16b. The Use Of Fertilizer And Its Impact On Productivity In Northern Ghana

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Maxime Salin-Maradeix is a second-year graduate student completing a Master's in Agricultural Economics at K-State. He has graduated, early in the summer 2015, from the EI Purpan where he got a Master degree in Agricultural Engineering. He has been working, as a Graduate Research Assistant for Dr. Amanor-Boadu in K-State, on the fertilizer use in Northern Ghana. This research work is part of the Feed the Future Initiative monitored by METSS-Ghana in which K-state is an active member. Maxime's main areas of interest are strategic decisions and implementation of agricultural development projects.

Abstract/Summary

The purpose of this study is to gain a better understanding of how fertilizer affects the variation in productivity among smallholder farmers in northern Ghana. A two-part model is estimated and it takes into account several factors affecting producer's decision such as main crop and seed selection, irrigation, managerial decisions, and education. The results of this study lead to some recommendations in order to improve the use of fertilizer in Northern Ghana.

Factors affecting fertilizer use: The Evidence from northern Ghana

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Outline

- Motivation
- Background
- Method
- Results
- Implication
- Conclusions

Motivation

Fertilizer use

- Direct impact on crop yield
- Results observed in a cropping season

Agricultural productivity

- Smallholder farmers' profit increases
- Poverty reduction
- Food security

Background Ghana

- Area: 92,099 sq mi
- Population: ~ 27 million
- Inequality north vs. south:
  - ➢ Resources concentrated in the south
  - ➢ Poverty in 2010:
    - decreased by 10% in south
    - increased by almost 20% in north

Source : http://www.timeforkids.com/destination/ghana/sightseeing [accessed 04/08/2015]

Agricultural Situation in Northern Ghana

- Agricultural activity: ~ 70% in North
- Poor soil quality
- Very low chemical fertilizer use:
  35 Kg/ha on average (MoFA, 2011)

Research Question

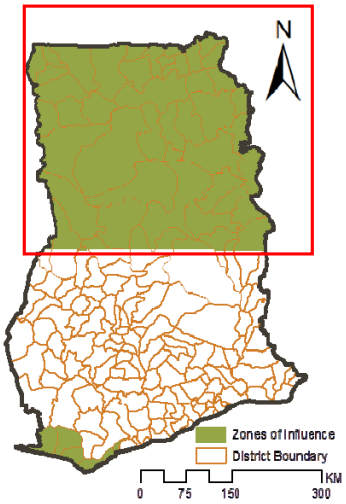
What factors affect the decision to use chemical fertilizers in northern Ghana?

Data

- 2 datasets used collected by USAID|Ghana:

1. Population Based Survey (PBS) 2012
   - Sample size: 4,410 households (in 25 districts)

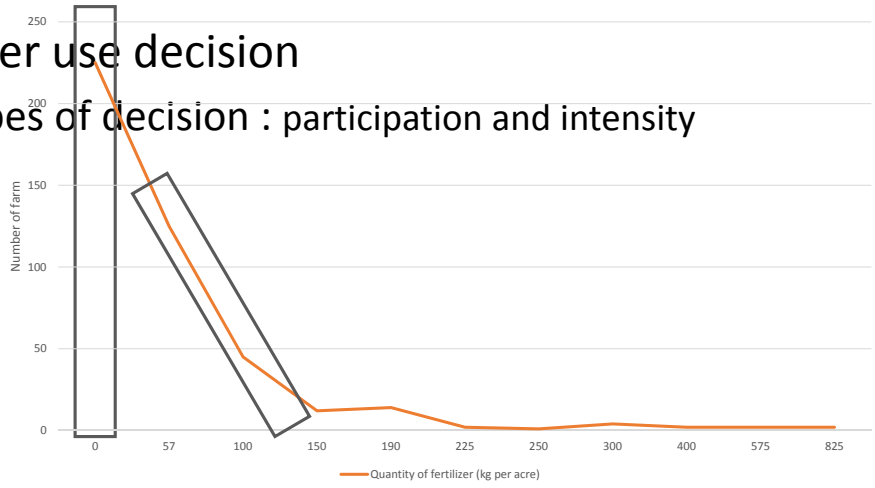
2. Agricultural Production Survey (APS) 2013
   - Sample size: 527 households
   - Focused on: maize, rice and soybean



Distribution of fertilizer use in northern Ghana

Fertilizer use decision

➢ 2 types of decision : participation and intensity



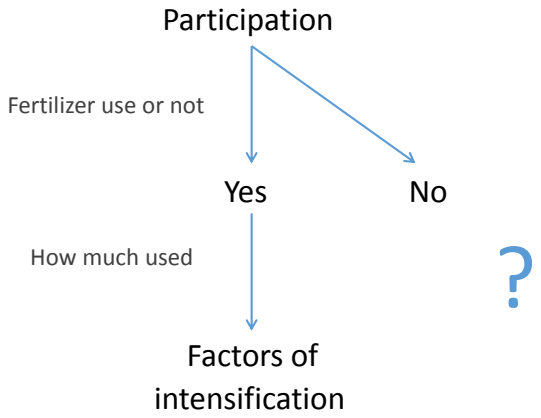
Model

Participation decision: $Y = \alpha Z + \beta F + \gamma M + \varepsilon$

Intensity decision: $I = \alpha' Z' + \beta' F' + \gamma' M' + U$

- Z and Z': vectors of demographic variables
- F and F': vectors of production variables
- M and M': vectors of market variables
- U and ε: error terms
- $\alpha, \beta, \gamma, \alpha', \beta'$ and γ': parameters

Two Step Decision

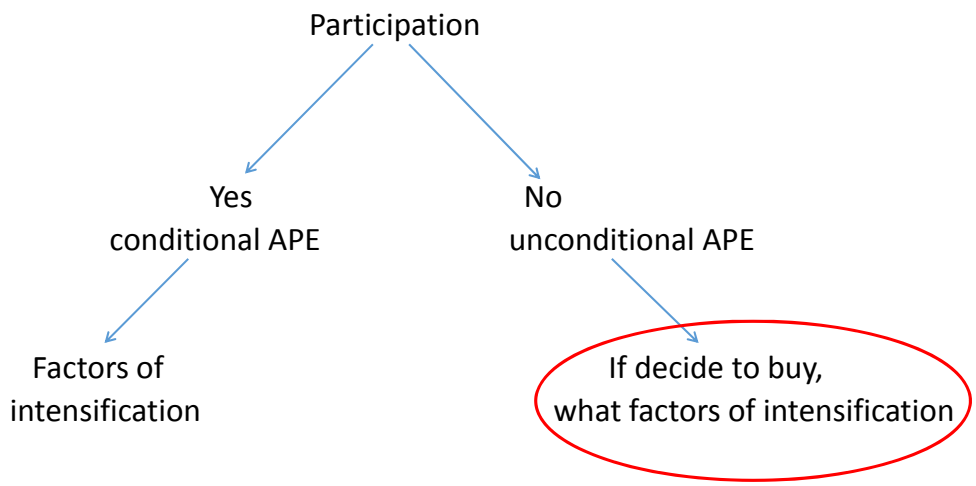


Estimation Method

Type II Tobit Model	Double-Hurdle Model
Probit – Tobit	Probit – Tobit
• Error terms can be dependent • Allows negative outcomes	• Error terms independent: variables can affect participation and amount decisions differently • Truncated normal distribution: outcome never negative

Double Hurdle Approach

- Average Partial Effect (APE):



Summary Statistics: Demographic Variables

Variable name	Obs.	Average	Standard deviation	95% confident interval	
Quantity of chemical fertilizer applied (kg per acre)	416	57.2	91.3	48.4	66
Age (years)	454	45	16.8	43.5	46.6
Gender[b] (%) (1 = female)	465	10		7	12
Household Size (people)	464	10.7	5.7	2	53
Education Level[b] (%) (1 = educated)	464	12		9	15
Literacy[b] (%) (1 = literate)	464	9		6	11

b represents binary variables

Summary Statistics: Production Variables

Variable name	Obs.	Average	Standard deviation	95% confident interval	
Land Ownership Status[b] (%) (1 = not outright owner)	453	24		20	28
Maize yield (kg per acre)	416	63.8	15.2	0	1,695.4
Mechanization[b] (%) (1 = animal or manual)	462	44		39	48
Technical assistance[b] (%) (1 = assistance)	465	26		22	30
Type of seed[b] (%) (1 = certified new seeds)	462	21		17	24
Irrigation[b] (%) (1 = irrigation)	465	3		1	4
Optimal date of planting[b] (%) (1= optimal)	465	37		33	41

b represents binary variables

Summary Statistics: Market Variables

Variable name	Obs.	Average	Standard deviation	95% confident interval	
Commercial crop[b] (%) (1 = commercial)	463	35		30	39
Agricultural group[b] (%) (1 = not member)	465	31		27	35
Credit access[b] (%) (1 = no access)	465	5		3	7
Fertilizer transport cost (GHS)	465	2.3	4.5	0	50
2012 crop sales (GHS)	462	692.6	1,085.4	0	12,460

b represents binary variables

Results: Demographic Variables

	Participation		Intensity		APEU	
Variable name	**Coef.**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
Age (years)	0.00	0.541	1.13	0.704	0.04	0.857
Gender (1 = female)	-0.31	0.468	-241.43	0.110	23.16	0.083*
Household Size (people)	0.01	0.588	-12.4	0.217	-0.85	0.172
Education Level (0 = none)	-0.19	0.653	242.39	0.316	-16.62	0.263
Literacy (0 = not literate)	-0.4	0.368	-178.73	0.449	19.36	0.343

***** p<0.01, ** p<0.05 and * p<0.10**

Results: Production Variables

	Participation		Intensity		APEU	
Variable name	**Coef.**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
Land Ownership Status (0 = outright owner)	-0.12	0.608	-380	0.036	-31.57	0.002***
2013 maize yield (kg per acre)	0.00	0.706	0.68	0.007	0.06	0.109
Mechanization (0 = tractor use)	0.09	0.685	-218.55	0.120	-16.14	0.149
Technical assistance (0 = no assistance)	-0.18	0.417	-152.36	0.218	14.34	0.163
Crop sales 2012	0.00	0.298	0.02	0.646	0.00	0.923
Irrigation	-4.99	0.969	-215.25	0.319	80.48	0.002***

***** p<0.01, ** p<0.05 and * p<0.10**

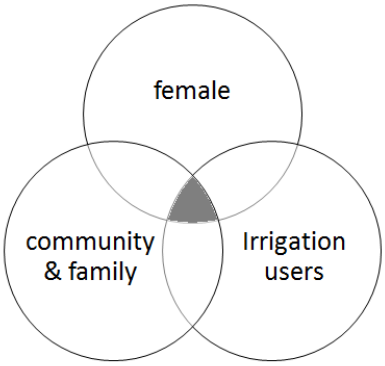
Results: Market Variables

	Participation		Intensity		APEU	
Variable name	**Coef.**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
Commercial crop (0 = not commercial)	-0.14	0.482	10.28	0.927	1.05	0.898
Agricultural group (0 = not member)	0.04	0.833	47.14	0.676	-4.29	0.643
Credit access (0 = no access)	-0.8	0.837	235.14	0.420	-17.52	0.236
Fertilizer transport cost (GHS)	1.4	0.000	31.18	0.016	20.57	0.572
2012 crop sales (GHS)	0.00	0.298	0.02	0.646	0.00	0.923

***** p<0.01, ** p<0.05 and * p<0.10**

Implication

- Fertilizer promotion
  - Objective : meet the expectations of specific farmers
    - ➢ Communication campaign: radio (FAO and IFA, 2000)
      - Female agricultural producers
      - Family and community (landowners)
      - Irrigation users



Conclusions

- Factors affecting fertilizer use decision in northern Ghana:
  - Gender
  - Irrigation
  - Landownership status

- Gives more insights for policy makers to improve agricultural productivity in northern Ghana

THANK YOU

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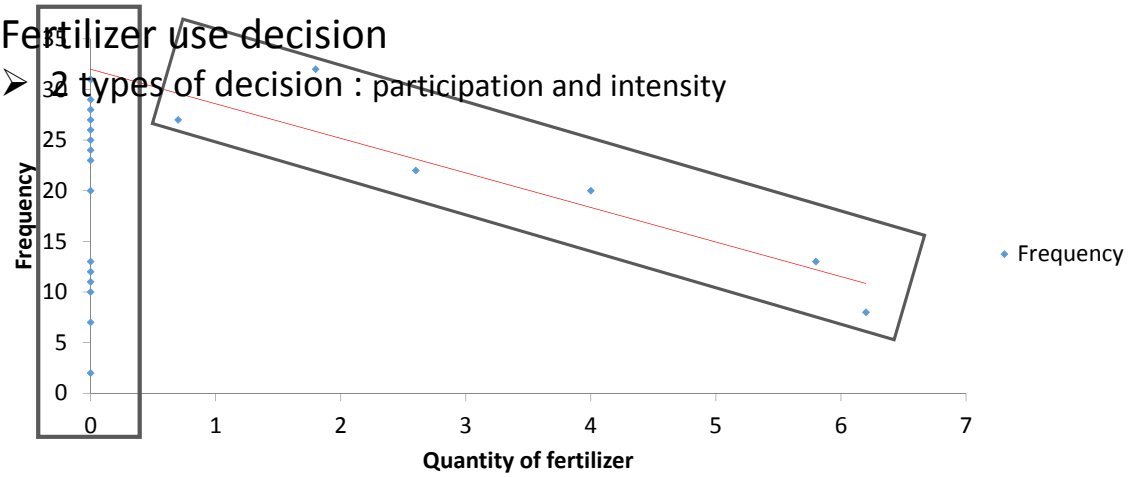
Distribution of fertilizer use in northern Ghana

Fertilizer use decision

- 2 types of decision : participation and intensity



Irrigation systems in Ghana

≤ 3 irrigation systems

5 irrigation systems

≥ 20 irrigation systems