FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

INNOVATION LAB FOR FOOD SECURITY POLICY

Origins and Impact of Increasing Herbicide Use in Mali

August 2, 2016

Steven Haggblade, Melinda Smale, Alpha Kergna, Veronique Theriault, and Amidou Assima

USAID FROM THE AMERICAN PEOPLE

MICHIGAN STATE UNIVERSITY

Outline

1. Supply system shocks
2. Farm-level adoption
3. Impact
    - damage abatement
    - gender

1. Supply system shock

- Monsanto's Roundup goes off-patent in 2000

Trends in herbicide prices and imports

Herbicide imports	2000	2005	2010	2014	Change
Quantity (tons)	1,132	1,037	1,420	2,660	135%
Price ('000 CFAF/liter)	3.9	2.9	2.1	1.9	-50%

Input sales in 16 markets

Zones	Percent of Retailers Selling Specific Inputs		
	herbicides	fertilizer	seeds
Served by parastatal marketing agencies			
1Cotton zone (CMDT)	76%	61%	48%
2Irrigated rice zone (ON)	61%	73%	50%
Without parastatal marketing companies			
3Accessible zones	72%	60%	72%
4Remote areas	58%	73%	32%
All markets surveyed	68%	66%	51%

Temporary and seasonal retailers

Growing numbers of glyphosate brands registered

Five-year intervals beginning in	Number of brands registered	
	International*	Regional**
1995	0	1
2000	4	5
2005	2	5
2010	1	16
2015	0	5

* International brands include those produced by the Big Six international pesticide companies: Bayer, BASF, Dow, Dupont, Monsanto and Syngenta.
**Regional brands include those registered by local firms, including products such as Glycel, Kalach and Sunoglyph.

(Un)registered glyphosate products

Roundup and imitators

(Un)registered glyphosate products

Les Berets Rouge: Glycel and imitators

Unregistered herbicide quantities

Herbicide type	Herbicide registration		
	registered	uncertain	total
Glyphosate*	31	36	67
Selective**	24	9	33
Total	55	45	100

Source: farm household survey.

Outline

1. Supply-system shocks
2. **Farm-level adoption**
3. Impact
    - damage abatement
    - gender

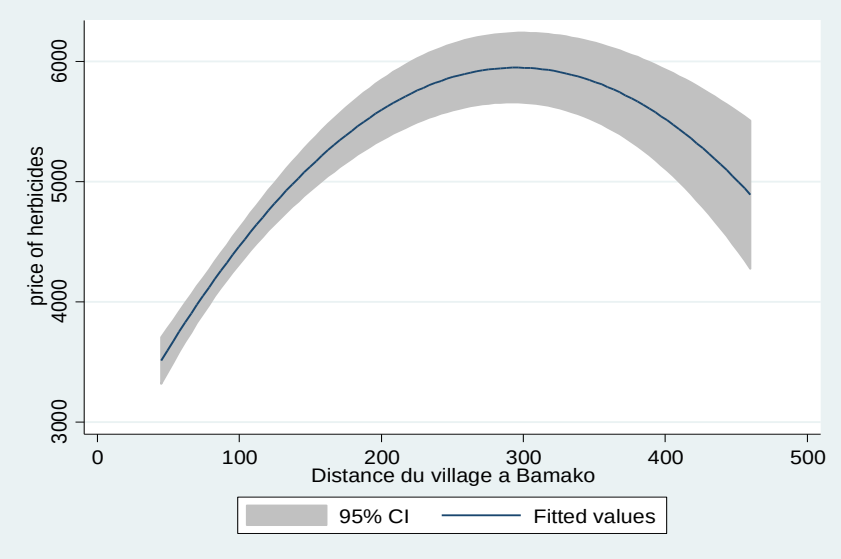
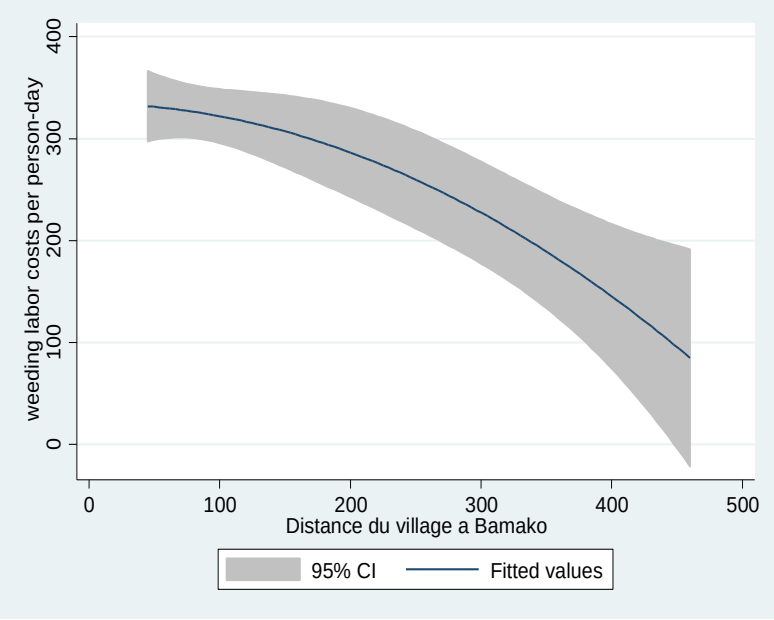
Factors affecting adoption

- Price of herbicides
- Price of weeding labor
- Gender
- Nonfarm income
- Crop

Factors affecting adoption

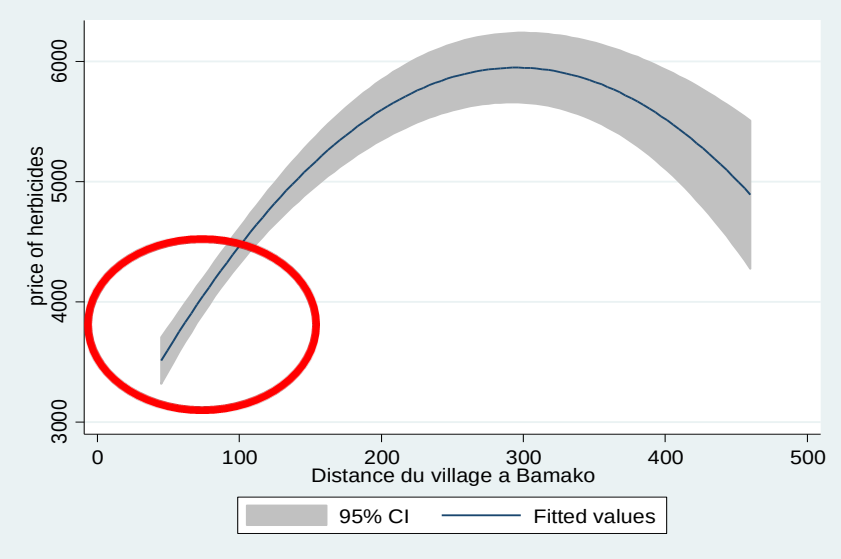
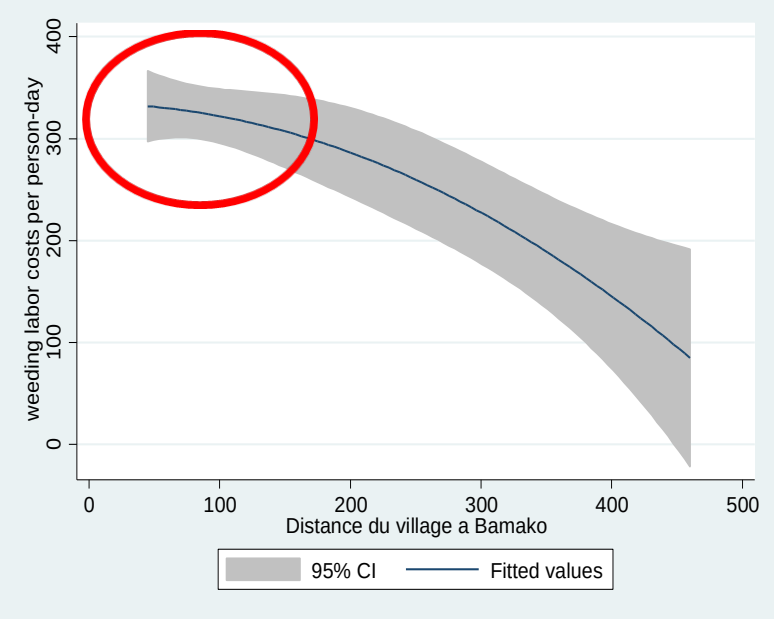
- **Price of herbicides**
- **Price of weeding labor**
- Gender
- Nonfarm income
- Crop

Spatial price gradients

a. Herbicide price (CFAF/liter)	b. Wage rate (CFAF/day)
	

Distance from Bamako (0 – 400 km) →

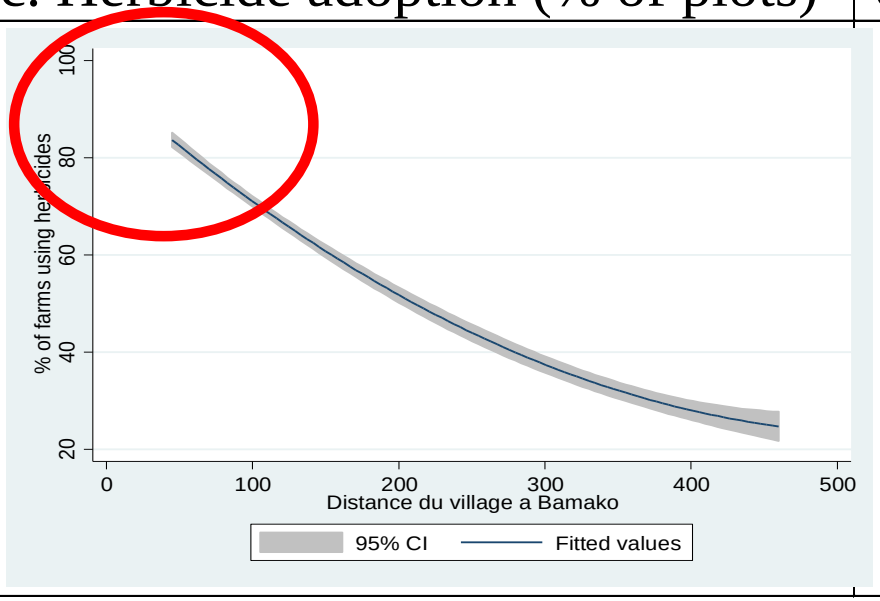
Spatial price gradients

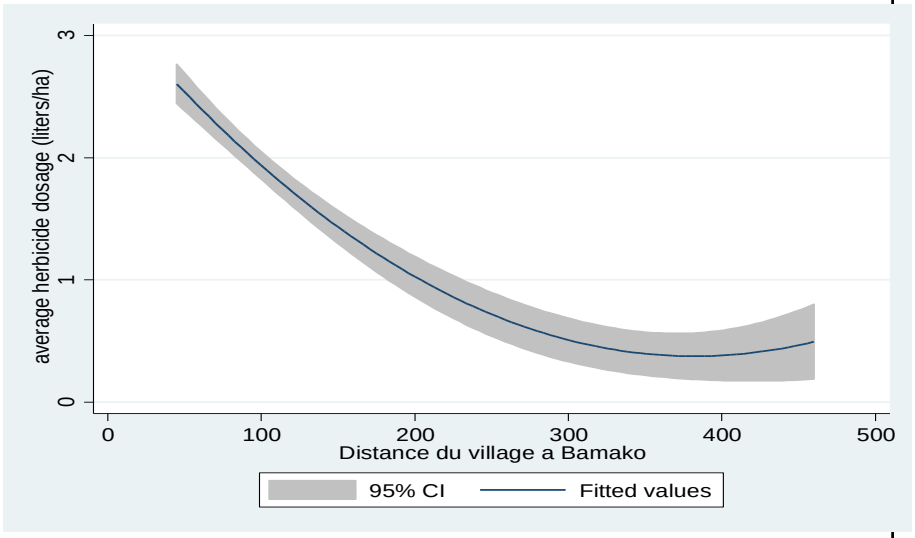
a. Herbicide price (CFAF/liter)	b. Wage rate (CFAF/day)
	

Distance from Bamako (0 – 400 km) →

Spatial adoption

c. Herbicide adoption (% of plots)	d. Application rate (liters/ha)





Distance from Bamako (0 – 400 km) →

Cragg adoption model: LHS = 1 if herbicides used on plot

Varaible	Coef.	Sig.
herbicide price (USD)	-0.049	***
daily weeding wage (USD)	1.040	***
number of active adults per EAF	0.004	
female manager	0.668	***
asset value of EAF (USD)	0.225	***
sorghum plot	-0.643	***

Log likelihood = -1967.4652
n=1205

Outline

1. Supply-system shocks
2. Farm-level adoption
3. Impact
    - damage abatement
    - gender

Production function with damage abatement

	Production function		w. damage abatement	
	(1)	(2)	(3)	(4)
Constant	4.300***	4.300***	7.970	8.746
Plot size	0.288***	0.292***	0.468***	0.569***
Kati	-0.717***	-0.702***	-1.287***	-1.429***
Dioula	0.015	0.021	0.079	0.007
Sorghum	-0.780***	-0.779***	-1.311***	-1.560***
Labor	0.473***	0.472***	1.179***	0.972***
Machinery	0.167**	0.167**	0.251***	0.309***
Fertilizer	-0.009	-0.008	0.003	-0.022
Manure	0.165**	0.167**	0.263**	0.328**
Seed	0.210***	0.211***	0.335***	0.423***
Herbicide qty		-0.016	0.001	
Herbicide (early)				-0.001
Herbicide (middle)				0.002
Herbicide (late)				0.007
Plowing			0.001	0.004
Observations	1,172	1,172	1,172	1,172
R-squared	0.607	0.607	0.634	0.634

Herbicide cost savings

Herbicide cost: 11,400 CFAF/ha

Weeding labor costs: 26,100 CFAF/ha

Gender differences in herbicide use

Plot manager	Plot Type	Crop grown		
		sorghum	maize	total
	Percent of plots using herbicides			
HH head	family	47	69	58
Woman	**individual**	**79**		**79**
Man	individual	90	60	80
Total		56	69	61
	Herbicide application rate (liters/ha)			
HH head	family	1.1	1.7	1.4
Woman	**individual**	**2.6**		**2.6**
Man	individual	3.3	2.5	3.1
Total		1.6	1.7	1.6

Gender implications

- Herbicides expand women's choices.
- Majority of women farmers
  - use herbicides
  - value opportunity cost of their time above cost of herbicides
- Key question: What do they do with time freed up from weeding?

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

INNOVATION LAB FOR FOOD SECURITY POLICY

Thank you

USAID FROM THE AMERICAN PEOPLE

MICHIGAN STATE UNIVERSITY