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Can lead farmers reveal the adoption potential of conservation agriculture? The case of Malawi

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ABSTRACT

This paper assesses the adoption potential of conservation agriculture (CA) and related technologies in Malawi, where CA appears appropriate to protect against land degradation and climate risks (droughts and floods). Estimation of adoption rates and their determinants is complicated by the relatively recent introduction of some of these technologies and limited awareness of CA principles and practices among the general population of smallholder farmers. We propose and use a lead farmer promoter-adopter approach, which relies on the promoters having had sufficient exposure and access to the technologies, their interest to adopt CA not having been distorted by excessive incentives, and them not being overly different from other smallholders in the target population. These conditions are reasonably satisfied in our application with a sample of 175 lead farmers from four districts in central and southern Malawi. Conditional on lead farmers being familiar with the technologies, we find adoption rates of 56% for organic manure and crop rotation, 26% for minimum tillage, 30% for mulching, and 12% for herbicide application. Lead farmers recommend CA and supporting agricultural practices to their followers at rates of 66% for organic manure, 49% for crop rotation, 45% for minimum tillage, 27% for mulching, and 6% for herbicide application. Assuming the validity of the promoter-adopter approach, these findings together suggest that, in central and southern Malawi, organic manure and crop rotation (in central Malawi only) have the highest adoption potential, mulching and minimum tillage come next, and herbicide application has the lowest potential. Ninety-seven percent of the lead farmers had adopted three or less of these technologies, full adoption of CA is therefore unlikely and suggest other reasons than information constraints as major impediments to its full adoption.

1. Introduction

Conservation agriculture (CA) aims to achieve improved and sustained agricultural productivity, increased profits and food security, while preserving and enhancing the resource base, through the application of three interlinked principles: minimum soil disturbance, permanent soil cover, and diversification through crop rotation or intercropping (FAO, 2013). The suitability of CA for smallholders in sub-Saharan Africa (SSA) has been much debated in recent years (Giller et al., 2009; Andersson and D'Souza, 2014). More recently, it is argued that the "niche" where CA fits in eastern and southern Africa is large and growing, given the potential of CA in terms of saving energy (including labor and draft power), controlling soil erosion, and enhancing water-use efficiency (Baudron et al., 2015). There is also some evidence that CA can yield economic benefits to smallholders (Thierfelder et al., 2016).

This paper examines adoption of CA and related technologies in Malawi, where CA seems highly relevant, given the country's high rural population density (for SSA), very small landholdings, water constraints, soil degradation, low livestock densities, and low demand for crop residues for livestock feed (Andersson and D'Souza, 2014; Ellis et al., 2003; Ngwira et al., 2013; Wani and Rockström, 2009; Corbeels et al., 2014; Thierfelder et al., 2013). Existing estimates of CA adoption in Malawi vary widely and are not reliable due to issues with the data and sample selection and how CA is defined in different studies (Andersson and D'Souza, 2014). In these studies, data collection has often been part of an on-going development project promoting CA. As a result, adoption figures are likely biased towards adopters and project beneficiaries, which limits wider applicability and our understanding of the CA adoption process. Uptake within the context of a project cannot be defined as true adoption; instead adoption and impact of a technology intervention needs to be assessed much later (e.g. 10–15 years)

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after the project ends. In addition, some projects may provide direct or indirect incentives to target beneficiaries or lead farmers at the project sites, and some respondents to CA surveys may therefore be influenced by their expectations regarding the project. The way CA is defined in many of these studies has been to reduce it to practicing a single CA component, usually minimum tillage, on some part of land in a particular season. Incremental adoption of more than one principles and full CA packages are rarely assessed.

While there is wide variation in estimates of CA adoption by Malawi smallholders, a consistent finding is that uptake remains low (Andersson and D'Souza, 2014). In neighboring Zambia, high abandonment of some forms of CA (i.e. mainly the manual basin system) has been documented (Arslan et al., 2014) while other, more mechanized CA systems, have increased (Grabowski et al., 2014). This is mainly due to the perceived extra labour digging the basins which has been confirmed in a recent study (Thierfelder et al., 2016).

To circumvent the challenges to studying technology adoption using a general sample of farmers with low awareness of the technology, this study assesses adoption potential of CA among a sample of lead/promoter farmers who have been exposed to the technologies due to their assigned role in dissemination of CA and related technologies.[1] Farmer-to-farmer extension (F2FE) has become an important element of Malawi's public agricultural extension system as a way to extend the reach of agricultural extension services in the face of limited budgets for employing more agricultural extension officers. Malawi's Department of Agricultural Extension Services (DAES) currently works with more than 12,000 lead farmers country-wide who train and promote agricultural technologies, including CA, through their networks of follower farmers and with the use of demonstrations and trials.

To identify the adoption potential we assess the extent of adoption among the lead farmers that are familiar with each of the CA and related technologies. For this adoption rate to be useful as a measure of adoption potential it is important that lead farmers are fairly representative of other farmers in their areas and have had sufficient time to gain knowledge of the technologies and their potential.[2] Likewise, it is important that their adoption has not been influenced by any distorting incentives to promote their own adoption. We assess the first of these by comparing the household and farm characteristics of lead farmers versus a random sample of households in the same areas. For the latter we investigate whether the lead farmers have received any incentives beyond their better access to information that could bias their own adoption levels.

We assess CA and related technology adoption potential using new data for a sample of 178 lead farmers in four districts of central and southern Malawi. A conceptual framework is developed that identifies potential links between the incentives, training, and extension information received by lead farmers and their motivation, activity level, familiarity, own adoption, and recommendations to follower farmers. The conceptual framework guides the empirical analysis of five research questions: (1) How motivated and active are the lead farmers, and what are the main factors associated with these variables? (2) What proportions of lead farmers are aware of the different CA and related technologies, and how is familiarity related to their exposure to different types of extension contacts, training, motivation, experience, and having held demonstrations and trials? (3) To what extent have lead farmers themselves adopted the CA and related technologies on their own farms, and what factors influence lead farmer adoption? (4) What are the pros and the cons of the CA and related technologies that lead farmers emphasize and that are important for the adoption potential? (5) What drives lead farmers to recommend adoption of CA and related technologies to their followers?

[1] We use the term "lead farmer" when referring to such farmer trainers, given its prominence in Malawi the geographic focus of our study, but several other labels are also commonly used (e.g. model farmer, community knowledge worker, contact farmer, volunteer farmer), depending on the specific roles and tasks performed.

[2] We think an exposure time of 5-7 years is sufficient to assess the adoption potential of CA technologies among lead farmers who may be considered potential early adopters.

2. Conceptual framework

We develop a framework to assess the adoption potential of new technologies based on the exposure, perceptions, and behaviors of well-informed promoters (i.e. lead farmers) who are also potential users of the technologies. Technology adoption may be constrained by many factors including some biological (e.g., competition for crop residues, high weed infestation in the first years after conversion, limited land area to rotate, some pests and diseases specific to CA), others economic (e.g., farmers are risk averse, cash constrained, labor constrained, have poor access to markets for inputs and outputs, lack appropriate implements, and have insufficient information and knowledge about CA), and some social (e.g., social networks and social capital) (Holden and Quiggin, 2017; Holden and Lunduka, 2013b; Thierfelder et al., 2015; Warriner and Moul, 1992; Bodin and Crona, 2009). In particular, farmers who have not been exposed to the new technology cannot adopt it, but they might have adopted had they known about it (Diagne and Demont, 2007). For these reasons it is challenging to judge the potential of new technologies from a general sample of farmers. However, a sample of promoters who may be early adopters or at least well-informed prospective adopters can provide useful insights about the potential of such technologies. This group is better informed and has better access to the technologies than the general farming population, and their perceptions and behavior therefore reveal valuable insights about the underlying technology potential, so long as these promoters are not too different from the average farmer in their area in other relevant characteristics such are resource endowments, or they have not been given distorting incentives (Andersson and D'Souza, 2014). Their responses may also provide insightful information about reasons for disadoption or non-adoption.

We assess this promoter and potential adopter model through a study of lead farmers and the potential of CA and related technologies in Malawi. Lead farmers are promoters of CA and related technologies as well as potential adopters. As promoters they may, however, also be constrained by their motivation or level of information. We assess such variation and control for it. This also gives additional insights about the information channels and efficiency of the lead farmer model to technology promotion. The conceptual framework that guides our empirical analyses is illustrated in Fig. 1. The figure illustrates the recursive nature of the adoption process. The familiarity with the technologies is conditioned by exposure to the extension system, specific and general training, motivation and incentives. Adoption depends on the (endogenous) familiarity and household, farm and other location-specific characteristics which affect the expected utility of the technology that drives adoption. Incentives may have indirect (through familiarity) and direct effects on adoption. Next, whether lead farmers recommend each of the technologies is assumed to depend on their own (endogenous) adoption, which is conditioned on their familiarity. Whether they recommend a technology may also be related to whether they have held demonstrations for the specific technology. We allow for interaction between having held demonstrations and own adoption for each technology. Having demonstrations may have its own effect on whether lead farmers recommend the technology whether they have adopted it themselves or not. But there could also be a significant synergy between having demonstrations and own adoption. Finally, the hashed lines indicate how the adoption potential may be drawn from lead farmers' own adoption and recommendation of the technologies given their familiarity with and access to them.

The conceptual framework indicates that government inputs into Farmer-to-Farmer Extension (F2FE) (incentives, extension system contacts, and training) influence lead farmers' motivation and activity levels (number of demonstration trials and number of followers). Inputs into F2FE on the part of government and lead farmers (i.e. motivation