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Socioeconomic and institutional factors influencing adoption of conservation farming by vulnerable households in Zimbabwe

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ABSTRACT

Since 2004, there has been a series of initiatives in Zimbabwe to promote conservation agriculture (CA) through various donor-funded relief initiatives with the aim of improving crop production among vulnerable farmers. In April 2007, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) implemented a survey to collect data from 12 districts and 232 households that had been practicing hand hoe-based conservation farming (CF) for at least one prior season with extension and input support from non-governmental organizations. This study was undertaken to better understand the household and institutional factors that influence CF adoption patterns among the beneficiaries of these relief initiatives. Results from the study show that institutional support and agro-ecological location have strong statistical influence on the adoption intensity of different CF components. Besides the practice of preparing basins, at least 70% of the households had also adopted the following components of CF: manure application in the planting basin, topdressing with nitrogen fertilizer at the 5–6 leaf stage of the cereal crop, and timely post-planting weeding. Household labor availability and impacts of HIV/AIDS did not limit the intensity of adoption of CF. An enterprise budget analysis proved that because of the significant yield gains realized with CF, the technology is more viable than conventional tillage practices of broadcasting manure and overall spring tillage on the day of planting. The increased profitability in adopting CF was also reflected in steady increases in the area each household committed to CF from an average area of 1450 m^2 in 2004 to more than 2000 m^2 in 2007.

1. Introduction

Since 2004, there has been a series of initiatives in Zimbabwe to promote conservation agriculture (CA) through various donor-funded relief and recovery programs with the aim of improving crop production among vulnerable smallholder farmers. The most common CA package being promoted is a hand hoe-based system that focuses on the creation of planting basins in the dry season, locally referred to as 'conservation farming' (CF) (Protracted Relief Program, 2005; Hove and Twomlow, 2007).

The terms 'conservation agriculture' and 'conservation farming' have often been used interchangeably in various literatures. For the purposes of this article, however, the two are different. In this article, we have adopted the terminology as defined by the United Nation's Food and Agriculture Organization (FAO) Conservation Agriculture Task Force for Zimbabwe (Twomlow et al., 2008a). Conservation agriculture is a broad term, which encompasses activities such as minimum and zero tillage, tractor powered, animal powered and manual methods, integrated pest management, integrated soil and water management, and includes CF. It is generally defined as any tillage sequence that minimizes or reduces the loss of soil and water and achieves at least 30% soil cover using crop residues. Conservation farming is CA practiced by smallholder farmers using small farm implements such as the hand hoe to create planting basins. It is actually a modification of the traditional pit systems once common in southern Africa. It is also a variation on the *Zai* pit system from West Africa, which may also be considered a CF technology (Mando et al., 2006). The *Zai* system works by a combination of water harvesting in wide shallow pits (0.6 m by 0.6 m by 0.3 m) and concentrating available fertility amendments, such as animal manure and leaves in the pit. Typically, some 10,000 Zai are prepared per ha, but the number actually dug in any given season is restricted by the availability of fertility amendments.

In 2004, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) began providing technical assistance to more than 10 non-governmental organizations (NGOs) under the United Kingdom's Department for International Development (DFID) Protracted Relief Programme (PRP) to promote CF across 13 districts in the Semi-Arid areas of Zimbabwe (www.prpzim.info/). As a result, farmers are showing a growing interest in CF and reporting yield gains ranging from 10 to more than 200% as compared to the traditional practice of overall spring plowing and planting (Hove and

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Box 1 Components of CF practices promoted in Zimbabwe (adapted from PRP (2005))

(1) Winter weeding: The first step in preparing a field using CF methods is to remove all weeds. This should be done soon after harvesting in May/June. Weeding is done using implements such as hand hoes and machetes that disturb the soil as little as possible. The importance of weeding before land preparation is to ensure that the plot is weed-free at basin preparation and also to prevent the dispersal of weed seeds.

(2) Digging planting basins: Planting basins are holes dug in a weed-free field into which a crop is planted and are prepared in the dry season from July to October. Recommended dimensions are 15 cm width, 15 cm depth, and 15 cm length. The basins enable the farmer to plant the crop after the first effective rains when the basins have captured rainwater and drained naturally. Seeds are placed in each basin at the appropriate seeding rate and covered with clod-free soil. The advantage of using basins is that they enhance the capture of water from the first rains of the wet season and enable precision application of both organic and inorganic fertilizer as it is applied directly into the pit and not broadcast.

(3) Application of crop residues: Crop residues are applied on the soil surface in the dry season, soon after harvesting. The residues must provide at least 30% soil cover. The mulch buffers the soil against extreme temperatures (thereby reducing soil evaporation), cushions the soil against traffic, and suppresses weeds through shading and improves soil fertility.

(4) Application of manure: Fertility amendments are applied soon after land preparation in the dry season. In CF, the application of both organic and inorganic fertilizers is recommended as they complement each other. Organic fertilizers such as manure and/or composts are applied at a rate of at least a handful per planting basin. More can be used in wetter areas.

(5) Application of basal fertilizer: Inorganic basal fertilizer is also applied soon after land preparation before the onset of the rains. One level beer bottle cap is applied per planting basin and covered lightly with clod-free soil. Application rates can be increased in wetter areas and may depend on crop types.

(6) Application of topdressing: Nitrogen fertilizer is applied to crops between 3 and 6 weeks after crop emergence soon after the first weeding at a rate of one level beer bottle cap per basin. Application is done on moist soils. Precision application ensures that the nutrients are available where they are needed.

(7) Timely weeding: In conventional tillage systems, farmers plow/cultivate repeatedly in order to suppress weeds. With reduced tillage, weeds can be a problem requiring more effort initially. One strategy is to weed in a timely manner (i.e., when the weeds are still small) preventing the weeds from setting seed. Timely weeding in combination with mulch should eventually lead to effective weed control.

(8) Crop rotation: Rotating crops is one of the key principles of CF. Cereal/legume rotations are desirable because there is optimum plant nutrient use by synergy between different crop types. The advantages of crop rotation include improvement of soil fertility, controlling weeds, pests and diseases, and producing different types of outputs, which reduce the risk of total crop failure in cases of drought and disease outbreaks.

Source: Protracted Relief Program (2005).

Twomlow, 2007; Twomlow et al., 2008a). Despite the fact that these yield increases depend on the level of experience of the farm household and seasonal rainfall, a growing number of farmers are voluntarily taking up various parts of the CF practices. Box 1 summarizes key components of CF practices promoted in Zimbabwe (Protracted Relief Program, 2005) and will be the basis for adoption measurement in this article.

Over the past decade, there has been a growing advocacy that CA is important in establishing household food security for poorer farmers in sub-Saharan Africa (SSA) and Asia, an approach that can help attain the United Nations' Millennium Development Goal on food security (Hobbs, 2007; Hobbs et al., 2007). Despite this growing interest in CA, certain sources such as Gowing and Palmer (2008) argue that the technology transfer effort in SSA is still limited to on-farm demonstration trials and that farmers are not adopting CA practices. This is despite years of research and development investment in SSA (Twomlow et al., 2006; Lal, 2007; Rockstrom et al., 2007) and is in direct contrast to the mounting evidence of impact from South America and parts of Asia (Derpsch, 2005; Hobbs et al., 2007).

Yet, the picture is not as gloomy as Gowing and Palmer (2008) paint and much can be attributed to a lack of internationally published work on CA adoption trends among poor farmers in Africa. For example, Zambia has had an active Conservation Farming Unit (CFU) since the mid 1990s, which is currently working with more than 50,000 smallholder farmers (Haggblade and Tembo, 2003; www.conservationagriculture.net). Since 2003 lessons from Zambia's CFU in terms of training and support approaches have been transferred to Zimbabwe via relief programs, where there has been an active agenda of promoting the principles of CA (Twomlow et al., 2008a). This has resulted in Zambia and Zimbabwe being considered leading spots for CA in southern Africa.

There are two parts to a farmer's decision to implement CF techniques: one is the decision of whether or not to adopt the technology and the second is to determine the level or intensity of technology use (Sall et al., 2000; Brett, 2004). In Zimbabwe, the decision to adopt CF practices was not, in most cases, voluntary. Farmers who first participated in CF promotion were selected by NGOs as vulnerable households facing production constraints. Vulnerable households are defined as families that face difficulties in meeting their basic livelihood needs. This definition has been extended by relief agencies in Zimbabwe to include households affected by the HIV/AIDS epidemic. These households were provided with agricultural inputs and appropriate extension support as incentives to adopt the CF technology (Twomlow et al., 2008a). After a period of learning the new CF technology, vulnerable households, including some spontaneous adopters, will experience variations in the level of use of the new farming practice.

There is mounting evidence that less vulnerable households are also taking up aspects of the package with no external incentives. There has been some spontaneous adoption, mostly from farmers learning the technology from their neighbors. At the same time there has also been some dis-adoption by farmers who originally participated in the CF promotions, but subsequently opted out due to various reasons. Among the farmers who continue to practice CF, many have modified the package and generally adopted some components of the technology while leaving out other recommended practices.

Recent evaluations suggest an incremental uptake of the various components of the CF technology (Mazvimavi et al., 2008). However, there is a need to better understand why some farmers adopt the complete package and others only partly adopt CF. It is critical to understand both farm and farmer characteristics that are likely to affect the level of adoption of this technology. This study was motivated by the need to identify the socioeconomic and institutional factors that influence the adoption of CF technol-