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Intrahousehold Productivity Differentials and Land Quality in the Sudan Savanna of Mali

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Outline

- Context
- Udry's 1996 model
- Our approach
- Findings
- Implications

Context

Household decisions

Vertical and horizontal extended family structure with senior male headship

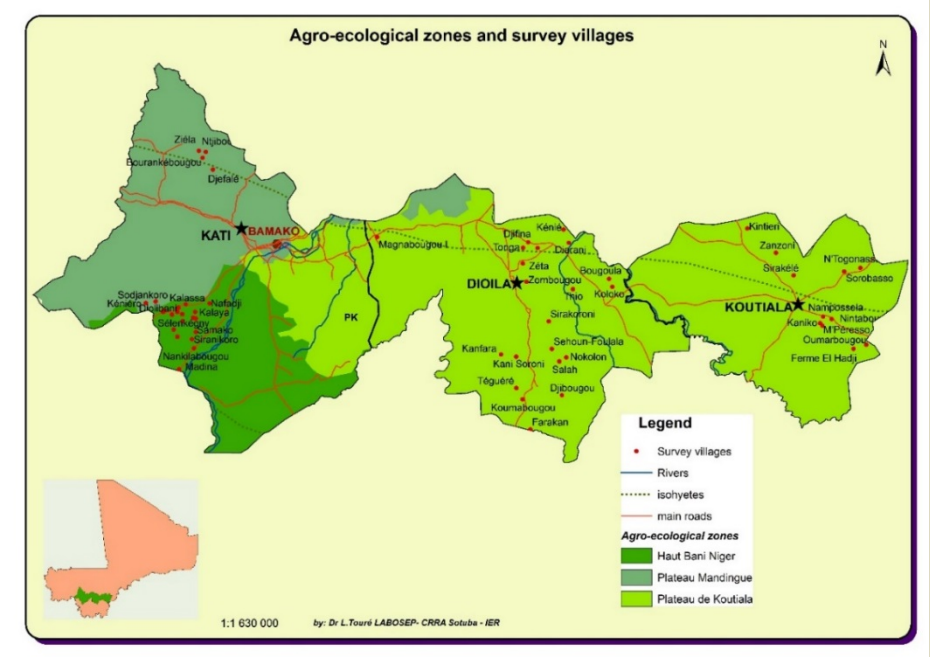
Land use rights conferred by status (age, marriage)

Plots managed collectively and individually

Modern input use negotiated

High potential sorghum and maize production

but stagnating yields



Context

Direct outcomes of household bargaining include the allocation of modern inputs, but intrahousehold models are largely absent from the vast literature on fertilizer adoption.

Udry's model

$$Q_{htci} = \mathbf{X}_{htci}\boldsymbol{\beta} + \boldsymbol{\gamma}\mathbf{G}_{htci} + \lambda_{htc} + \boldsymbol{\varepsilon}_{htci},$$

Q	yield on plot i planted to crop c at time t by a member of household h
X	vector of plot characteristics
G	gender of individual who controls the plot
λ	household-year-crop fixed effect
ε	error (and unobserved plot quality variation)

Observed plot quality: toposequence, farmer-perceived soil type

Udry's model

- Gender and "generation" differentials in yield
- Followed by many studies about gender gaps
- These did not account for land quality

Our approach

Hypothesis: unobserved variation in land quality explains the gender differential

Our approach

$$(1)\ Z_{icj} = \mathbf{X}_{icj}\boldsymbol{\beta} + \mathbf{G}_{icj}\boldsymbol{\gamma} + \lambda_{cj} + \boldsymbol{\varepsilon}_{icj},$$

$$(2)\ Q_{icj} = \mathbf{X}_{icj}\boldsymbol{\beta} + \mathbf{G}_{icj}\boldsymbol{\gamma} + \lambda_{cj} + \boldsymbol{\varepsilon}_{icj},$$

Z	fertilizer applied per ha to plot i planted to crop c by member of household j
X	vector of characteristics of plot i planted to crop c at time t by household member h
G	gender or generation of individual who controls the plot
λ	household-crop fixed effect
ε	error (and unobserved plot quality variation)

Observed plot quality:
toposequence, farmer-perceived soil type, sampled soil nutrients

Our approach

$$(3)\ Q_{icj} = \mathbf{X}_{icj}\boldsymbol{\beta} + \mathbf{W}_{icj}\boldsymbol{\delta} + \boldsymbol{\varepsilon}_{icj}, \text{ for } G=1,0$$

Q	yield plot i planted to crop c by member of household j
$\mathbf{X}$	vector of characteristics of plot i planted to crop c at time t by household member h
G	gender of individual who controls the plot
W	other production inputs
ε	error (and unobserved plot quality variation)

Observed plot quality: sampled soil nutrients

Findings

Intensity of fertilizer use

	Gender		Relation to head	
	perceived soil	measured soil	perceived soil	measured soil
Female plot manager	-15.27***	-7.513		
First wife			-12.56**	-4.880
Second wife			-23.31***	-17.43**
Daughter-in-law			-22.26***	-10.87
Son			3.212	4.200
Plot area	***	***	***	***

Findings

Productivity (yield)

	gender only	gender add plot size	gender add perceived soil	gender substitute measured soil
Female plot manager	-771.7***	-877.7***	-550.1***	-307.0**

Only coefficient on G shown

Findings

What explains a persistent productivity gap?

- **unequal access to resources**
- **different production technologies**

Findings

	Male Plot Manager	Female Plot Manager	All Plot managers
N applied	4.789*	3.008	4.144**
Sorghum primary crop	-609.8***		-649.1***
Plot size	-13.66	166.0*	1.374
Legume intercrop		-274.7***	-335.3***
Labor	1.706**	2.950**	2.017***
Equipment	0.464***	0.114	0.436***
C	-31.50	88.66	8.892
N	-178.0**	-29.80	-132.0**
P	174.8***	46.21	126.3***
K	-2.395	-75.18	-20.98
Sand	-13.48	143.0	-12.60
Silt	-15.53	144.7	-13.97
Clay	4.998	168.0	6.053

Conclusions

- Consistent with Udry's hypothesis, when we control for more unobserved variation in land quality the gender differential in disappears in fertilizer use
- Gender and generation gaps in yield persisted, but diminished as we controlled for plot characteristics
- Distinct objectives and modes of production could explain the differentials

Implications

- Should we continue to be concerned about differentials and allocative inefficiency?
- Do we need more intrahousehold modeling of fertilizer adoption?
- What do these models really tell us for agricultural policy in this context? In other contexts?

Findings

Relationship to head	All plots N applied (kg/ha)	Sorghum N applied (kg/ha)	Maize N applied (kg/ha)
		(mean)	
Head	21.7	5.64	40.0
First wife	9.69	9.69	
Second wife	8.05	8.05	
Son	17.4	3.95	35.2
Brother	25.2	6.82	45.8
Daughter-in-law	6.36	6.36	
Total	19.5	6.41	39.8