Risk Aversion and Adoption of Conservation Agriculture Practices in Eastern Uganda

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SANREM INNOVATION LAB

The issue

The Green Revolution increased agricultural productivity in numerous countries, especially in Asia and Latin America. However, not all countries were able to capitalize on the improved farming technologies. Uganda for example still has over two thirds of its labor force working on farms and yet remains a net food importer. One theory as to why countries like Uganda have not capitalized on higher yield technologies is that the poor are too risk averse to invest in high-risk, high-return investments. Poor farmers continue to farm with their old proven techniques and do not capitalize on farming innovations in order to avoid production risk.

Conservation agriculture practices (CAPs) may help increase food production, decrease labor needs, and provide environmental benefits such as soil retention and carbon sequestration. Practices such as minimum tillage, cover crops, and beneficial crop rotations have the potential to increase soil fertility and slow soil erosion. These CAPs also sequester carbon by increasing the organic matter in the soil. Many farming techniques can deplete the soil's quality over years of use, lowering future yields. The development and spread of CAPs, especially in developed countries and on larger farms in developing nations, have demonstrated their potential benefits in recent years.

Is risk aversion a issue that needs special attention among the poor?

Michael Lipton (1968) argued the poor are more risk averse because they are living close to starvation and a little loss could cause catastrophic harm. Lipton assumed people living close to starvation and without explicit safety nets will be forced to do things like sell their land and other valuable assets or hire themselves out as indentured servants if a catastrophe strikes. Lipton concluded that poor farmers in less-developed countries are risk averse and the policies and interventions in agriculture need to take that into account.

Hans Binswanger (1980) was the first of a few economist to empirically test if Lipton's hypothesis was valid. Binswanger offered lotteries of varying risk to farmers in India to see if wealthier farmers with more assets to smooth consumption were less risk averse than poorer farmers. Although Lipton's argument seems logical Binswanger's research could not find any correlation between wealth and risk preferences.

Since Binswanger's time, a few economists have replicated his research; some have found similar results, some have found that poorer farmers are more risk averse than wealthier farmers. Binswanger (1980), Mosley & Verschoor (2005), and Cook (2011) have not found a significant correlation between risk preferences and wealth. However, Wik et al. (2004) and Yesuf & Bluffstone (2004) found a significant negative correlation between risk aversion and wealth, concluding that poorer farmers are more risk averse. The problem with risk aversion and wealth being negatively correlated is that poor risk-averse farmers might not invest in innovations that yield higher returns due to higher risk. Risk aversion might create a vicious cycle of poverty in which people stay in poverty due to their choices to avoid high-risk, high-return investments. Yesuf and Bluffstone also found that previous success reduced a respondent's risk aversion. These findings suggest that escaping poverty may require or at least be greatly helped by intervention in risk mitigation.

Methods

This research was carried out in two districts of eastern Uganda were SANREM has test plots: Tororo and Kapchorwa. 200 farmers were randomly chosen in each district and one-on-one interviews were carried out by trained enumerators on the respondents' farm.

Risk Measurement

The respondents' risk preferences were measured with a hypothetical ordered lottery selection where lottery options A-F were laid out on a concave risk frontier. Lottery A was a completely safe one with the same payout for winning or losing. Lotteries B-E had higher expected yields and higher variances. Farmers 'pay' for the higher expected yield by taking on more risk. Lottery F increased the variance while keeping the expected yield equal to the fifth choice; this option added the 'cost' of more risk without a higher payout. The respondent chose the lottery with the expected yield and risk combination that gives them the highest utility. Each lottery gave a 50/50 chance of a bad harvest or a good harvest to make the math easier and pictures were used since there was some illiteracy. The two regions were given different lotteries because the lotteries were based as close to actual yields as possible to decrease hypothetical bias. The two tables below give information about each lottery and you will notice that Kapchorwa harvests are significantly higher Due to their expectations of high yields in that area.

Tororo Ordered Lottery Selection

Lottery Option	E (Yield)	Variance	Risk Aversion Classification	Partial Risk Aversion	$\frac{\Delta E(yield)}{\Delta Variance}$
A	4.5	0	Extreme	∞ to 6.244	1 to .6
B	5.25	1.25	Severe	6.244 to 1.674	.6 to .5
C	5.75	2.25	Intermediate	1.674 to .720	.5 to .33
D	6	3	Moderate	.720 to .190	.33 to .14
E	6.25	4.75	Slight to Neutral	.190 to 0	.14 to 0
F	6.25	6.25	Neutral to Negative	0 to $-\infty$	0 to $-\infty$

Kapchorwa Ordered Lottery selection

Lottery Option	E(Yield)	Variance	Risk Aversion Classification	Partial Risk Aversion	$\frac{\Delta E(yield)}{\Delta Variance}$
A	15	0	Extreme	∞ to 5.649	1 to .73
B	20.5	7.5	Severe	5.649 to 1.419	.73 to .6
C	23.5	12.5	Intermediate	1.419 to .55	.6 to .33
D	24	14	Moderate	.55 to .274	.33 to .2
E	24.5	16.5	Slight to Neutral	.274 to 0	.2 to 0
F	24.5	18.5	Neutral to Negative	0 to $-\infty$	0 to $-\infty$

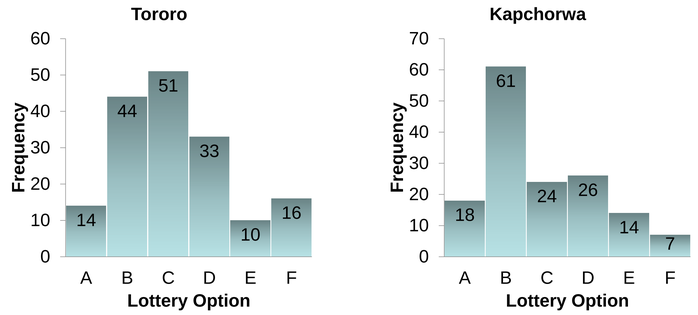
In the above tables the first column names each lottery option A-F, the second and third column give the mean and variance of that lottery. The fourth column gives a qualitative classification that corresponds to that lotteries level of risk. The fifth column gives a partial risk aversion (PRA) PRA coefficients are unit free and can be compared to other studies in different currencies and different scales. The last column gives a 'price' by dividing the expected yield by the variance. The 'price' is simply the slope between the lotteries graphed in yield/variance space and gives the tradeoff between yield and risk in an eastern Ugandan farming context.

Demographics of Interest

Wealth was stratified by those who have corrugated iron roof and those who have grass roofs. To test Yesuf and Bluffstone's theory that the poor are path dependent and need small guaranteed successes to gain the confidence to adopt innovations on their own, this study asked respondents about previous successful and unsuccessful innovations as well as crop failures. Ugandans who primary income comes from off-farm could be less risk averse due to their ability to smooth consumption when farming activity fails.

Results

Below are two histograms showing the frequency of lottery chosen in each district. Tororo which is lower, flatter and drier appears less risk averse with most people choosing an intermediate lottery. The people in Kapchorwa which is steeper and gets more rainfall primarily chose the severely risk averse lottery.



An ordered probit was estimated for each region and none of the attributes of interest were found to be different than zero at a 10% significance level.

Tororo Estimates

Variables	Coefficient	P value
Gender	-.04	.812
Age	.021	.46
Age Squared	0	.593
Education	.015	.841
Over Half Income	.296	.17
Crop Fail	.535	.518
Successful	.513	.609
Unsuccessful	-.2	.126
Roof	-.184	.416
Log Likelihood	-271.026	
Pseudo	.011	
Observations	168	

Kapchorwa Estimates

Variables	Coefficient	P value
Gender	.147	.440
Age	.03	.420
Age Squared	0	.330
Education	-.065	.458
Over Half Income	-.174	.626
Crop Fail	-.646	.392
Successful	.402	.609
Unsuccessful	.146	.890
Roof	.17	.370
Log Likelihood	-234.619	
Pseudo	.011	
Observations	150	

Conclusion

This study used self-reported previous successful and unsuccessful innovations and found that people are not more willing to take on risk when they have had previous success, as suggested by Yesuf and Bluffstone. Lipton's argument that the poor living in fear of a catastrophe that will cause irreparable harm are inherently more risk averse seems logical, but the research here does not support it. This research does not find any trends that show as farmers get wealthier their tolerance for risk changes.

In Kapchorwa erosion is a problem and CAPs can help slow erosion. However, they may be slow to adopt an entirely new farming system due to their severe risk aversion. In Tororo risk aversion may not be as big a problem but CAPs offers them less benefits. Therefore, adoption could be slow in both districts. Risk aversion is not innate to poverty, rather adoption of CAPs will likely depend on the quality of information about the benefits and costs CAPs offers to the Ugandan farmers.

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