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## Introduction

- Market-oriented economic and policy reforms in Kenya have been aimed at spurring agricultural transformation
- Increasing urban population and rural population densities
- Climate change has led to increased incidences of rainfall stress
- Many rural households are diversified in crop, agricultural and livelihoods
- How has this influenced household maize security situation in rural Kenya

## Objectives

To determine the welfare effect of crop, agricultural and livelihood diversification on rural smallholder household food security in the presence of rainfall stress

- Determine the effect of smallholder diversification on rural household maize security in the presence of rainfall stress and policy reforms
- Examine heterogeneity in household maize security between land rich and land-poor

## Method

### AR(1) Dynamic Panel Data Model

$$y_{it} = \alpha y_{i,t-1} + \beta' x_{it}^* + \eta_i + v_{it} \\ = \theta x_{it} + \eta_i + v_{it}$$

### Empirical model

$$FS_{it} \\ = FS'_{i,t-1} \alpha + X'_{it} \beta + D'_{it} \varphi + \omega'_{it} \delta + \pi'_{it} \sigma + \eta_i + v_{it}$$

### Diversification Index

$$D_{it,k} = 1 - \sum_{a=1}^N (S_{at,k})^2, and \\ \sum_{a=1}^N (S_{at,k}) = 1$$

## Marginal effect of smallholder diversification

$$\frac{\partial W}{\partial D} = \varphi + + \omega' \sigma$$

## Data

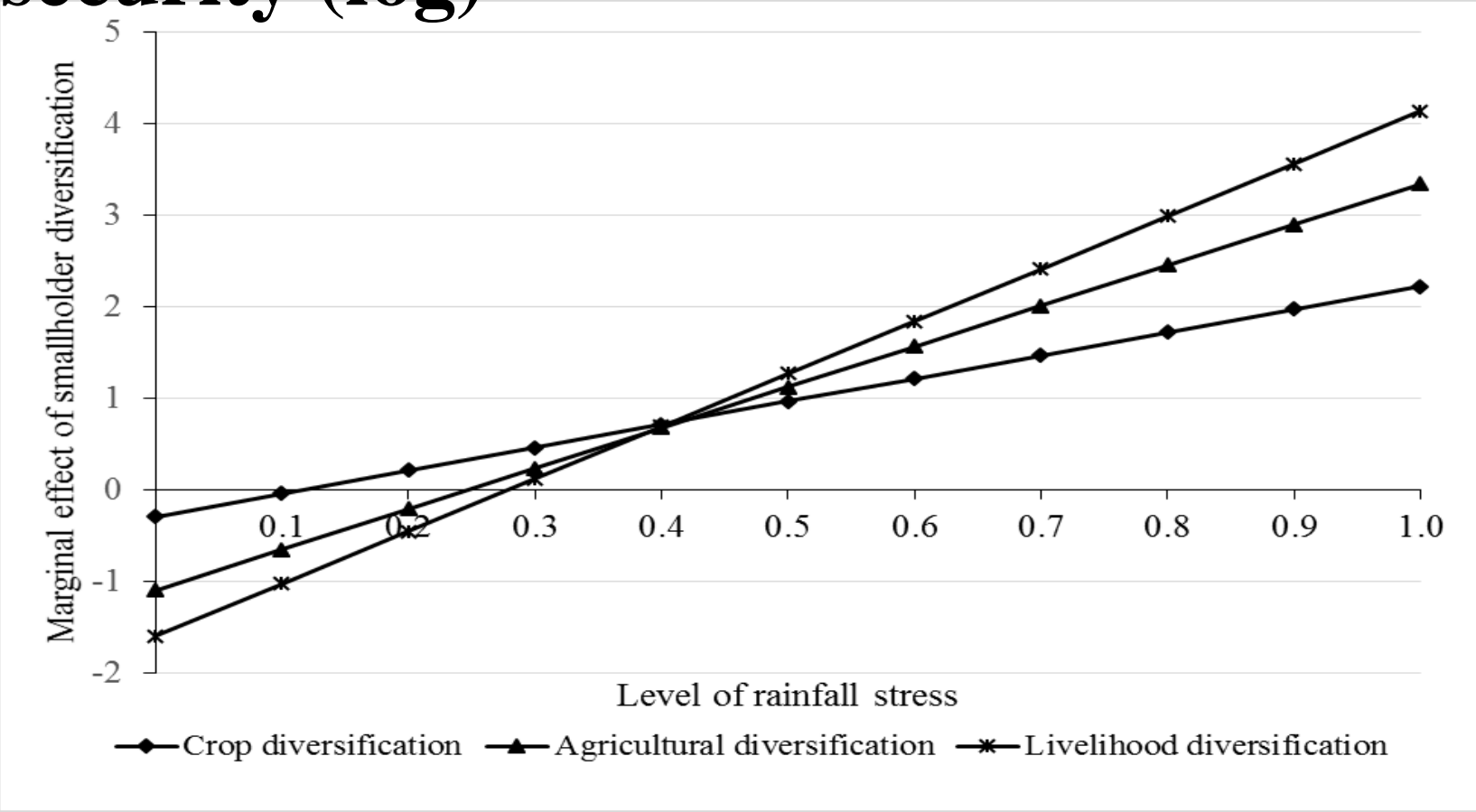
- Four-period household panel data of 1,243 rural farm households, 2000 – 2010
- Rainfall data 1999 -2010

## Results

### DPD regression of effect of smallholder diversification on maize security

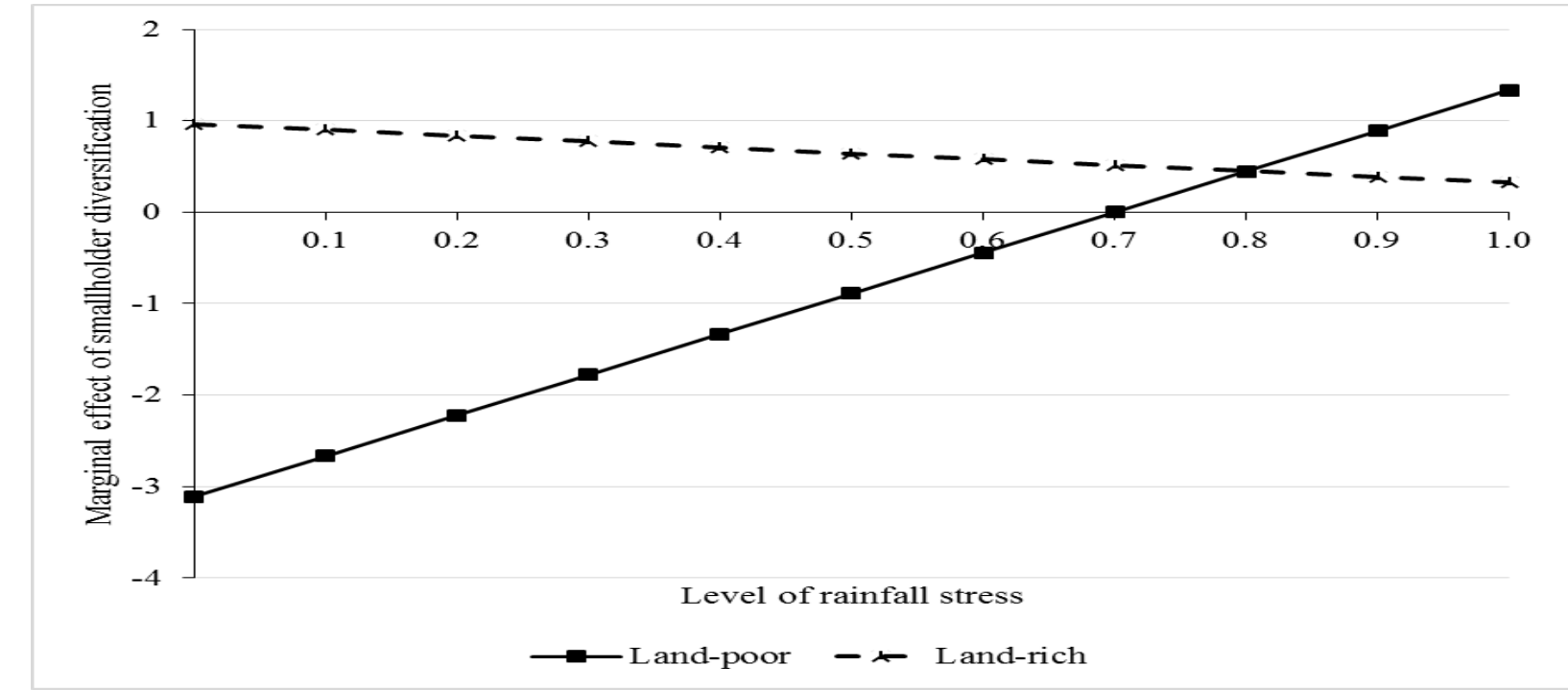
VARIABLES	Model with		
	Crop diversification	Agricultural diversification	Livelihood diversification
Lagged log of maize calories (kcal/day/ae)	0.0063 (0.0057)	0.0033 (0.0063)	0.0071 (0.0064)
Log of acreage cultivated (acres)	0.1821** (0.0778)	0.2209** (0.0872)	0.2214** (0.0905)
Log of Maize acreage (acres)	0.1424*** (0.0354)	0.1682*** (0.0408)	0.1369*** (0.0411)
Log of real household net assets (Ksh/ae)	0.1113** (0.0446)	0.0969* (0.0513)	0.1341** (0.0527)
Log of real household income (Ksh/ae)	-0.2391* (0.1277)	-0.3889** (0.1524)	-0.3041** (0.1452)
Crop commercialization index	1.2112*** (0.3385)	1.2762*** (0.3262)	1.0274*** (0.3366)
Rainfall stress	-1.4382** (0.7302)	-2.7352** (1.0916)	-3.6054*** (1.2268)
Diversification index	-0.2938 (0.3913)	-1.0968* (0.6008)	-1.6009** (0.6816)
Rainfall stress * diversification index	2.5146** (1.1061)	4.4332*** (1.5947)	5.7321*** (1.8539)
Log of main season total rainfall (mm)	0.0184 (0.0628)	0.0510 (0.0695)	0.0359 (0.0715)
Gender of household head (1=male)	-0.1152 (0.0893)	-0.1619 (0.0999)	-0.1671 (0.1045)
Age of household head (years)	0.0042 (0.0039)	0.0045 (0.0041)	0.0067 (0.0045)
Education level of household head (years)	-0.0062 (0.0063)	-0.0028 (0.0068)	-0.0032 (0.0068)
Household size	-0.1620*** (0.0188)	-0.1777*** (0.0213)	-0.1681*** (0.0211)
Year > 2004	0.0462 (0.0440)	0.0315 (0.0475)	0.0090 (0.0490)
Constant	5.7188*** (0.7555)	6.7048*** (1.0068)	6.6281*** (0.9689)
Number of obs	2,826	2,826	2,826
Number of households	1,032	1,032	1,032

## Marginal effect of smallholder diversification on household maize security (log)



- At lower rainfall stress levels, crop diversification enhances hh maize security than agricultural or livelihood diversification
- At higher rainfall stress, livelihood diversification enhances hh maize security
- At stress levels =40%, no difference in the effect of crop, agricultural or livelihood diversification on hh maize security

## Heterogeneity in the marginal effect based on land size



## Conclusions

- Smallholder diversification may be a strategy to mitigate household maize insecurity in the presence of rainfall stress
- Hence need for better rainfall forecasting