



Adoption Pathways project Policy brief No. 1/2015

Men's and Women's Risk Preferences: Evidence from the Adoption of Maize Technology in Kenya

Abby Love, Nicholas Magnan, and Gregory J. Colson

Background

New agricultural technologies are constantly being developed with the goal of improving the livelihoods of rural households and communities in developing countries. To have impact, however, such technologies need to be adopted. The decision of whether or not to adopt new technologies involves a complex set of factors, including the decision-maker's wealth status, education levels, access to information, ability to obtain credit, and—importantly—attitude toward risk. Farmers depend on the success of their crops both for consumption and for income, so uncertain returns on technological investments make the decision to change technologies—such as switching from a local maize variety to a high-yielding, but costly hybrid—an inherently risky one. Moreover, because developing-country farmers rarely have formal insurance or savings to fall back on, agricultural production failures can have dire and long-term consequences. A number of studies have tied risk preferences to technology adoption, but the study on which this policy brief is based was, to the authors' knowledge, the first to explore potential differences in how men's and women's risk preferences influence technology adoption.

Introduction

Agriculture employs over 70 percent of Kenya's population, particularly in rural areas, and accounts for 51 percent of the country's gross domestic product. Maize is also the staple of the Kenyan diet, particularly in rural areas. Kenyan farmers have adopted a number of improved varieties, but maize production is still in the mid-range, overall, compared with its East African counterparts. During 2000–2012, the average yearly maize yield in Kenya was 1619 kg/ha compared with 2,145 kg/ha in Ethiopia, 1,554 kg/ha in Tanzania, 3,537 kg/ha in South Africa, and 9,157 kg/ha in the United States for the same time period. Clearly, Kenyan maize production has room for yield improvement.

Hybrid maize seeds are produced by cross-breeding male and female plants from separate lines to produce seed with greater vigor, which promotes higher yields; the costs associated with hybrids are higher, however, and to maintain their vigor hybrid seed must be purchased each season.

The study on which this policy brief is based evaluated households' choice between nonhybrid maize varieties (that is, local or "improved" seed) and hybrid ones. In rainfed environments, using hybrid maize can be very risky. Hybrid seed is expensive, and it performs best with the use of costly fertilizer. Under these circumstances, unless there is sufficient rain, farmers will incur substantial losses. Some hybrid seed, however, is conceived specifically to help farmers manage their risk by achieving good yields under moderate drought conditions. The arid east of Kenya has had eight notable droughts in the

past 15 years, making drought-tolerant hybrids extremely relevant for that region. Rain is more prevalent in the west, but in that region maize is susceptible to gray leaf spot, a fungus that thrives under moist, warm conditions. So a different set of hybrids has been developed to deal with this risk in Kenya. As a result, farmers in both the arid east and the dry west must choose among high-yielding hybrids, risk-reducing hybrids, and status quo local varieties—a decision in which risk preferences stand to be in an important factor.

Survey and data

Household data were collected between September and November 2013 in five districts in Kenya as a part of the Adoption Pathways Project, a collaboration between the International Maize and Wheat Improvement Center (CIMMYT); Australian Centre for International Agricultural Research (ACIAR); and researchers in Ethiopia, Kenya, Malawi, Mozambique, and Tanzania. The purpose of the project was to accelerate demand-driven research and the delivery and adoption of innovations to improve food security. In Kenya, the team purposefully chose five districts to represent market differences and accessibility (Embu, Meru, and Tharaka Nithi in the East, and Bungoma and Siaya in the West). Within these districts, administrative divisions, villages proportional to the size of the division, and households were randomly chosen.

Survey data were then combined with data from a field experiment conducted shortly after the survey. Households fell into two categories: (1) male-headed households in which husbands were

*In rainfed environments, using hybrid maize can be a very risky; however, **some hybrid seed is conceived specifically to help households manage their risk**; in Kenya, hybrids have been developed that are tolerant to drought and resistant to grey leaf spot.*

identified as the primary decision-maker and wives as the secondary decision-maker, and (2) female-headed households, where the head (whether single, widowed, or separated/divorced) was the sole decision-maker. The survey encompassed questions about on-farm production, input use, yields, and technology choices; household demographics; seed and other input use at the plot level; and the management of household plots. After the household survey had been conducted with the household head, individual surveys were conducted concurrently with both the male household head and his wife in order to encourage honest responses. In female-headed households, the household head answered both surveys. The individual survey contained questions related to savings, group

membership, leadership, household decision-making, and asset ownership. Data from both these surveys were used to estimate the effect of men's and women's risk preferences on the adoption of maize technology at the plot level. The sample comprised 540 households and 802 primary, secondary, or sole household decision-makers.

In December 2013, enumerators experimentally elicited risk preference parameters (Box 1) from the same two categories of households that had completed the individual surveys—that is, male-headed, dual decision-making households (only including households where both the husband and the wife had completed the earlier individual surveys) and female-headed, sole decision-making households. This final sample had 172 households and 304 decision-makers.

Box 1. Risk aversion, loss aversion, and nonlinear weighting probability

The study's experimental methodology drew from prospect theory, which defines an individual's risk preferences according to three parameters: risk aversion; loss aversion; and nonlinear probability weighting.

- **Risk aversion** involves the degree of risk a household is willing to incur in making agricultural production and other decisions. Numerous studies have found correlations between gender and risk aversion, with men being repeatedly associated with lower risk aversion. Reasons for this cited in studies include differing emotional reactions to uncertain outcomes, differences in confidence levels, and different interpretations of uncertain situations. Female household heads are often more risk-averse because they tend to have greater resource constraints (for example, savings, and income-earning opportunities); they may have greater time constraints, for example, in performing household duties and caring for children; and they may have fewer options in the event of negative events, such as a drought or illness of a family member.
- **Loss aversion** measures how individuals react toward potential losses compared with potential gains; loss-averse individuals dislike a loss more than they like a gain of equal size.
- **Nonlinear probability weighting** occurs when individuals overweight small probabilities, typically by perceiving a very unlikely negative event to be more likely than it is; as a result, these individuals place a premium on outcomes they consider to be certain.

Results

Based on individuals' decisions in the "virtual lottery" (see Box 2), a value for the three risk parameters was estimated. Many respondents in the sample exhibited extremely high levels of risk aversion and were either extremely loss-averse or barely loss-averse. On the whole, respondents also slightly overweighted small probabilities. Husbands and wives within the same households and across the sample of male-headed (that is, dual decision-maker) households exhibited no significant differences in their risk preferences, loss preferences, or probability weighting. The women in the female-headed (that is, sole decision-maker) households, however, were significantly more loss-averse than the women (and men) in the male-headed households. One possible explanation for this finding is that women in female-headed households are generally more resource-constrained and lack the support and security of a partner and second income generator.

Box 2. Experimental methods for determining risk parameters

Participants were asked to make several series of choices between two options in a "virtual lottery," whereby the potential payout of the riskier choice (Option B) incrementally increased throughout each series. Initially, for example, Option A involved a 70 percent probability of recipients receiving 110 Kenyan shillings (KSH) and a 30 percent probability of their receiving 440 KSH, while Option B involved a 90 percent probability of recipients receiving 55 KSH and a 10 percent probability of their receiving 920 KSH. Progressing through the series of choices, the percentages remained unchanged, but the expected value of Option B incrementally increased, eventually surpassing the expected value of Option A. Hence, more or less risk-averse decision-makers were identified based on the point at which they decided it was worth the risk to switch from Option A to Option B. Similarly, to estimate loss aversion another series of choices contained both gains and losses; once again, more or less loss-averse decision-makers were identified based on the point at which they decided to switch from Option A to Option B. Participants were paid 200 KSH with certainty, and won additional money based on their responses to the other series; hence, the choices were not purely hypothetical but translated into actual risks and benefits. More details on the methodology can be found in T. Tanaka, C. Camerer, and Q. Nguyen, 2010, "Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam" *American Economic Review* 100 (1): 557–571.

While men's and women's risk preferences did not differ on average, they did have different effects on the sample households' choices of maize seed. Generally, women's preferences were more correlated with seed choices than were men's. In male-headed households, men's risk preferences did not significantly influence the choice of maize technology. Among these households, women's loss aversion decreased the probability that the household would adopt a risky, high-yielding variety. Risk aversion and probability weighting did not play a significant role for either men or women. The analysis of results for female-headed households presented a different story. Risk-averse female household heads were more likely to adopt a stress-tolerant hybrid and less likely to adopt a high-yielding hybrid. Loss-averse female household heads were also less likely to adopt a high-yielding variety. These results are both very intuitive. Somewhat perplexingly, however, female household heads who overweighted small probabilities (for example, the probability of a drought or a grey leaf spot infestation) were *less* likely to adopt a stress-tolerant hybrid. This could be because they perceived the main source of uncertainty to be the varieties' *effectiveness* in mitigating the stress rather than the occurrence of the stress itself.

Given that the stresses and varieties targeting them differed by region, results for the east and west were analyzed separately; in addition, the low sample size of female-headed households meant that this regional analysis could only be applied to the male-headed households. In the arid east, once again, men's preferences were not significantly correlated with adoption decisions, but women's preferences were. If wives were risk-averse, households were less likely to adopt a high-yielding hybrid variety. Similarly, if wives were loss-averse, households were less likely to adopt a high-yielding hybrid variety. And where wives overweighted small probabilities, households were more likely to adopt a drought-tolerant hybrid. In the west, none of the risk parameters for either the men or the women were significantly correlated with their choice of maize seed. This could be because grey leaf spot is only one of a number of risks associated with humidity, so hybrid seed resistant to that particular stress may not be appropriate.

It may seem surprising that men's risk preferences were completely uncorrelated with outcomes, whereas the reverse was the case for women. It could be that men did not take the game seriously. One criticism of experimental approaches like this one is that participants make decisions differently than they do in real life, for example, taking larger risks in the desire to "play"; however, because men did not exhibit less risk aversion than women overall, that is unlikely to be the case. Regardless of whether or not men took the game seriously or provided answers that reflected their real life decision-making processes, the most interesting results of this study lie with the women. Clearly, women's risk preferences matter. This is particularly true in the results for female-headed households and in the drought-prone eastern region of Kenya.

Policy Implications

The study on which this brief is based shows that women's risk preferences matter in household decisions on the choice of maize seed. This is true for both female-headed and male-headed households, indicating, overall, that women's opinions matter. It is therefore important for agricultural extension services to reach out to both men and women to inform them of the properties of various seeds and other technologies so they can make informed decisions. These results also suggest that marketing risk-

If wives were risk-averse, households were less likely to adopt a high-yielding hybrid variety. Similarly, if wives were loss-averse, households were less likely to adopt a high-yielding hybrid variety. And where wives overweighted small probabilities, households were more likely to adopt a drought-tolerant hybrid.

mitigating products like insurance to women could be a way to increase adoption. More research on this topic could explore the role of bargaining power in the (relative) importance of women's preferences, and test interventions designed to increase the adoption of hybrid maize varieties and the uptake of insurance and other products specifically targeting women.

This brief is based on Love, A., Magnan, N., and Colson G. J. (2014). "Male and Female Risk Preferences and Maize Technology Adoption in Kenya," a selected paper prepared for the Agricultural and Applied Economics Association's Annual Meeting held in Minneapolis, Minnesota, July 27–29, 2014.

Contact: Nicholas Magnan – nmagnan@uga.edu