



The effect of farmyard manure on the continued and discontinued use of inorganic fertilizer in Ethiopia: An ordered probit analysis[☆]



Sied Hassen^{a,b,*}

^a Environment and Climate Research Centre, Ethiopian Development Research Institute, Ethiopia

^b Department of Economics, Mekelle University, Ethiopia

ARTICLE INFO

JEL Classification:

Q01
Q12
Q16
Q18

Keywords:

Adoption (continued use)
Discontinued use
Fertilizer
Manure
Ordered probit

ABSTRACT

In this paper, we analyze whether the continued and discontinued use of inorganic fertilizer is related to the use/non-use of farmyard manure (a sustainable land management practice) among farm households in Ethiopia. Random effects generalized order Probit and IV-ordered Probit regression results based on a panel plot level data suggest that the discontinued use of the inorganic fertilizer is related to the non-use of farmyard manure. Further, we find that black/brown soil type, flatter slope, shorter extension centers, and access to water are negatively correlated with discontinued use of the green revolution agricultural technology. Our results strengthen previous findings of complementarity between green revolution technologies and sustainable land management practices by showing that the latter can reduce the likelihood of discontinued use of green revolution inputs.

1. Introduction

Increasing agricultural productivity through the adoption and continued use of green revolution technologies (such as inorganic fertilizer) and other sustainable land management practices (such as farmyard manure) has long been seen as a key policy option to curb under-nourishment in Africa. Despite numerous efforts to enhance the adoption and diffusion of such beneficial practices, their use in rural Africa is low and thus a significant proportion of the population in Africa is malnourished (O’Gorman, 2006; Teklewold et al., 2013). Several adoption studies have been conducted in Africa and other developing countries to identify the reasons for low adoption (e.g., Croppenstedt et al., 2003; Marenja and Barrett, 2007; Kassie et al., 2009; Alem et al., 2010; Wollni et al., 2010; Dercon and Christiaensen, 2011; Teklewold et al., 2013). This paper focuses on the effect of application of farmyard manure on the continued and discontinued use of inorganic fertilizer among farm households in Ethiopia. This is an issue, which have been given inadequate emphasis in the literature.

In Ethiopia, only 30–40% of small holders use chemical fertilizer and those who use apply on average 37–40 kg per hectare (ha) and it is

considerably below the recommended rate and also below comparable smallholder farmers in neighboring Kenya (Rashid et al., 2013). One reason for such low use of chemical fertilizer could also be related the structure of the fertilizer market in Ethiopia. Unlike many other developing countries, Ethiopia has moved from partial liberalization in 1990s to government monopoly control over imports, and distribution of the fertilizer. Agricultural Input Supply Enterprise (AISE) is a quasi-government institution with exclusive rights of importing fertilizer into Ethiopia and distributes the fertilizer to cooperative unions and commercial farmers (AFAP, 2016).

Existing studies on agricultural technology adoption in developing countries find the following factors as the most important in limiting the take-up of new agricultural technologies: risk and uncertainty, knowledge and education, profitability, input availability, credit constraints, tenure security, labor availability, biophysical factors, market incentives and social networks (Croppenstedt et al., 2003; Pattanayak et al., 2003; Bandiera and Rasul, 2005; Doss, 2006; Marenja and Barrett, 2007; Kassie et al., 2009; Alem et al., 2010; Conley and Udry, 2010; Wollni et al., 2010; Dercon and Christiaensen, 2011; Teklewold et al., 2013). Among the studies conducted in Ethiopia, Dercon and

[☆] I would like to thank two anonymous reviewers, and editor of this journal for proving helpful comments and suggestions. I also thank Yonas Alem, Gunnar Köhlin, Peter Berck, Menale Kassie, Subhrendu Pattanayak, Thomas Sterner, Måns Söderbom, two anonymous reviewers of the Environment for Development (EFD) Initiative, and participants at the 8th annual meeting of the EFD Network, October 23–26, 2014, Dar es Salaam, Tanzania for constructive comments on earlier versions of the paper. Financial support from the Swedish International Development Cooperation Agency (Sida) through the Environmental Economics Unit (EEU) of the Department of Economics, University of Gothenburg, is gratefully acknowledged. All errors and omissions are mine.

* Corresponding author at: Environment and Climate Research Centre, Ethiopian Development Research Institute, Ethiopia.
E-mail address: siedy2004@gmail.com.

Christiaensen (2011) find that lack of insurance or alternative consumption smoothing mechanisms lead farmers to make less investment in inorganic fertilizer. Alem et al. (2010) also documented that rainfall variability raises the risk and uncertainty of inorganic fertilizer use, while abundant rainfall in previous years relaxes the liquidity constraints and affordability of fertilizer in the Central Highlands of Ethiopia. While these are the common factors limiting farmers' transition from the state of non-adoption to adoption, Doss (2006) highlighted the need for study of the continued use of agricultural technologies following initial adoption.

Discontinued use of a technology is an important issue in the study of agricultural technologies adoption in helping to identify factors that boost long-term adoption/use of technologies. Neill and Lee (2001) documented that farmers in Honduras discontinue the practice of legume-maize crop rotation at a rate of 10% per year due to emergence of weed species that increase labor requirements. This increased labor requirement has also been noted as a reason for the discontinued use of the Systems of Rice Intensification (SRI) in Madagascar (Moser and Barrett, 2006). Moreover, Marenya and Barrett (2007) also find that farm size, value of livestock owned, off-farm income, family labor supply, educational attainment, and female household head are significant factors in discouraging farmers' use of integrated natural resource management practices in Western Kenya. Further, Wendland and Sills (2008) document that household preference, resource endowments, risk and uncertainty affect households' decisions on continued use of soybeans in Togo and Benin.

Building on the few existing agricultural technology discontinued use studies (e.g., Neill and Lee, 2001; Moser and Barrett, 2006; Marenya and Barrett, 2007; Wendland and Sills, 2008), the contribution of the current study is presented below. Using credible instrumental and panel data regression methods, we analyze whether the application of farmyard manure is related continued/discontinued use of the inorganic fertilizer. Agronomics literature and a few economics studies have documented complementarity of the inorganic fertilizer with farmyard manure (Marenya and Barrett, 2009; Chivenge et al., 2011). Application of manure enhances the organic components and water holding capacity of soil. These organic components and water holding capacity are important elements to facilitate the decomposition and release of nutrients when inorganic fertilizer is applied to the soil. However, this complementarity result is from an agronomical controlled trial experiment. The real world is different from the controlled trial experiment. Usually farmers' behavior deviates from controlled trial experiment results due to the following reasons.

For example, due to liquidity constraints, risk, or lack of knowledge about the complementary nature of the inputs, farmers may perceive that the application of manure can substitute for the use of inorganic fertilizer. For example, farmers may perceive that manure, like chemical fertilizer, increase soil fertility though each is adding different nutrients to the soil. As a result, those who use manure may be less likely to adopt and use inorganic fertilizer. Likewise, due to these and other reasons, farmers who used to apply inorganic fertilizer may discontinue using inorganic fertilizer and replace it with manure. For example, in an area where there is erratic and meager rainfall, and where the plot's soil type lacks important minerals and nutrients, application of inorganic fertilizer can make the seedling or crop "burn"¹; by raising the acidity of the soil. Farmers who experienced this negative effect of inorganic fertilizer may discontinue using inorganic fertilizer and replace it with manure. These are explanations on how farmers can perceive that the inorganic fertilizer can be substituted by manure in both initial decision (on the decision to whether to initially use it or not) and latter stage (on the decision to discontinued use of it).

¹ When there is not sufficient rainfall or moisture in the soil, application of chemical fertilizer (UREA and DAP are types of fertilizer available in the study area) will make the seedling or crop die (burn) due to the acidic nature of these fertilizer types.

On the other hand, farmers' choices for inorganic fertilizer and manure can also be complementary in continued use or discontinued use decisions. Farmers who know about scientifically proven complementarity and those who have the access and capacity to buy inorganic fertilizer may use it with farmyard manure. These farmers are most likely to reap the benefit of the mix and are less likely to discontinue the use of inorganic fertilizer. For these farmers, inorganic fertilizer and farmyard manure are complementary in both adoption (initial decision) and discontinued use decisions (latter stage), i.e., for such farmers, there may be no difference between perceived and actual substitutability and complementarity of the technologies.

Which of the above behaviors prevails is an empirical issue and the substitutability and complementarity results may not be symmetric between continued use (adoption) and discontinued use decisions. This is because in discontinued use (latter stage) farmers have some experience with the technologies. Over time, farmers' knowledge about the technologies and other constraints might differ, thus potentially affecting the decision process and subsequently affecting nature of the substitutability and complementarity of the technologies. We used both an IV-ordered probit and random effect generalized ordered probit methods with Mundlak specifications to answer our research questions.

Our results indicate that farmers that farmers who use farmyard manure are less likely to discontinue the use of inorganic chemical fertilizer and more likely to continue use of it. Farmers who use a mix of inorganic fertilizer and farmyard manure and/or soil and water conservation methods are more likely to continue use of inorganic fertilizer. Our results also indicate that inorganic fertilizer are complementary in both continued use (adoption) and discontinued use decisions, implying that the discontinued use of one leads to discontinued use of the other. We also find that farmers who apply inorganic fertilizer in plots with black/brown soil type, plots that are not sloping, plots that are near the farmer's homestead and near extension centers, and plots that have access to water are less likely to discontinue using it.

The rest of paper is organized as follows. Section two introduces the conceptual framework and empirical strategy of our study. In section three, we describe the data source and study area. Sections four and five present descriptive statistics and econometric results, respectively. Finally, the last section concludes.

2. Conceptual framework and empirical strategy

Farmers' continued use of inorganic fertilizer can be modeled using a random utility framework. Let U^n be the benefit of non-use of inorganic fertilizer, U^c be the benefit of continued use of inorganic fertilizer and U^d be the benefit in the state of discontinued use (dis-adoption). Farmer i decides to continue use of inorganic fertilizer on plot p at time t if $Y_{ipt}^* = U_{ipt}^c > U_{ipt}^d > U_{ipt}^n$,² discontinued use of it if $Y_{ipt}^* = U_{ipt}^d > U_{ipt}^c > U_{ipt}^n$ and do not use at all if $Y_{ipt}^* = U_{ipt}^n > U_{ipt}^c$ where Y_{ipt}^* is the latent utility of continued or discontinued use of fertilizer. This latent continued use/discontinued use decision is determined by:

$$Y_{ipt}^* = X'_{ipt}\beta + \varepsilon_{ipt} \quad (1)$$

$$\varepsilon_{ipt} = \alpha_{ip} + \eta_{ipt} \quad (2)$$

Where X_{ipt} represents a vector of observed farmer i and plot p characteristics for continued use/discontinued use of chemical fertilizer adoption at time t and β is a vector of unknown parameters for the continued use/discontinued use of chemical fertilizer. ε_{ipt} is the composite error term, which consists of α_{ip} farmer i time invariant characteristics and/plot-specific unobserved characteristics, and η_{ipt} , unobserved time varying individual farmer/plot characteristics. Because

² Here we assumed that a farmer who dis-adopts chemical fertilizer is at least better in terms of experience than one who never tried inorganic fertilizer.

Download English Version:

<https://daneshyari.com/en/article/6546703>

Download Persian Version:

<https://daneshyari.com/article/6546703>

[Daneshyari.com](https://daneshyari.com)