Do farmers economically value seeds of different quality differently? Evidence from willingness to pay studies in Tanzania and Ghana

By

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Do farmers economically value seeds of different quality differently? Evidence from willingness to pay studies in Tanzania and Ghana[1]

Abstract

Low effective demand is often cited as a major reason for the lack of private-sector involvement in the seed system for legume crops such as beans and cowpeas. The viability of a seed system depends on whether farmers can perceive the 'seed' product as a quality planting material, and whether they are willing to pay a premium price for seed compared to grain price. To evaluate this, double blind field experiments and bidding experimental auctions were conducted with more than 500 bean and cowpea farmers in northern Tanzania and northern Ghana to gauge the demand for three types of seed products: certified seeds, quality declared seeds (QDS), and recycled seeds (i.e., grain) saved from previous harvest. These three types of seeds differ in seed input (i.e., which generation of seed is used to produce them), the regulatory supervision they receive or not receive, and technical conditions under which they are produced, and thus vary in quality and cost of producing them. Whether the cost differential across these types of seeds makes them qualitatively different products as reflected in their perceived or actual performance of the plant, and whether that translates into differential price farmers are willing to pay for these seeds are the research questions addressed by this research. The paper highlights three interesting results which have implications on designing seed systems for legume crops. First, seed quality matters--on average certified seeds consistently outperformed QDS, and QDS outperformed farmer recycled seeds of the same variety. Second, all else equal, farmers are willing to pay premium for quality seeds--the relative difference in Farmers' willingness-to-pay (WTP) for different seed types is correlated with the relative difference in their perceived quality differences. Third, results confirm the downward sloping demand curve for quality seed. In other words, the number of farmers who are willing-to-pay a premium price for quality seed declines as price of seed increases. The implication of these findings is that there is no one-size-fits-all strategy to meet the seed needs of all the farmers. The strategy should be built on multi-pronged approaches based on subsidies to meet the needs of farmers on the lower end of the WTP spectrum, private sector based approaches to meet the needs of farmers on the higher end of the WTP spectrum, and alternative models based on in-kind subsidy and not-for-profit seed production models for farmers in the middle ranges.

Key words: *willingness to pay, auction experiment, bean seed, cowpea seed, seed demand, Quality Declared Seed, certified seed, recycled seed, Tanzania, Ghana*

JEL codes: *O33 Technological Change: Choices and Consequences; Q12 Micro Analysis of Farm Firms, Farm Households, and Farm Input Markets; Q18 Agricultural Policy; C90 Design of Experiments: General; C93 Field Experiments*

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Introduction

According to the last available estimates, the public food and agricultural research and development (R&D) spending in developing countries totaled about $15 billion in 2009 (Beintema et al. 2012). A significant portion of these investments is devoted to crop research focused on developing improved varieties of staple crops. Benefits from such crop improvement research can only be transferred to farmers if an 'improved' variety (i.e., a variety that is genetically superior to a local variety) is made available, and good quality seeds of that improved variety are planted by farmers. Thus, gains from investments in crop improvement research depend on both the genetic improvement embodied in the seed as well as on the existence and performance of a seed system that can deliver this improved genetics to farmers in the form of a good quality seed or planting material. An effective and well-functioning seed system is therefore critical to ensure that the benefits of billions of dollars of research investments reach the intended farmers.

One of the important factors that determine the existence of a functional seed system is the 'effective demand' for seed (i.e., planting material) of improved varieties as reflected in the volume and frequency of purchase of fresh seed by farmers. Even where farmers have adopted improved varieties, the low volume and low frequency of seed demand has been often cited as a major reason for the lack of private sector involvement in the seed system. This is especially the case for self-pollinated legume crops like beans, cowpeas, and pigeon peas. Several factors contribute towards this low demand for seed of legume crops. First relates to the self-pollinated nature of these crops. Self-pollination produces progenies that are more uniform than those that result from outcrossing, and thus it is easier for farmers to save the seeds from their own harvest. Additionally, farmers may not perceive quality difference between 'seed' vs 'grain,' which makes seed (as a commercial product) highly competitive with grain (i.e., harvested output from own production with the intention for sale or consumption) and reduces its effective demand. Secondly, economic factors such as low affordability and lack of availability also contribute to low demand for seed. However, low effective demand is often cited as a major reason for the lack of availability of seeds, as it thwarts private-sector involvement in the seed system. The end result of this viscous loop is that farmers in developing countries continue to grow low quality planting material, which lowers crop productivity. Moreover, the seed system has to rely on government subsidies and donor funded projects to disseminate genetically improved and high quality seeds, which raises the question of sustainability of such a strategy.

To break from this viscous cycle of low effective demand and lack of private sector response to low demand, requires the coexistence of the following demand and supply side conditions. Keeping the genetics constant, the demand side conditions depend on whether the farmers are able to perceive the 'seed' product as a quality planting material, and are willing to pay a premium price for seed compared to grain price. On the supply side, the required conditions are that the price farmers are willing to pay is high enough to recover the cost of producing quality seed, and that the quantity and frequency of seed demanded at that price is large enough to attract suppliers to produce and sell seeds.

There are no rigorous studies that have examined these demand and supply side conditions and requirements in a systematic manner. This study is an attempt to understand these conditions by

conducting field experiments and bidding experimental auctions to assess farmers' willingness to pay for quality cowpea seeds in Ghana and bean seeds in Tanzania. Bean farmers in Tanzania and cowpea farmers in Ghana have access to potentially three types of planting materials: certified seeds, quality declared seeds (QDS), and recycled seeds (i.e., grain) from previous harvest. These three types of seeds differ in seed input (i.e., which generation of seed is used to produce them), the regulatory supervision they receive or not receive, and technical conditions under which they are produced, and thus vary in quality and cost of producing them. Whether the cost differential across these types of seeds makes them qualitatively different products as reflected in their perceived or actual performance of the plant, and whether that translates into differential price farmers are willing to pay for these seeds are empirical questions rarely addressed in the literature.

This study is designed to address the following two research questions to fill this evidential gap in the literature:

- For a given improved variety (i.e., keeping the genetics constant), what is the difference in the performance of bean or a cowpea crop across the three seed types – certified, QDS and farmer saved grain when the seeds are planted and managed by farmers under their conditions?
- How does the observed differential performance of different types of seeds translate into farmers' willingness to pay (WTP) for these seeds?

We first describe the methodology and data, followed by the discussion of results and conclusions.

Methodology

Double-blind field experiments (FE) were established in 12 villages in the Hai and Karatu districts (northern Tanzania) and in 10 villages in Binduri district in Upper East Region of Ghana. The fields were used to demonstrate the value of three types of seed quality of bean variety (*Jesca*) in Tanzania and cowpea variety (*Songotra*) in Ghana. These are improved varieties released by the research programs through their respective national variety registration systems and commonly grown by farmers in the study areas. For a given variety, the seed types included in the FEs were certified,[2] quality declared and recycled seeds. These three types of seeds represent different seed quality grades as reflected by their vigor (i.e., germination rate, disease free) and purity—desired traits that contribute to the uniform and successful establishment of healthy seedlings that emerge from the seeds planted. While certified 1 seed is produced using basic (or foundation) seed as planting material, certified 2 seed is produced using certified 1 seed as planting material. In contrast, specialized farmers (trained by research organizations) produce QDS following quality standards similar to certified seed, but without the 'certification' from the government. Recycled seed is the seed that is produced by the farmer as grain (mostly for consumption at home or sold in the market) and saved for use in the following season as planting material or procured from the market as grain. The quality of this type of seed varies greatly as there are no seed quality standards imposed during the production or post-harvest processing stage for this type of seed.

[2] In Tanzania, two categories of certified seeds representing two consecutive generation of seed production (certified 1 and certified 2) were included in the field experiments.

FEs were hosted by farmers and planted using farmers' own land and management practices. Each seed type were procured by the researchers and equal quantities of seeds of each type were given to the host farmers to plant on 10x10m plots (in Tanzania) and 10x20m plots in Ghana. Plots were labeled by alphabets (e.g., A, B, C and D in the case of Tanzania and G, L, and M in the case of Ghana). Neither the farmers' nor the extension agent who helped in the technical supervision knew the identity of the seed types associated with these labels. The reason for doing the FE as a double blind experiment was to reduce any systematic bias on the part of the technical staff or the farmer managing the plot towards or against any pre-conceived higher and lower quality seed type (i.e., the Hawthorne effect). Another reason for the double blind experiments was to reduce any bias farmers as observers may have towards a specific seed type based on their prior personal experience or 'hearsay.' In Tanzania, FEs were established in the 2015 short rain season (July-September) in the Hai district, and in the 2016 long rain season (March to July) in the Karatu district. In Ghana, the FEs were conducted in all the villages in the 2016 cowpea growing season (July-September).

Two field days were held at one FE in each village where farmers from the village were invited to observe the bean and cowpea plots around flowering stage (Field day 1) and around harvest stage (Field day 2). During the field days, each farmer was asked to evaluate the performance of the seed plots on characteristics they considered important, and rate one plot (i.e., seed type) as the best and one as the worst (only on Field day 2).

Once farmers had learned how different types of seeds of a particular variety performed in the field, WTP auctions were carried out during Field Day 2 to elicit information about how much they were willing to pay for these seeds based on the perceived/observed differences in their performance. We followed the Becker-DeGroot-Marschak (BDM, 1964) method, where participants do not bid against other people, but only against themselves. The WTP elicitation mechanism is typically performed using one of two methods – a full bidding or an endow-upgrade method. In this study we used the full bidding method, whereby farmers participated in three auctions (e.g., one for certified seed, one for QD seed and one for recycled seed). Farmers were asked to "bid" their maximum willingness to pay for one kilo of seed for a given type of seed (referred by the labels A, B, C, D in the case of Tanzania, and labels G, L, M, in the case of Ghana) knowing that one of the three or four auctions will be chosen randomly and the bid for that seed would then be compared to a randomly drawn price (from a given revealed range).[3] If the bid is greater than or equal to the randomly drawn price, then the farmer purchased that seed for the randomly drawn price (not their bid). The difference in the bids between the three auctions reveals the premium (or discount) due to the different quality attributes as perceived by the farmer.

About 20-40 farmers from each village (only one per family) that had attended both the field days were given local currency equivalent to about $1.85 (in Tanzania) and $2.6 (in Ghana) as their initial endowment (so they didn't have to bid using their own money). Prior to the seed BDM auction, a practice BDM auction experiment was conducted with a bar of soap (a product that has a readily

[3] The revealed price range for bean seeds in Tanzania was 0 to 3950 shillings (and farmers were allowed to bid at an increment of 50 shillings), and the price range for cowpea seeds in Ghana was 0 to 9.90 cedis (and farmers were allowed to bid at an increment of 0.10 cedis).

apparent valuation) to make sure farmers understood the auction mechanism. Additional small amount of cash ($0.25-0.5) was given to farmers for this practice BDM auction.[4]

Data

A total of 247 bean farmers in northern Tanzania and 269 farmers in northern Ghana participated in both the field days and the bidding experiments. Data from the two field days (i.e., farmer ranking of different plots at the flowering and harvesting stages) in the double blind field experiments and bidding experimental auctions are used to gauge the perception of seed quality differential across the three seed types, and the relative willingness to pay for each type of seed. After the fields were harvested, the extension agents collected the yield data from each plot. In the case of cowpea experiments in Ghana, the seeds used for planting in the FEs and the seeds harvested from these plots were subjected to seed quality tests by sending some samples to a seed testing laboratory. The yield data (for both Tanzania and Ghana) and the seed quality test results (in the case of Ghana) both serve as objective measures of the relative performance of each seed type, and are used to compare the relative difference in quality as perceived and reported by farmers through their subjective rankings.

Data were also collected from all the participating farmers using a structured questionnaire to understand the household and farmer characteristics, and agricultural practices, including their use and experience with different types of seeds.

In the case of Ghana, cost of production and quantity of production data were collected using the record keeping method from two cowpea certified seed producers, 4 QDS producers, and 5 cowpea grain producers. Some of the certified and QDS seed producers also produced cowpea grain, and cost of production data were collected from these farmers for both seed types. Thus, in total, we have data on cost and quantity of production for cowpea grain from 9 farmers. These data are used to estimate the relative difference in the cost of producing three types of cowpea seeds—certified, QDS, and grain, to compare with the relative difference in farmers' WTP for these seed types.

Results

The results of this study will be presented at the conference. Overall, the experiments conducted in Tanzania and Ghana point to three interesting results, which have implications on designing seed systems for legume crops. First, seed quality matters--on average certified seeds consistently outperformed QDS, and QDS outperformed farmer recycled seeds of the same variety. Second, all else equal, farmers are willing to pay premium for quality seeds--the relative difference in Farmers' willingness-to-pay (WTP) for different seed types is correlated with the relative difference in their perceived quality differences. Third, results confirm the downward sloping demand curve for quality seed—the number of farmers willing-to-pay a premium price for quality seed declines as price of

[4] In Tanzania, farmers were given 4000 Shillings as endowment for the seed BDM and 500 Shillings for the practice BDM). In Ghana, farmers received 10 Cedi as endowment for the seed BDM and 2 Cedi for the practice BDM. The exchange rate from 1 US$ to local currency at the time of these experiments was about 2100 Tanzanian Shillings and 3.8 Ghanaian Cedi.

seed increases. The implication of these findings is that there is no one-size-fits-all strategy to meet the seed needs of all the farmers. The strategy should be built on multi-pronged approaches based on subsidies to meet the needs of farmers on the lower end of the WTP spectrum, private sector based approaches to meet the needs of farmers on the higher end of the WTP spectrum, and alternative models based on in-kind subsidy and not-for-profit seed production models for farmers in the middle ranges.

Further research is needed to assess the quantity and frequency of seed farmers would be willing to purchase at a premium price to gauge the size of the demand.

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