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Gender specific perceptions and adoption of the climate-smart push–pull technology in eastern Africa

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ABSTRACT

The performance of the agricultural sector in many developing countries has been rated as below average, in particular the staple cereal crops whose productivity is limited by both biotic and abiotic factors. Furthermore, underperformance by the agricultural sector has in part been attributed to the inability of women to access resources, yet they represent a crucial resource in agriculture and the rural economy through their roles as farmers and entrepreneurs. These challenges can be overcome by understanding gender roles and perceptions, and aligning innovations to fit the preferences of specific gender. This study evaluated gender specific perceptions and the extent of adoption of a climate-smart push–pull technology for controlling stemborers, African witch weed (*Striga* spp.), and improving soil fertility in drier agro-ecological zones where these constraints are quickly spreading. The findings show that slightly higher percentage of women (98.6%) perceived the technology as effective compared to men (96.7%). Women also highly rated the beneficial attributes of the technology such as increased cereal production (97.3% of the women vs 94.6% of men), decline in *Striga* spp. weed (97.2% women vs 92.4% of men), increase in soil fertility (95.9% of women vs 90% of men), increase in fodder production (94.1% of women vs 91.3% of men) and increase in cereal and fodder production even with drought (82.3% of women vs 66.5% of men). The findings show that, women who are the most vulnerable of the smallholder farmers, are bound to benefit from the technology, mostly because its attributes favors their (women) preferences.

1. Introduction

Low production of the main staple crops and livestock remain a key challenge in achieving food security in Africa and this has resulted in high food and nutrition insecurity, malnutrition and poverty, particularly for the resource-constrained smallholder farmers, mostly women, practicing rain-fed agriculture (Gurney et al., 2006; World Bank, 2007). The parasitic African witch weed (*Striga* spp.), lepidopteran stemborers, *Chilo partellus* Swinhoe (Lepidoptera: Crambidae) and *Busseola fusca* Füller (Lepidoptera: Noctuidae) and degraded soils have been classified as the main causes of dismal cereal production in Africa and this has been aggravated by climate change and unpredictable rainfall (Smil, 2000; Kfir et al., 2002; Sauerborn et al., 2003; Okalebo et al., 2006; De Groote et al., 2010; Midega et al., 2013). The push–pull technology, developed by the International Centre of Insect Physiology and Ecology (ICIPE) and partners has been accepted as a low-cost conservation agriculture method that manages these constraints simultaneously and has been well adopted in the higher potential areas, with farmers reporting doubled and tripled cereal yields and more fodder for their livestock (Cook et al., 2007; Khan et al., 2000, 2008c, 2001, 2006; Khan and Pickett, 2004; Hassanali et al., 2008). However, the performance of the original conventional push–pull technology, that utilized silverleaf desmodium, *Desmodium uncinatum* (Jacq.) DC as the repellent intercrop against stemborer moths and the Napier grass *Pennisetum purpureum* (L.) Schumach. as a trap crop, was limited by the increasingly hot and dry conditions associated with climate change (Midega et al., 2010; Khan et al., 2010, 2014; Pickett et al., 2014). This necessitated its adaptation by incorporation of a drought-tolerant trap plant *Brachiaria* spp., particularly the commercial hybrid, *Brachiaria* cv mulato II, commonly known as brachiaria, and intercrop with drought tolerant species of green leaf desmodium, *Desmodium intortum* (Mill.) plants (Khan et al., 2014; Pickett et al., 2014; Midega et al., 2015), now termed as the 'climate-smart' push–pull system,

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which extends its benefits to smallholder farmers in a wider range of agro-ecological zones in sub-Saharan Africa (SSA).

Since its adaptation and subsequent dissemination in the drier agro-ecological zones, the adoption pattern and farmers' perceptions have remained unclear, yet this is important for a successful up-scaling plan. Farmers' perceptions are considered subjective but have direct influence on decisions to adopt new technologies and are therefore very relevant in economic modeling (Adesina and Baidu-Forson, 1995; D'Antoni et al., 2012). Rogers (1995) noted that technology characteristics such as perceived usefulness, ease of use, compatibility, observability and trialability, are key influential factors affecting farmers' attitudes and perceptions towards adopting the proposed new technological innovations. Moreover, the importance of gender in influencing farmers' perceptions of new technologies has been emphasized as men and women experience their social, economic and environmental reality in different ways (Brody et al., 2008). The importance of gender is reflected in the different roles played by both men and women in farming systems often defined by culture and context within the country. Although men and women carry out different roles in farming, both make important contributions to agriculture with women contributing over 50% of agricultural labor besides other reproductive roles (FAO, 2011). In addition, the different social expectations, roles, status, and economic power of men and women can influence perceptions which in essence affect adoption patterns.

Farmers' perception of new technologies and adoption cannot be separated. At the center of this interaction is the household member who makes decisions on whether or not to adopt technologies and this decision is dependent on how farmers perceive the technology (Van de Ban and Hawkin, 1988). Effective dissemination and adoption of new innovations can therefore be achieved if there is complete knowledge of how the technologies are perceived. In theory, farmers' adoption behavior have been explained using three paradigms; the innovation-diffusion model which assumes that while the technology is technically and culturally suitable, information asymmetry and high search cost may limit its adoption (Feder and Slade, 1984; Smale et al., 1994; Shampine, 1998); the economic constraint model which further argues that in the short run, input fixity such as access to credit, land and labor restricts production flexibility and therefore conditions technology adoption decisions (Aikens et al., 1975; Smale et al., 1994; Shampine, 1998); and the adopters' perception paradigm, which suggests that the perceived attributes of the technology conditions adoption behavior of farmers implying that even with full information, farmers may subjectively evaluate the technology (Kivlin and Fliegel, 1967; Ashby and Sperling, 1992). Other studies by Adesina and Zinnah (1993) and Prager and Posthumus (2010) also observed that in light of prevailing socio-economic environment, farmers' subjective perceptions of a new technology may condition their adoption behavior. Kaimowitz and Merril-Sands (1989) further acknowledged that farmers are not passive consumers of technologies but active problem solvers and therefore getting feedback from them is desirable. Consequently, farmers' attitudes and perceptions cannot be ignored since they can enable or inhibit adoption of the new technology. In view of this, understanding different genders' perceptions of a given technology is crucial in the generation and diffusion of new technologies.

Studies on farmers' perceptions and attitudes can be utilized to assess impacts of agricultural research and provide information for policy reform (Olwande et al., 2009) and understanding farmers' perceptions of a particular technology shapes the subsequent actions taken in technology dissemination. Morse and Buhler (1997) acknowledged that lack of information about farmers' knowledge, perceptions and practices could hinder further establishment of effective pest management methods. Indeed, the need to understand farmer knowledge systems was recognized as a basis for development of pest management technologies adapted to local farmers' situations (Van Huis and Meerman, 1997; Norton et al., 1999). Therefore, understanding farmers' perceptions and specifically from a gender point of view will enhance access to and benefit from productivity enhancing technologies, which is critical in achieving food security in Africa (AGRA, 2013).

The objective of this study was therefore to investigate different genders' perception of the climate-smart push–pull technology, particularly understanding farmers' opinion on its effectiveness and benefits hitherto. The special focus on gender was intended to allude to the existing differences between men and women in the perceptions of the technology with an expectation of catalyzing gender awareness in technology dissemination targeting each group of farmers from a point of view of their preferred technology attributes. Previous studies by Khan et al. (2008a) evaluated farmers' perception of the push–pull technology in Kenya based on the conventional push–pull type. With the new attributes of the climate-smart push–pull type and its expansion thereof in drier agro-ecological zones, there is likelihood of variations in socio-cultural and bio-physical factors that may influence farmers' responses.

2. Methodology

2.1. Sampling and data collection

This study was conducted in drier agro-ecological zones (Midega et al., 2015) of Kenya, Uganda, Tanzania and Ethiopia where the climate-smart push–pull technology is being promoted since its adaptation in 2011. Cross-sectional data were collected using a structured questionnaire using a team of enumerators recruited and trained by each country. This study was conducted in April 2014 at least two years after the adaptation and initial dissemination of the technology. One weakness that might occur in this study is that it was carried out at the point when the adoption status was still relatively low, hence the small sample size. Low adoption was attributed to the stage of dissemination, as well as a possibility of farmers waiting to accumulate more knowledge since the technology is considered relatively knowledge intensive. In actual fact, this study was a follow-up of the *ex ante* study conducted in 2012 (results now published as Murage et al., 2015) and was necessitated by the need to understand how farmers perceived the new climate-smart technology in order to plan for its expansive dissemination and scaling up. Sampling therefore targeted early adopters from the push–pull villages and apart from Kenya where dissemination had started slightly earlier, the number of farmers who had taken up the technology in the other selected countries was still small. In view of this, we sampled and interviewed 461 respondents; 282 in Kenya, 42 in Ethiopia, 105 in Tanzania, and 32 in Uganda, which was approximately half of the number of adopters in each country at the time of survey. The questionnaire focused on gender disaggregated socio-economic characteristics of the respondents, farm attributes, major crops grown and their constraints, perceived technology attributes and determinants of the extent of adoption of the technology, reasons for adoption, sources of information, observed benefits of adoption and constraints, and willingness to expand and continue using the technology.

2.2. Model specification and data analysis

A combination of descriptive and econometric analysis was used to summarize the data. The main responses on the attributes of