How Does Gender Affect Sustainable Intensification of Cereal Production in the West African Sahel?

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Motivation

Population dynamics and climate change exacerbate food insecurity

Household decision-making processes are undergoing changes

- More women are planting sorghum- a crop traditionally cultivated by men

Understanding gender differences in the adoption of intensification strategies is crucial

Previous work

Women play a major role in agriculture, but they face more constraints than men

Gender differentials in farm productivity

- Access to inputs and resources
- Tenure rights
- Household versus plot

Technology adoption

- Intensification strategies are context-specific
- Gender dimension is often ignored

Objective

Do determinants of adoption of intensification strategy sets differ by gender of the plot manager across cereal crops in Burkina Faso?

- Plot as unit of analysis
- Control for headship
- Farming system

Farming Structure & Gender Dynamics

Sorghum, millet, and maize account for over 70% of total cultivated land

Family conducts farm work across numerous plots

- Collective plots are managed by the head of the household
- Individual plots are managed by different household members

Upon marriage, women may have access to individual plots

Data

Continuous Farm Household Survey (*Enquête Permanente Agricole*)

- Nationally representative (45 provinces, 826 villages)
- 2009/10-2011/12
- 2700 households growing cereals, 11 000 individual cereal plots
- Production, area, livestock holding, income and expenditure, input use

NOAA's Climate Prediction Center

- Rainfall variability at the commune level

Empirical Strategy

Perceived benefits derived from adopting an intensification strategy

(1) $y_{it}^{*} = X'_{it}\beta + u_{it} + c_i$ *i*=1,….*n*, and t=1,…,T

The decision to adopt is observable (y_{it})

(2) y_{it} =1 if $y_{it}^{*} > 0$

=0 Otherwise

Probability of adopting an intensification strategy

(3) Prob ($y_{it} = 1 \mid X_{it}$) = F($X'_{it}\beta + c_i$)

Empirical Strategy

Multivariate Probit Model

- Estimating several probit models simultaneously
- Allowing the error terms to be correlated

Chamberlain-Mundlak device

- Allowing for unobserved heterogeneity (ci) to be correlated with observed covariates

(4) $$c_i = \overline{X'}_i\delta + u_i + c, \quad u_i \,|X_i \sim N(0, \sigma_u^2)$$

The reduced form

(5) $$\text{Prob}\,(y_{it} = 1 \,|X_{it}) = \text{F}(X'_{it}\beta + \overline{X'}_i\delta + \alpha_i + c)$$

Defining Adoption

Dependent variables

- Yield-enhancing inputs (set 1) - improved seed and inorganic fertilizer
- Yield-protecting inputs (set 2) - pesticides, fungicides, and herbicides
- Soil and water conservation (set 3) – amendments, anti-erosion, and water-harvesting structures.

Explanatory variables

- Gender of the plot manager and household headship
- Age, education, marital status
- Size, distance to residence, topography, and tenure rights
- Labor availability
- Total landholding, livestock, non-farm income, cotton hectares
- Access to credit and extension service, density of agrodealers
- Coefficient of variation in total annual rainfall

Descriptive Statistics

Table 1. Number of plots by gender, type of management, and crops

	Sorghum	Millet	Maize
Total No. of Plots	18701	11318	10799
Collectively Managed	12805	7707	9321
Individually Managed	5893	3608	1475
Managed by women	3991	2577	533
Managed by Men	1901	1028	939

Descriptive Statistics

Table 2. Plot Adoption Rates (%)

	Sorghum		Millet		Maize	
	Male	Female	Male	Female	Male	Female
Improved seeds	0.8	0.7	1.2	0.7	8.1	3.6***
Fertilizer	7.3	6.4	7.1	4.7***	33.3	26.6***
Herbicide	7.9	6.0***	2.1	1.5	17.5	13,0***
Pesticide	2.9	3.9**	1.9	2.4	2.6	1.7
Fungicide	9.8	9.2	8.3	7.7	4.4	1.7***
Manure	16.3	15.1	17.9	12.8***	36.0	28.1***
Anti-erosion	14.6	12.2***	11.5	11.6	9.6	13,0**
Yield-enhancing set	8.2	7.2	8.6	5.7***	36.7	28.9***
Yield-protecting set	19.3	18.1	11.8	11.5	21.5	15.4***
SWC set	25.4	22.9***	25	21.1***	39.1	33.4***

Econometric Results

Pooled Multivariate Probit (MVP)- significant explanatory variables

- Gender (-)
- Household headship (-)
- Marital status (+)
- Distance (+/-)
- Size (+)
- Landholding (-)
- Credit (+)
- Agrodealers (-)
- Crops (-/+)
- Age (-/+)
- Tenure rights (+)
- Topography (+)
- Labor (+/-)
- Cotton hectares (+)
- Extension services (-)
- Rainfall (+)

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- **Tenure rights** (+)
- Topography (+)
- Labor (+/-)
- Cotton hectares (+)
- **Extension services** (-)
- Rainfall (+)

Econometric Results

Separate Multivariate Probit- for each cereal crop

Gender influences the decision and determinants of adoption

- Being a woman negatively affects the probability of adopting

- Secure rights over plots positively influence women's probability of adopting
- Marital status of men positively influences their decision to adopt

Conclusions

Adoption on individual plots differs across gender and crops

- Lower adoption rates among plots managed by women
- Higher adoption rates for maize

Turning to gender differences,

- Marital status positively influences adoption for men only
- Secure rights positively influence adoption for women

Plot, household and market-related characteristics influence adoption of intensification strategies

Policy Implications

The interrelatedness of adoption strategy sets

- Designing mechanisms to encourage the use of combinations of practices

The variation in input use within strategy sets

- Farmers are not best approached with a fixed package in mind

Design policies that respect opportunities and incentives for individuals within multigenerational, multi-family farms

Thank you

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