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Determinants of success and intensity of livestock feed technologies use in Ethiopia: Evidence from a positive deviance perspective

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ABSTRACT

This study explores factors associated with success and intensity of livestock feed technologies use among positive deviants in feed technology adoption in Ethiopia. We used a nation-wide dataset of over 603 farm households, which surveyed pockets of successes in using improved livestock feed technologies. Heckman two-stage estimation procedures were used to identify factors associated with success and intensity of livestock feed technology use simultaneously. Results from the first stage of selection equation show that households socioeconomic and institutional factors such as education status of the head, herd size, exercise in feed technology utilization, cooperative membership, distance to district center, and diverse use of technologies have significant effect on success in livestock feed technologies adoption. The second stage demonstrates that intensity of household collaboration or network, membership in livestock related cooperatives, training, access to livestock feed technologies with packages, diverse use of technologies, engagement in livestock enterprises, livestock management system, willingness to invest more in feed technologies, and agro-ecologies significantly influence the intensity of feed technologies use. These results suggest that success and intensified use of improved feed technologies demand different entry strategies for risk factors, enablers, and behaviors, which may differ from the classic agricultural technologies transfer system. These include availability of appropriate biophysical and resource environments, functional linkages between different actors, access to inputs and social capital, and enabling institutional support system. Moreover, this study shows that when there is limited adoption, few pockets of success in improved technologies use, positive deviant approach would be more informative to understand the underlying factors and principles for success and intensified use of technologies than the most commonly reported conventional adoption rate studies.

1. Introduction

In developing countries, where most of the smallholder farmers practice mixed farming system, livestock production is the major source of household food, income, traction power and a means to accumulate assets. Smallholder farmers do not only generate cash income from sale of livestock and livestock products, but they also use livestock as a cash buffer, capital reserve, and hedge against inflation. Despite mixed livestock growth pattern observed in different regions of developing countries, in general, the productivity (output/animal) of different livestock species in developing countries is still the lowest in the world. For instance, in Sub-Saharan Africa, significant decline in milk and beef production per animal have been recorded since 1961, which has made the average contribution of the region to the world milk and beef production among the lowest (Nin et al., 2007). Broadly, this could mainly be attributed to inadequate production inputs, traditional management system, poor enabling environment and associated research and development efforts exerted to generate improved technologies (McDermott et al., 2010; Fuglie and Wang, 2012; Makkar, 2014).

Empirical findings on livestock production and productivity also show that, in most developing countries, lack of adequate quantity and quality of feed remains one of the most important constraints that smallholder livestock farmers face especially during the dry season (Thornton, 2010). Even though well-integrated and comprehensive livestock strategy is necessary to address various constraints and improve the production and productivity of livestock in developing countries, improved livestock feed and feeding system would have significant contribution by dealing with multiple challenges related with livestock nutrition, health, and husbandry system simultaneously. Improved feed technologies have better social, economic, and environmental benefits over the traditional feed types. Their contribution in improving feed supply, enhancing the health and productivity of animals, augmenting land use efficiency, and reclaiming land degradation and others have been well studied and documented in different countries (Peters et al., 2001; Bouton, 2007; Koralagama et al., 2008; White et al., 2013; Yami et al.,

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2013: Franzel et al., 2014; Rao et al., 2015). For instance, Turinawe et al. (2012) shows that farmers who used improved feed technologies had significantly higher gross margins than those using traditional feeding methods. Moreover, using improved feed technologies like forages does not only improve animal nutrition but it also contributes to improve crop productivity by maintaining soil fertility through nitrogen fixation, reduce pressure on natural pastures, reduce soil erosion on marginal lands, and improve carbon sequestration to mitigate climate change (Peters et al., 2001; Entz et al., 2002; Rao et al., 2015).

In Ethiopia, like to other developing countries, due to inadequate feed availability and malnutrition, animals' performance measured by birth weight, growth rate, milk yield, mortality rate, and reproductive performance are below the expected range and different animals in the country are not able to produce at their genetic potential (Shapiro et al., 2015). To address this constraint and improve the production and productivity of animals, so far a plethora research and development efforts have been exerted by national and international research institutes to generate and disseminate improved livestock feed and feeding system in the country. Various exotic and indigenous improved technologies were introduced to smallholder farmers by different strategies. For instance, improved livestock feed technologies such as forage legumes, perennial grasses, and pastures were first introduced by Arsi Rural Development Unit (ARDU) (Davis et al., 2010; Tekalign, 2014). Then through various projects such as Fourth Livestock Development Project (FLDP); Crop Diversification and Marketing Development (CDMD); and Feed Enhancement for Ethiopian Development (FEED); improved forage seeds were disseminated to smallholder farmers in different parts of the country (Tekalign, 2014). Moreover, the role of agricultural research institutes such as International Livestock Research Institute (ILRI), Kulumsa and Melkassa Agricultural Research Centers and others in testing the adaptability and nutritional contents of various exotic and indigenous forages crops for different agro-ecological zones was very significant. As a result different improved forages and fodder crops have been released for different ecological zones and considerable efforts have been made to disseminate these pasture and forage technologies to smallholder farmers.

However, despite a number of efforts that have been exerted to introduce various improved feed technologies and feeding systems, adoption and use of these technologies have been still very limited and insignificant (Gebremedhin et al., 2003, Bassa, 2016). For example, based on 2014/15 livestock survey report only 0.3% of livestock holders practiced using improved feed technologies for their livestock (CSA, 2015). This can be attributed to various socio-economic, institutional and biophysical factors entailing limited household resource endowment, especially labor and land to plant forage; mismatch of farmers need's and technologies; limited market integration and extension services provision including weak information flows and linkages to other inputs providers; and multiple bio-physical stress and shocks (Adugna et al., 2012).

Various researches have been conducted to quantify the level of livestock feed technologies adoption and understand the main reasons behind the limited adoption rate among smallholder farmers in developing countries (Gebremedhin et al., 2003; Adugna et al., 2012; Beshir, 2013). Nevertheless, most of the previous studies have mainly focused on the rate of adoption and factors associated with adoption or non-adoption of technologies for a very specific location and at a point in time. Moreover, most of the reported adoption studies generally assumed widespread use of technologies, which does not hold true in the case of improved livestock feed technologies especially in developing countries. Apart from quantifying and describing the situations on the ground, the contributions of such type of studies to generate proven and practicable solutions that could inform policies and strategies to enhance widespread adoption and use of technologies are minimal. Therefore, using a positive deviance approach, this study tries to explore additional insights on factors associated with success and intensity of improved livestock feed technologies use, where positive deviant farmers have been able to derive economic value from using diverse improved feed technologies.

The main purpose of this study was to assess the common factors, processes, and organizational and institutional arrangements underpinning successful cases in improved livestock feed technologies adoption in Ethiopia, which have paramount implication for promoting widespread adoption and use of improved livestock feed technologies in developing countries or elsewhere in the world. This paper has two major contributions to the existing literature on adoption of agricultural technologies in developing countries. Firstly, since the study used a comprehensive national level data on positive deviants in feed technology adoption, it provides affordable, acceptable, sustainable, and multifaceted possible solutions for challenges and constraints associated with widespread adoption and use of livestock feed technologies in developing countries. Secondly, unlike to most of previous similar studies, which have focused mainly on easily and quickly unchangeable socio-economic characters, this study shows the relative importance of household enabling factors and behaviors such as trainings, collaboration and networks, technology transfer arrangements, engagement in farm enterprises (entry strategies), and attitudinal changes that have strong association with both success and intensity of improved livestock feed technologies use in developing countries.

The rest of this paper is organized as follows. The second section discusses the conceptual framework, the econometric models, and estimation strategy employed. Section three describes sampling procedures and data used in the study. Section four presents the results and discussion, and finally, summary of findings and policy implications are presented.

2. Conceptual framework and econometric estimation model

2.1. Positive deviant analysis in evaluating livestock improved feed technologies use

Studies on livestock feed technologies adoption and use in developing countries show the presence of limited adoption and scattered pocket of success among smallholder farmers in developing countries. As it is indicated above, this could be attributed to socio-economic, institutional, and environment related factors mainly affecting the process of technology generation, dissemination, and use. Most available studies on livestock feed technologies mainly focused on rate of adoption and have rarely made an attempt to scrutinize the processes underlying the observed limited adoption and pocket of successes. As a result, in general there is limited information on fundamental factors that contribute to the observed pockets of success in feed technologies adoption. Consequently, using the concept of positive deviance, this study aims to move one step further from the most commonly reported adoption rate studies by focusing only on the limited adopters and tiny pockets of successes observed among smallholder farmers. This helps to draw feasible lessons from the successful cases on the underlying factors and principles pertinent for success and widespread adoption of improved feed technologies in developing countries.

In academic literatures, individuals that exist in resource-poor communities with uncommon beneficial practices that allow the household to have better livelihood or outcomes as compared to their similarly impoverished neighbours are considered as 'positive deviants' (Lapping et al., 2002; Marsh and Schroeder, 2002). The term positive deviance refers to an inductive approach to determine successful practices of individuals who succeed where most tend to fail (Stuckey et al., 2011). Primarily, the concept of positive deviance originates in the field of epidemiology and biostatistics referring to positive outliers in a frequency distribution of various events. For instance, in disease epidemic outbreak, there were survivors that led researchers to question why these survivors who share the same environmental and socio-economic conditions exposed to the same situations remained healthy while others got sick (Lapping et al., 2002). This encouraged researches to follow new approaches to explore the cases differently focusing only on the survivors and examine the underlying factors related with surviving. Such type of approach helps to scrutinize the practice and behavior of individuals in a community with the same socio-technical context who have achieved better results than their peers (Fowles et al., 2005). According to Pant and Odame (2009),

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