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Barriers to the Adoption of Non-Certified Organic Agriculture by Smallholders in Sub-Saharan Africa: Evidence from East Mau Catchment, Nakuru, Kenya

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1. Introduction

Food insecurity continues to be pervasive in Sub-Saharan Africa. Agricultural productivity is very wobbly mainly due to soil fertility problems. In the stir of the resource constraints for external farm inputs faced by smallholder farmers in the region, sustainable agriculture that relies on on-farm or local resources presents desirable option for enhancing agricultural productivity. Food and Agricultural Organization (FAO) argues that sustainable agriculture consists of five major attributes: it conserves resources, environmentally non-degrading, technically appropriate, and economically and socially acceptable (FAO 2008). This definition fits well with the principles of organic agriculture: health, ecology, fairness and care (IFOAM, 2009). Organic agriculture in general, is a "system of farm management based on natural methods of enhancing soil fertility and resisting disease, rejection of synthetic fertilizers and pesticides, and minimization of damage to the environment and wildlife" (Raynolds, 2000). Without using agro chemicals inputs this approach builds on a set of management practices such as use of organic manure (intercropping, crop rotation and biological pest control) in order to improve soil fertility and ecological balance (Freyer,2007). Consequently, organic agriculture means more than producing without use of agro-chemicals or the so-called 'organic by default'' but rather natural soil fertility building is key. *Non-certified* organic farming is "agriculture'' that meets organic production standards, but is not subjected to organic inspection, certification, and labeling" (Scialabba and Hattam, 2002). It is mainly aimed at subsistence and local markets unlike certified organic production which is mainly aimed at regional and international markets.

Organic agriculture is frequently promoted as an exit strategy from food insecurity and poverty for small-scale resource poor farmers. Potential benefits include affordable and enhanced soil repletion, improved environmental health (water quality, biodiversity conservation among others). Poverty alleviation through increased incomes by reducing cost of production and premium prices have been widely documented. However, uptake has been slow and promotion and research into sustainable technologies has had little impact on its adoption. This paper investigates the barriers to adoption of non-certified organic agriculture technologies by smallholder farmers in Kenya. Following the definition of organic farming above it may appear nebulous to conceptualize at first instance. It appears to be context and region specific. For the developed world it means healthy food and niche markets but for the developing regions it means food security and reduced costs of inputs. In this study we conceptualize non-certified organic farming

as an assortment of practices rather than a single innovation technology package. The promotion of these practices have been done singly or a times in combination over the last two decades when Green Revolution started showing mixed signals of solving food insecurity in the region. It is hypothesized that farmers choose from this profusion of practices based on their economic, demographic, institutional, technical as well as farm characteristics. Different techniques always have unique characteristics for example labour intensity for which farmers match with their situation and choose to take up or reject. By identifying significant characteristics associated with non-adoption/adoption of these practices, we can better inform policies that promote adoption of sustainable agricultural production practices.

2. Materials and Methods

The data we use were collected collaboratively by the Organic Agriculture with Trees (OAT) research project. This is a research effort between the University of Natural and Applied Life Sciences (BOKU), Vienna, Egerton, Kenya and World Agroforestry Centre, Nairobi under the broader theme 'Timber Marketing'. The data were collected from 308 smallholder farm family interviews carried out in 2007 in four administrative divisions (Mau Narok, Mauche, Njoro and Elburgon) of the East Mau catchment in the larger Nakuru district. Cross- sectional data were collected using structured questions on farm level input use and other investment in organic farming techniques (OFT) such as manure application, use of bio-pesticides, tree planting, alley cropping incorporation of plant Stover into cultivated soils among others.

The farmers decision to adopt technological innovations is an issue extensively studies since the early 1950s. There are thousands of literatures on adoption studies both in Kenya and without. One common example that led to such analysis in the literature is the adoption of Hybrid maize and fertilizer as innovation during the GR era. Rogers and Shoemaker, 1971 defines adoption as a mental process. However, for a rigorous theoretical analysis, we need a precise quantitative definition. According to Feder *et al.,* 1985, adoption is the level of use of a new technology in long-run equilibrium given full information and potential about the new technology. Qualitative response models, also called binary choice, discrete or dichotomous models are often used to evaluate farmers decision making process concerning the adoption of agricultural technologies. The models are based on the assumption that farmers are faced by two alternatives, to adopt or not to adopt, a choice that is driven by the level of utility derived from the technology (Mazuze, 2004). Probit and Logit models are the most suitable methodologies developed to investigate the effects of explanatory variables on dichotomous dependent variables (Amemiya, 1973 cited by Feder *et al*, 1985). Results from both models have been shown not to vary much however; probit model assumes a normal distribution.

An ordered probit model was used to estimate the determinants of the adoption of OFTs by farmers. An ordered probit model assumes that the dependent variable depends on a latent variable y_i^*. Following Knight *et al*., (2006), an ordered probit model can be describes as follows:

$$y_i^* = x_i'\beta + \varepsilon_i, \varepsilon_i \sim NID(0, \sigma^2)$$

$$y_i = 0 \; if \; y_i^* \leq \mu_0$$

$$= 1 \; if \; \mu_0 < y_i^* \leq \mu_1$$

$$= 2 \; if \; \mu_1 < y_i^*$$

The μs are threshhold parameters which separate adjuscent categories, estimated wth the βs. The probability that an observed outcome is in a category is

$$P(y_i = 0) = \Phi(x_i'\beta)$$
$$P(y_i = 1) = \Phi(\mu - x_i'\beta) - \Phi(-x_i'\beta)$$
$$P(y_i = 2) = 1 - \Phi(\mu - x_i'\beta)$$

where Φ denotes the cumulative normal distribution of ε_i. Maximum likelihood parameters are then used to obtain the parameter values that maximize the probability of observing the outcome y. Maximizing and then taking the first derivative of the lod log-lihood function produces the parameters for each explanatory variable. This produces the marginal effects or marginal probabilities, which measure the the change in the probabilities resulting from a unit change in one of the regressors while holding other regressors constant. Predicted marginal probabilities were used to assess the influence of the indepedent variables on the depedent variable. In this study the depedent variable was the level of OFP adoption which had three levels (Y=0: Low adoption; Y=1: Moderate adoption and Y=2: High adoption.) depending on the number of OFP that a farmer was practicing.

3. Results and Discussions

Table 1: Emperical results from Ordered Probit regression Model

		Marginal Probabilities		
Variable	**Coefficient**	**Y=0**	**Y=1**	**Y=2**
Years of farming experience	0.027*	-0.158	0.005	0.0043
	(0.0097)			
Farm size (ha)	-0.327*	0.1567	-0.076	-0.067
	(0.1246)			
Household size	1.115*	-0.175	0.562	0.421
	(0.409)			
Tropical livestock units (TLU)	0.052	0.568	0.025	0.0487
	(0.0364)			
Distance to tarmac road	-0.142**	-0.258	0.0254	0.035
	(0.0663)			
Gender (Male=1)	-0.228	-0.256	0.458	0.524
	(0.2247)			
Religion (Protestant=1)	0.789*	0.758	-0.587	-0.362
	(0.2295)			
Use of Hired Labor	0.243	0.025	-0.256	0.0254
	(0.384)			
Ethnicity (Ogiek=1)	-1.023***	0.125	-0.025	-0.0064
	(0.596)			
Model summery				
Number of observations = 209				
LR chi2 (9) = 67.72				
Prob > chi2 = 0.000				
Pseudo R^2 = 0.159				

*,**,and *** implies parameters are significant at 1%, 5% and 10% levels respectively. Figures in parentheses are the standard errors

The most important techniques found among smallholder farmers in the region were: intercropping, crop rotation, use of animal manure and composting, soil conservation techniques (terracing, agro forestry). Other techniques practiced by farmers included:

double digging, use of biopesticides, mulching, zero-tillage among others. However, their adoption displayed a wider inter-household and inter-technique variation. Based on these variations farmers were clustered into three adoption levels: low, medium and high adopters. While there is heterogeneity with regard to the factors that influence adoption across the groups revealed the importance of farmer circumstances on adoption decisions. Particularly results indicate that farmers' experience, household size, distance to the road, religion and ethnicity play an important role in the adoption of organic farming techniques among smallholders. Recommendations to facilitate adoption of different techniques include: the creation of more awareness among farmers of soil fertility effects and long-term benefits of organic soil fertility management, market linkages and support the development of farmer groups.

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