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Genetically Modified Maize: Less Drudgery for Her, More Maize for Him? Evidence from Smallholder Maize Farmers in South Africa

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Summary. — Genetically modified (GM) crop technologies have made great strides since its first introduction in 1996. Although there is an extensive and growing body of literature on the economic impact of the adoption of GM crops in both developing and developed economies, there is only scant evidence that the technology has had any specific and distinguishable impact among female and male farmers. In economies where female farmers and female household members have a significant and often differentiated role in agriculture production, it is crucial to be able to answer this question. This paper presents quantitative and qualitative results from a study of the gender-specific adoption and performance effects of insect resistant (Bt) and herbicide-tolerant (HT) maize produced by smallholder farmers in the Kwa Zulu Natal province in South Africa. The findings indicate that women farmers value the labor-saving benefit of HT maize alongside the stacked varieties which offer both insect control and labor saving. Higher yields are the main reason behind male adoption, while female farmers tend to favor other aspects like taste, quality, and the ease of farming herbicide-tolerant (HT) crops. Women farmers (and also children) saved significant time because less weeding is required, an activity that has traditionally been the responsibility of female farmers. The newer stacked varieties were preferred by both male and female farmers and seemed to be in high demand by both groups. However, lack of GM seed availability in the region and poor market access were possible limitations to the adoption and spread of the technology.

Key words — women farmers, GM maize, gender, technology adoption, Africa

1. INTRODUCTION

Genetically modified (GM) crops, have been one of the fastest adopted agricultural technologies in recent history (Khush, 2012). Initial adoption in 1996 was limited to commercial producers in a handful of countries mainly the United States, followed by Argentina, and Canada. Over the years farmers in Latin America and Asia have been adopting the technology at a fast pace. However, commercial production of GM crops in Africa has been limited to South Africa, Egypt, Burkina Faso, and more recently Sudan. Among them, South Africa is the only country where smallholder farmers have been producing a subsistence food crop using GM technology for more than a decade.

A substantial number of scholarly articles assessing the impact of GM crops in developed and developing economies has been reviewed by different authors (i.e., Smale *et al.*, 2009; Areal, Reisgo, & Rodriguez-Cerezo, 2013; Finger *et al.*, 2011, Klu¨mper & Qaim, 2014). The majority of these published articles have not taken into consideration gender differentiated impacts. However, with increased adoption of these technologies in developing countries, notably South Africa and given the important role female farmers and household members play in smallholder production systems in some regions of the world, it has become apparent that gender-differentiated assessment of adoption and impacts of GM crops demands further attention.

While numerous studies have shown that technology introductions in agriculture are gender differentiated and that these differences have relevant policy implications, (Peterman, Behrman, & Quisumbing, 2010; Quisumbing & Pandolfelli, 2009), few have studied the gender differentiated impact of GM crops in detail. Subramanian and Qaim (2010), 2009), Subramanian, Kirwan, Pink, and Qaim (2010) and Zambrano, Smale, Maldonado, and Mendoza (2012) have made some first advances suggesting that women and men farmers and household members derive differentiated benefits from the cultivation of GM crops. These studies have analyzed the impact on women farmers in cultivating Bt cotton in India and Colombia. The findings are context specific for the regions studied and will require further analysis to make wider generalization. Little, if any, gender-focused work has been done in Africa, although some authors (Morse & Bennett, 2008; Thirtle, Beyers, Ismael, & Piesse, 2003) have mentioned some gender aspects in their evaluation of insect-resistant (Bt) cotton in South Africa. Recent work on GM maize in KwaZulu-Natal by Gouse (2012a) and Regier and Dalton (2013) have collected gender disaggregated data for GM maize but there has not been any substantial analysis regarding the differentiated effects on men and women farmers. Determining the gender implications of the adoption of GM crops is thus a quite relevant task at hand.

There is also a critical gap in our understanding of the labor effects of different GM crop technologies and how that affects technology adoption and use among men and women farmers. Despite the fact that the assessment of herbicide-tolerant (HT)

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maize technologies in South Africa (Gouse, 2012b) and other regions of the world confirmed that one of the main technology benefits is the reduction in weeding labor and management time, these differentials have not been analyzed from a gender perspective. In the South African context, in particular, in the KwaZulu Natal (KZN) province, land supply is abundant while labor is in short supply. Increased migration of agricultural workers to urban areas and a high incidence of HIV/AIDS have diminished labor supply in the region (Gouse, Piesse, Thirtle, & Poulton, 2009). However, due to customary laws, it is still difficult for woman-headed households to access land as well as labor (Assefa & Van Den Berg, 2009). For this reason technologies such as herbicide-tolerant (HT) maize, that is a labor-saving technology, has the potential to play an important role in alleviating the time and labor constraints faced not only by women head of households but by all other household members.

This paper attempts to fill this important gap in the literature by analyzing gender-specific effects of cultivating GM maize in the northern region of KwaZulu-Natal (KZN) in South Africa. It summarizes findings from a University of Pretoria and International Food Policy Research Institute (IFPRI) project studying the gender-specific adoption and performance effects of smallholder farmers who plant GM maize. We present household member gender-focused findings based on two approaches pursued in the examination of Bt and HT maize cultivation by small-scale farmers. First, we quantitatively analyze gender disaggregated, original field data collected by Gouse (2012a), Gouse (2012b)). Second, we make use of qualitative data collected through small group discussions conducted with men and women farmers in two sites, Hlabisa and Simdlangentsha in KZN in order to better understand some of the nuances of household decision making and specific responsibilities in the maize production system. This paper is organized as follows. In the next section we provide an overall background of the current literature that informs our research and present an overview of Bt and HT maize adoption in South Africa. In section three we describe the study design including the field survey and small group discussions used for the analysis and present the results. Finally, we conclude by outlining specific findings and lessons from the analysis conducted in South Africa.

2. BACKGROUND

The overall assessment of commercialized GM crops has shown that the use of Bt technologies has reduced insect damage and insecticide applications while increasing gross income. HT technologies in most cases decreased the use of more toxic herbicides and have reduced management time (Areal *et al.*, 2013; Klu¨mper & Qaim, 2014) though there are substantial variation according to cropping system and geographical location (Smale *et al.*, 2009). The benefits to smallholder farmers in developing countries using the technology has also been documented and found to be positive (Azadi *et al.*, 2015; Graff, Roland-Holst & Zilberman, 2006; Klu¨mper & Qaim, 2014; Subramanian & Qaim, 2009). Research from South Africa and Philippines show that smallholder farmers have received significant benefits from cultivating GM maize (Yorobe & Quicoy 2006; Gouse *et al.*, 2009). While Bt maize in Philippines has been responsible mainly for higher yields, analysis of HT maize in South Africa shows that there are significant labor-saving benefits (Regier & Dalton, 2013; Sanglestsawai, Rejesus, & Yorobe, 2014; Assefa & Van Den Berg, 2009).

(a) *Gender and agriculture*

What these studies have not shown are the differentiated effects that the technology has had on men and women farmers. Women play a fundamental role in agriculture, especially in Africa. The Food and Agriculture Organization (FAO, 2011) estimated that female share of agricultural labor is almost 50% in Sub-Saharan Africa, compared to 43% for the developing countries in general. As has been underscored by the extensive and growing body of literature on gender and agriculture (FAO, 2011; FAO, IFAD, & ILO, 2010), women's roles and responsibilities in agriculture—within the household and the community—are complex, diverse and multifaceted (Doss, 2001; Doss & Morris, 2001; Meizen-Dick *et al.*, 2011; Quisumbing & Pandofelli, 2009). Studies suggest that, despite the wide variability among regions and countries, women farmers play a major role in labor-intensive activities such as planting and weeding, among many other agricultural activities (Schultz, 2004; Meizen-Dick *et al.*, 2011). Time-use studies (Charmes, 2005; Fälth & Blackden, 2009; Bardasi & Wodon, 2009) have also shown that women not only have substantially less free time than their male counterparts, but are more often confined to performing time-intensive and socially unrewarding activities such as fetching of water and fire wood. Women, compared to their male counterparts, also devote disproportionally more time to multiple on-farm and off-farm responsibilities.[1]

When considering Sub-Saharan agriculture, Dey Abbas (1997) asserts that the most relevant area of gender asymmetries tend to be the availability and control of household labor for farm activities. Uptake of productivity enhancing technologies are more limited for female farmers, especially in female-headed households. It is interesting to note that even when women have the financial and cultural possibility of hiring labor, they find it challenging to manage hired male labor (Zambrano *et al.*, 2012).

Beside the cultural constraints described so far, another factor that appears to have made labor a key factor limiting production, particularly for female farmers, is the higher male participation in off-farm activities. With increasing number of male household members absent from the rural household, the role of women in maintaining and producing cash crops (Ezumah & Di Domenico, 1995) has increased, blurring even further the difference between male and female crop production (Carr, 2008; Doss, 2001) and making labor a more limiting input for *de jure* or *de facto* female-headed households or plot managers.

In the South African context, especially in the former homeland areas in KZN and the Eastern Cape, it has been documented that women farmers, both in woman-headed households as well as in homesteads headed by men, have unequal access to labor (Hull, 2014). While woman-headed households have problems accessing both land and labor for farming, women farmers within homesteads headed by men have to depend on their status in the household and with the household head to access family labor (Hull, 2014).

In the complex and often under-studied agricultural household environment, the role of technology and its adoption and use, especially that of a GM crop, still requires more study.

(b) *Gender and the Potential Factors Impacting Farmers' Adoption Decision*

Compared to a considerable body of literature on female farmers and technology adoption, the number of publications on female farmers and adoption of genetically modified crops

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