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Combining participatory crop trials and experimental auctions to estimate farmer preferences for improved common bean in Rwanda

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ABSTRACT

Participatory crop improvement raises the prospects for developing seed varieties that meet the needs of subsistence farmers but may face challenges regarding preference elicitation, particularly in complicated policy environments. We integrate binding experimental auctions with participatory variety selection to elicit farmers' preferences for improved common bean varieties in Rwanda. We find that auctions reveal farmer preferences more accurately than stated nonbinding rankings in this context and that participatory on-farm crop research is essential to understanding how farmers evaluate tradeoffs between multiple crop attributes. We also find that farmers highly value intercrop yield despite government policy that encourages farmers to monocrop.

Introduction

Improved varieties of staple crops can be an important development tool simultaneously targeting malnutrition and chronic low yields (Becerril and Abdulai, 2010). However, successful introduction of improved varieties in developing countries can be hindered by the challenges associated with the heterogeneous microclimates found throughout the tropics (Morris and Bellon, 2004). Identifying varieties that farmers are likely to adopt is also complicated by the complexity of traditional cropping systems, suboptimal conditions found on farmers' fields and a lack of understanding of farmers' preferences.

Classic plant breeding typically focuses on improving the biological attributes of a crop rather than specifically trying to understand "the specialized production and consumption requirements of people who live in these environments" (Morris and Bellon, 2004, p.22). Participatory crop improvement methods emerged as a way to collaborate with farmers in order to better understand their preferences for new varieties and improve adoption. Two specific forms of participatory crop improvement research are Participatory Plant Breeding (PPB) where farmers evaluate plant characteristics during the breeding process and Participatory Variety Selection (PVS) where farmers evaluate varieties emerging from breeding programs (Witcombe et al., 1996). Both methods seek to identify plant trait preferences and generate plant varieties to better meet farmers' needs. Engaging farmers in participatory variety selection is particularly important when on-farm conditions are likely to be different from those on research stations, which is common in areas with diverse agroecological environments and low input systems (Morris and Bellon, 2004).

One potential challenge with participatory variety selection is that it may still remain difficult to obtain information from the participating farmers on which varieties they actually prefer. Improved attributes of staple crops are often accompanied by negative attributes such as poor taste or unorthodox color that hamper adoption. Understanding how farmers evaluate multiple attributes is essential for more efficient plant breeding, policymaking, and resource use. Depending on their relationship, however, farmers may be inclined to tell the researchers what they think the researchers want to hear, a form of social desirability bias (Norwood and Lusk, 2011). In such a situation, which appears to describe the case we investigate in this article, more sophisticated elicitation methods may be required. In this research we compare two elicitation methods for improved varieties: stated nonbinding rankings common in participatory methods and revealed bids from binding experimental auctions.

The research reported in this paper engages bean and maize subsistence farmers in Northern Rwanda by combining on-farm agronomic trials with experimental auctions for improved varieties of common bean. This paper addresses two main questions regarding the quality of information that researchers can obtain about

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farmer preferences among different varieties: (1) What is the effect of the method of preference elicitation? (2) Does taking part in on-farm participatory crop improvement research influence farmer preferences for the varieties?

Background

Experimental auctions for improved staple crops

In recent years, researchers have used experimental auction techniques in developing countries to estimate preferences for improved staple crops including biofortified white and yellow maize meal in Kenya (De Groote et al., 2011), biofortified orange maize meal in Mozambique (Stevens and Winter-Nelson, 2008), biofortified orange maize in Ghana (De Groote et al., 2010), and biofortified "golden" rice in the Philippines (Corrigan et al., 2009). These papers look specifically at the tradeoff consumers make between a positive attribute (fortification) and a negative attribute (unorthodox color). For example, De Groote et al. (2011) found that the premium consumers were willing to pay for fortified maize (24%) was higher than the discount they required to buy yellow maize (11%). One limitation of such applications of experimental auctions is that they tend to focus exclusively on consumer behavior even though in some of the countries where they are undertaken, up to 90% of the population is also involved in production, which is the case in Rwanda.

If subsistence farmers' consumption and production decisions are interdependent as economic theory predicts, their preferences for a new crop variety should be based on consumption and production characteristics including nutrient content, taste, color, yield, and possibly others. Studies that concentrate only on production attributes (Asrat et al., 2010) and do not provide farmers with information on the consumption attributes do not capture the interdependency of decision-making. Two papers that specifically look at both consumption and production traits find evidence that both are determinants of farmer preferences. Dalton (2003) concludes that evaluating only on production characteristics in research with rice farmers in West Africa leads to 19.1% of all varieties being miscategorized as inferior. Asfaw et al. (2012) conclude that combining drought tolerant attributes with marketability and attractive culinary traits is most important to common bean farmers in Ethiopia.

This research extends previous work in the consumer choice literature by estimating farmer preferences for common beans in Rwanda based on consumption attributes (taste and nutrient content) and production attributes (locally specific yield data) through the use of information treatments in a field experiment. We also examine the differences in revealed preferences between farmers who took part in participatory variety selection and those who only tasted the beans and received information treatments. We treat farmers as both consumers and producers and we use an incentive-compatible elicitation method to investigate the effect of participating in research and the effect of binding preference elicitation methods.

Improving common beans in Rwanda

Common bean (*Phaseolus vulgaris* L.) is a major grain legume crop in Rwanda produced mainly for subsistence agriculture but also to a limited extent for regional markets. Much of Rwanda's bean production is on small farms averaging 0.65 ha, traditionally intercropped with maize or other crops (NIS, 2010). There are estimated to be at least 550 varieties of common bean in Rwanda (CIAT, 1993) and farmers traditionally plant mixtures containing as many as 30 varieties (Voss, 1992). The Rwandan Agricultural Board (RAB) reports that bean farmers' average yield is 25% of its potential as a result of rain variability, poor soil, and inadequate soil nutrients or inputs (RAB, 2012).

Common bean provides a valuable source of protein, minerals and vitamins with bean consumption in Rwanda estimated to be as high as 48 kg per capita per year (Broughton et al., 2003). Rwanda has the world's 10th highest percentage of population suffering from undernourishment at 40% in 2009 (FAO, 2012) as well as high rates of iron deficiency: 11% among women and 42% among school age children (World Bank, 2012). Common bean is conducive to biofortification of iron and zinc content because the baseline grain iron content is high and there is wide variability of mineral content, 30–110 ppm for iron and 25–60 ppm for zinc (Beebe et al., 2000). HarvestPlus estimates that an additional 40 ppm above baseline iron levels in common bean could meet a large proportion of the recommended daily intake of iron (Welch et al., 2000).

Adoption of bean varieties with improved nutrient content and yield performance has the potential to improve health outcomes and reduce poverty in rural areas of Rwanda. In the late 1980s and early 1990s, the low adoption rates of improved bean varieties in Rwanda led to extensive advancements in client-oriented plant breeding, where researchers collaborated with farmers to identify suitable varieties (Sperling et al., 1993). The success of participatory research with improved bean varieties allowed farmers to intensify bean production and gradually become part of the national agricultural research system in Rwanda. The institutionalization of methods like PVS makes it increasingly important to examine the contexts within which the participation is embedded. This is especially true in the current policy environment in Rwanda as the relationship between farmers and the Rwandan government is affected by sweeping changes in agricultural policy.

Multiplication and dissemination of improved varieties of crops is one component of phase II of the Strategic Plan for the Transformation of Agriculture in Rwanda (PSTA II), released in February 2009 (Ministry of Agriculture and Animal Resources, 2012). The plan incentivizes farmers with improved seeds and fertilizers, post harvest storage facilities, and extension services, to shift from diverse intercropping systems to monocropping. Previous research and anecdotal evidence paint a more authoritarian picture of local authorities destroying farmers' crops if they do not comply with the policy, effectively making intercropping illegal (Huggins, 2013). PTSA II is a radical departure from traditional farming in Rwanda and presents a challenging context to elicit farmers' preferences for improved crop varieties using participatory methods.

Methods

In this research, we are interested in whether the results of stated and revealed preference elicitation methods for improved common bean varieties are consistent given the policy context in Rwanda. We also want to understand the impact of taking part in the participatory research on farmers' preferences. To explore these issues we conducted experimental auctions and non-binding rankings with farmers who participated in on-farm crop trials and farmers with similar soil and climatic conditions who did not participate in the crop trials.

Data

Two types of data were used: (1) agronomic data collected through on-farm research of climbing bean varieties and (2) preference data collected through stated rankings, experimental auctions, and a brief survey with two subject pools of farmers. The agronomic data and a subset of the experimental auction data came from farmers who participated in an on-farm study of variety