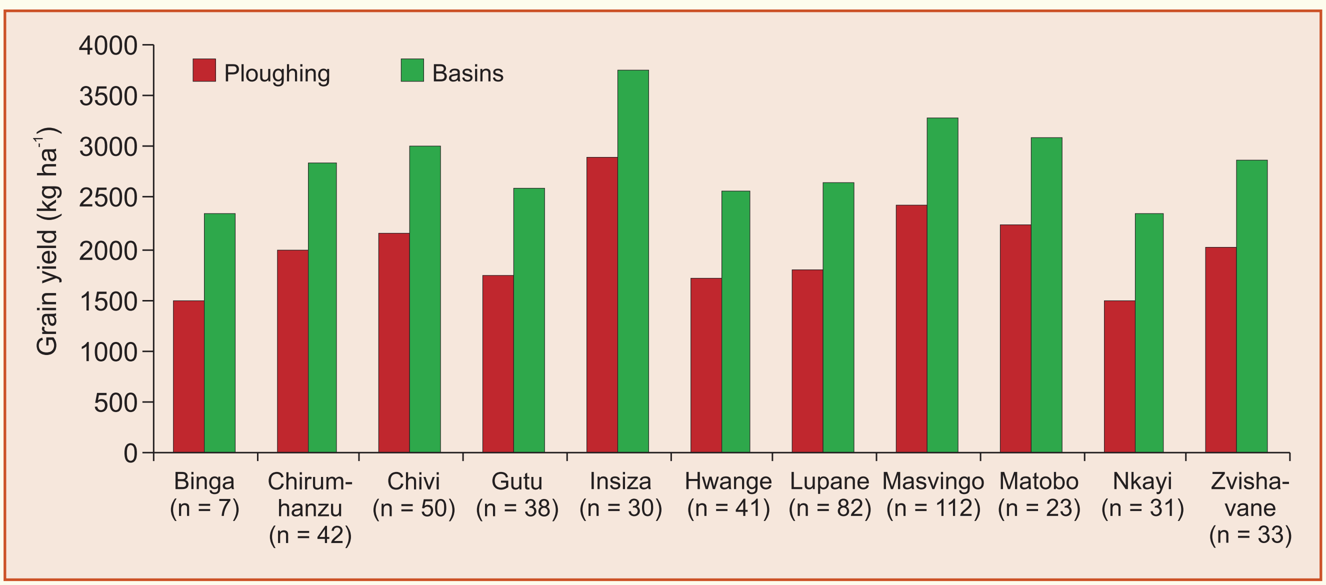

Figure 2. Maize yield responses to basin tillage compared to conventional farmer practice across 11 districts in southern Zimbabwe in 2005/06.

application, as well as the starting quality of soils and incidence of diseases and pests. Yet a wide range of farmers obtained significant yield gains from basin tillage that this technology appears remarkably robust, with positive yield increases observed in both below average (Figure 1) and above average seasons (Figure 2).

Failures observed during the 2004/05 season in Mwenezi and Zvishavane (Figure 1) were attributed to agriculturally inexperienced NGO headquarters and field staff, various logistical problems that led to delays in training, the late arrival of inputs and fewer monitoring support visits than planned. One typical result of these problems was that over-eager and inexperienced NGO staff rushed the training, with basin preparation and planting in some instances occurring on the same day. In fact, germination and plant vigor were observed to be poorer in basins prepared and planted on the same day compared with the farmer practice.

The Important Elements of the Package

Impact of Mulch

Figure 3 clearly shows the additional yield benefits that accrue from mulching even in a wet year such as 2005/06. However, it is still questionable how much mulch farmers will retain on their fields, given that a major source of household income in these mixed crop/livestock systems is from the sale of goats and sheep.

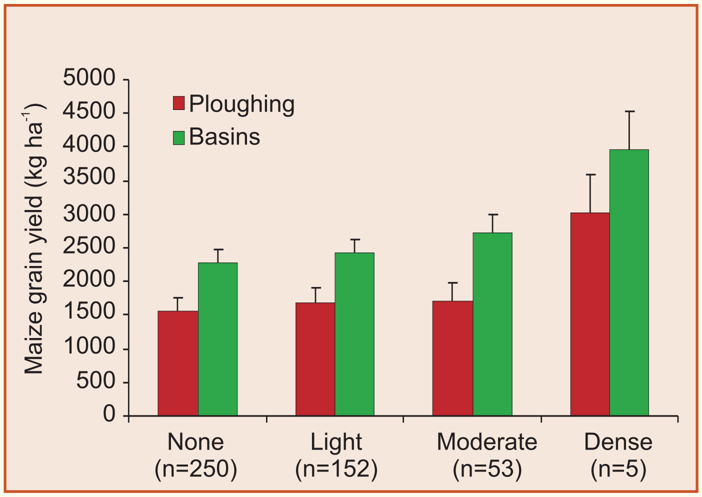

Figure 3. The impact of mulch cover of various levels on maize yield in response to basin tillage compared with conventional spring plowing for 11 districts in southern Zimbabwe in the 2005/06 season. Light – less than 1 t ha^{-1}, moderate – 3 t ha^{-1} (the target), and dense – more than 3 t ha^{-1}.

Impact of Fertilizer Amendments on Maize Yield Responses

The impact of basal and top dressing fertility management regimes on maize grain yield responses to basin tillage and conventional spring plowing are summarized in Figure 4.

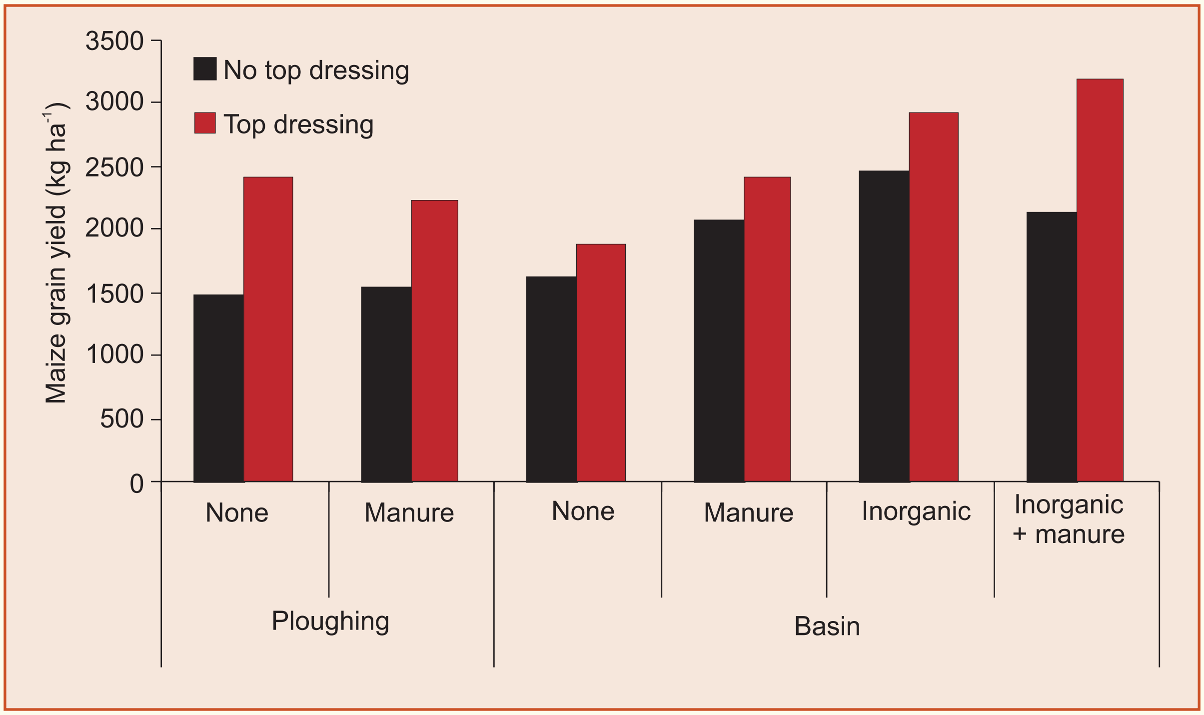

Figure 4. The impact of basal and top dressing fertilizer regimes on maize grain yield responses to basin tillage compared with conventional spring plowing for 11 districts in southern Zimbabwe in the 2005/06 season.

There is a strong synergistic effect between the type of basal fertilizer, top dressing and tillage system. Without any form of basal fertility amendments the basin tillage systems performed little better than the farmers' conventional spring plowing – 1621 kg ha^{-1} compared to 1476 kg ha–1. However, from Figure 4 it is clear that when farmers have access to a combination of manure and inorganic fertilizers, particularly inorganic fertilizer for top dressing, significant grain yields can be achieved. Top dressing with inorganic nitrogen fertilizer increased yields by more than 30%. Thus, for smallholder farmers to derive long-term yield benefits from the basin tillage technique beyond the current relief and recovery programs, additional investment will be required to ensure that smallholder farmers have access to inorganic fertilizers locally, particularly inorganic nitrogen-based fertilizers for top dressing.

Sustained Gains in Food Security

Figure 5 highlights the gains likely to be achieved if farmers continue to pursue basin tillage in the future. The initial data series summarizes the expected yield when farmers apply no fertilizer – the common current practice in semi-arid areas of the country. The second series highlights the gains achievable with sustained use of the full basin package. Basin tillage offers an opportunity for poor vulnerable households with no access to draft power to produce more grain per unit area than households with full draft power in the drier areas of Zimbabwe.

If the use of small quantities of inorganic fertilizers can be sustained after the relief programs stop handing out free fertilizer, these farmers can achieve a sustained set of higher grain yields and a sustained improvement in food security. Even if severe drought occurs (eg, in the upcoming 2006/07 cropping season) farmers will be better off than in previous drought years. If rains are more favorable, farmers, and the country as a whole, will be appreciably better off.

Next Steps

Conservation farming using basin tillage is a proven technology. However, one concern is that these gains will quickly be lost when the protracted relief programs end. Some of the questions and concerns to be addressed over the next two to three years include:

- Why is the area planted using conservation agriculture not increasing with time and experience?
- What will happen when NGOs withdraw their assistance?
- What is the role of the agriculture and extension service (AREX)?
- What is the role of the private sector?
- Is there evidence of declining weed pressure?
- Will labor demands decline over time?
- How to quantify the impact of rotations and identify crops and conservation agriculture practices?
- How to quantify changes in soil properties – carbon trading?
- Develop case studies of conservation agriculture successes
- Revise training materials – AREX must be facilitated to own the process
- Conduct detailed simulation work to look at climatic risk and long-term benefits.

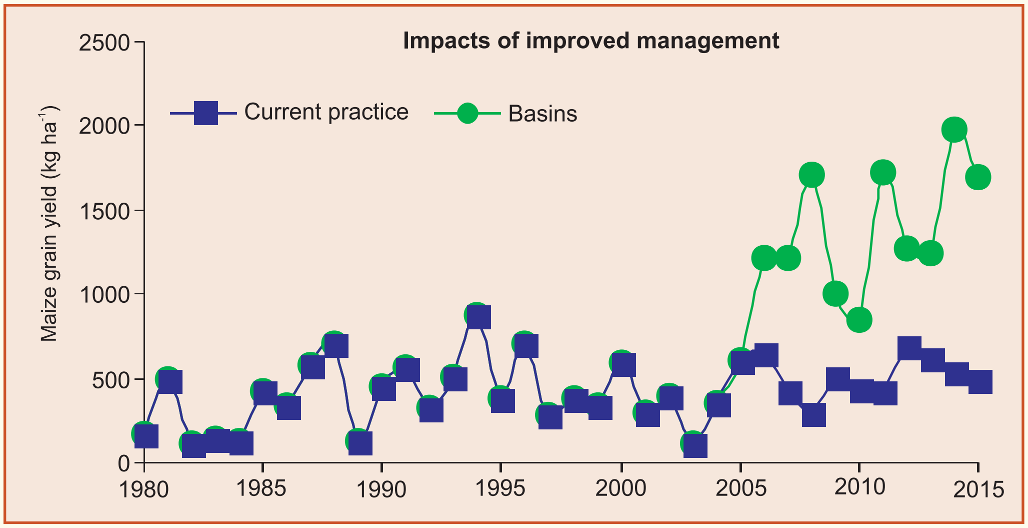

Figure 5. Maize grain yields obtainable in drought-prone, semi-arid parts of Zimbabwe with and without basin tillage technology, based on crop modeling confirmed by farmer-managed demonstration trials, 1980–2015.

More information about this work can be obtained from

International Crops Research Institute for the Semi-Arid Tropics
ICRISAT-Bulawayo, Box 776, Bulawayo, Zimbabwe.
Phone: +263-83-8311/2/3/4; fax: +263-83-8253/8307;
email: icrisatzw@cgiar.org