Adoption of Improved Seed, Varietal Diversity and their effects on Maize Productivity in Kenya

Brian Chiputwa[1], Genti Kostandini[2] , Olaf Erenstein[3] and Girma T. Kassie[4]

[1]*GlobalFood Program, Department of Agricultural and Rural Development , University of Göttingen, Germany*
[2]*Department of Agricultural and Applied Economics, University of Georgia, Athens, Georgia. 30602.*
[3]*International Maize and Wheat Improvement Center (CIMMYT), Addis Ababa, Ethiopia*
[3]*International Maize and Wheat Improvement Center (CIMMYT), Harare, Zimbabwe*

Selected Poster prepared for presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013.

Adoption of Improved Seed, Varietal Diversity and their effects on Maize Productivity in Kenya

Brian Chiputwa[1], Genti Kostandini[2] , Olaf Erenstein[3] and Girma T. Kassie[3]

[1]*GlobalFood Program, Department of Agricultural and Rural Development , University of Göttingen, Germany*
[2]*Department of Agricultural and Applied Economics, University of Georgia, Athens, Georgia. USA.*
[3]*International Maize and Wheat Improvement Center (CIMMYT)*

1. Introduction

- Production risk in Agriculture is a prominent threat to farmers' livelihoods.
- Factors contributing to production risk and uncertainty include adverse weather, input and output prices, pests and diseases.
- In most developed countries systems are in place to cushion farmers from against risk exposure e.g. crop insurance and futures markets.
- Due to imperfect and incomplete markets in developing countries, farmers manage risk by controlling levels of input use like land, fertilizer, and seeds.
- Seed management can involve adoption of improved varieties or growing multiple varieties simultaneously.

Figure 2. Maintaining Intra-crop diversity

Figure 1. Use of Improved varieties

2. Objectives

Main objectives of this paper.:

- To estimate the effects of improved varieties and maize diversity on the three moments of production (mean, variance and skewness).
- To draw insights on how improved seeds and maize diversity affect exposure downside risk by maize farmers.

3. Methodology

- A multi-stage random sampling was used to select 349 households in Machakosi and Makueni districts in Kenya.
- A structured questionnaire was used and survey districts are classified in the 20-40% medium drought risk zone
- For full survey details, refer to Muhammad et al. (2010).
- The surveys were conducted by the International Maize and Wheat Improvement Centre (CIMMYT) under the Drought Tolerant Maize for Africa (DTMA) initiative and supported by the Bill & Melinda Gates Foundation and Howard G. Buffet Foundation.

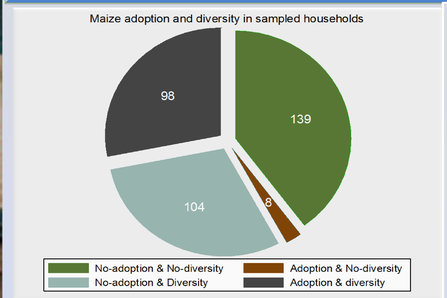
3. Methodology

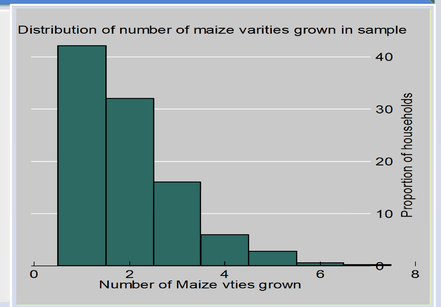
- To express maize diversity, we use the Margalef Index calculated as follows:

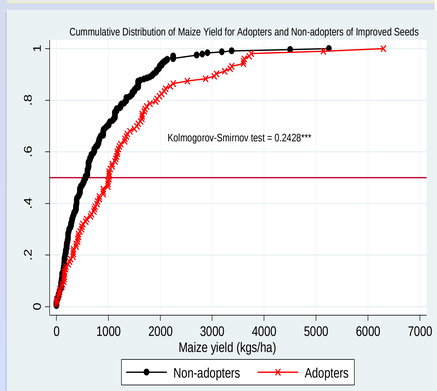
$$M_i = \frac{S_i - 1}{\ln N_i}$$

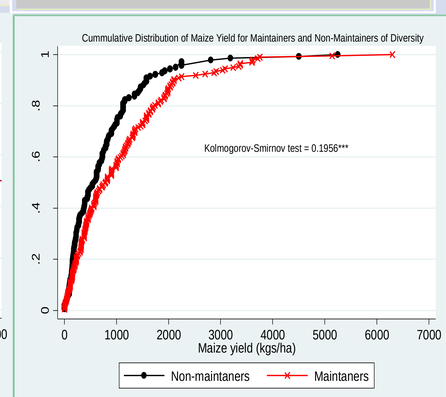
- Where M_i =Margalef Index, S_i = # of maize varieties & N_i = Area under maize
- We used a Generalized Method of Moments (GMM) to generate the three moments of maize production (Mean, Variance and Skewness).
- We then used a Three Stage Least Squares Regression to model the effects of improved varieties and diversity on the three moments.

4. Results & Discussion









Descriptive Statistics

- Farm households grow between 1 and 6 varieties simultaneously
- Based on the cumulative distribution function (CDFs), maize yield for adopters of improved seed is generally higher than that of non-adopters.
- Similarly, farms growing multiple varieties have higher yields compared to farms growing single varieties.

Three Stage Least Squares Regression Results

Independent variables	Mean function	Variance function	Skewness function
Fertilizer (kg)	0.159***	-0.0486***	-0.123***
Area (acres)	0.487***	-0.0372***	-0.481***
Total Livestock Unit(TLU)	0.0803***	-0.00740**	0.310***
Use of Manure (dummy)	0.0528	-0.0317**	-0.0153
Number of plots	-0.0219	-0.00251	-0.0838
Household size	-0.150***	0.363***	-1.780***
Household head age (years)	0.00408***	-0.000216	0.0138***
Altitude (m)	-0.00103***	0.000236***	-0.00249***
Low rainfall (dummy)	0.000254	0.0119	-0.0508
Diversity (Margalef index)	-2.933***	0.945**	-6.699**
[a]Diversity x altitude	0.00181**	-0.000595**	0.00388**
[a]Diversity x low rainfall	0.518**	-0.111	1.555**
Improved seed (predicted values)	0.165***	-0.0222	0.435***
Constant	7.757***	0.19	4.960***
Observations	332	332	332
R-squared	0.868	0.751	0.689

Significance level: *** =1% and ** =5% Source: DTMA Survey data
[a]Interaction terms

Econometric Results:

- **Mean function**: Land, fertilizer and improved seed have the greatest positive influence on mean yields,
- **Variance function**: Variables *household size*, *altitude*, and *diversity* contribute to the highest variability with elasticities of 0.39, 0.34 and 0.11, respectively.
- **Skewness function**: Higher maize diversity and farm altitude both negatively in their linear form, both increase farmers' exposure to downside risk.
  - However, high levels of maize diversity in areas of higher altitude and low rainfall reduces farmers' exposure to downside risk.
- Use of Improved seeds also reduces exposure to downside risk.

5. Conclusions

Use of improved seeds and growing multiple varieties (especially in higher altitudes and low rainfall areas) both leads to higher yields and can be used as a risk coping strategy to reduce crop failure in drought-prone areas.

Poster prepared for presentation at the Agricultural & Applied Economics Association's 2013, AAEA & CAES Joint Annual Meeting, Washington DC, August 4-6, 2013

Contact information: Brian Chiputwa **Brian.Chiputwa@agr.uni-goettingen.de**