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### Mali Food Security Policy Research Program

#### Intrahousehold Productivity Differentials and Land Quality in the Sudanian Savanna of Mali

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##### Motivation

Given the important role that women play in African agriculture, the persistent “gender gap” in crop productivity entails considerable social and economic costs. Past research conducted in West Africa has attributed the gap to inefficient allocation of resources among family members within households. In many farming systems of West Africa, including dryland cereals production in the Sudanian Savanna of Mali, crops are produced by extended family farms on multiple plots managed by different members. In Mali, encouraging productivity growth through promoting the use of chemical fertilizer is a national policy priority. In a recent analysis, we tested the “gender gap” by comparing rates of fertilizer use and crop yields. In contrast to previous studies, we are able to control for land quality by introducing soil nutrient measurements (Smale *et al.* 2017).

##### Data

We utilize data collected from 623 farm households in the Sudanian Savanna of Mali during the 2014/15 growing season. The dataset includes information about input use and production on roughly 700 sorghum plots and 500 maize plots managed by household members (these include the head, wives, brothers, sons, and

##### Key Findings

1. We find little evidence that intra-household allocation of fertilizer is inefficient when we are able to control for land quality.
2. Gender and generation gaps in productivity persist but lessen as we control for land quality.
3. Women’s fields may be less fertile, but productivity differentials may also reflect distinctive objectives and modes of production.

daughters-in-law). We include soils classes as perceived by farmers and soil nutrient content as measured by laboratory tests conducted on soil samples (see Assima *et al.* 2017 for details).

##### Methods

We test the specific hypothesis that variation in land quality, expressed in soil nutrients that farmers themselves cannot observe, and that were not included in earlier studies, could explain apparent gender and



generation gaps in resource use efficiency. We apply a household-crop fixed effects model originally developed by Udry (1996) and since adapted by other researchers in the region. The model enables us to focus on differences among plots planted to the same crop within the same household. We compare results obtained when using soil classes as perceived by farmers with those obtained when we employ soil nutrients measured in the laboratory.

## Results

Average yields are nearly four times as high on fields managed by men, but crop type explains part of this difference. None of the women in the sample managed maize plots, which yielded more than twice than sorghum plots, on average (1.5 vs. 0.6 t/ha). About two-thirds of women, and none of the men, intercropped sorghum and groundnuts, biasing yield estimates because the denominator is overstated relative to the actual area in the primary crop. The allocation of nitrogen (N) nutrients across sorghum and maize plots managed by household members is shown in Table 2. Looking at the first set of columns that represents use of fertilizer on all plots combined, application rates per ha appear markedly higher on plots managed by the head, brother, or son, compared to those managed by the first or second wife or daughters-in-law. Yet, controlling for crop, we see that use rates are lowest among sons managing either sorghum or maize plots (middle and right-hand set of columns), and on sorghum, highest among wives of the head. Mean rates of N nutrients applied to maize plots, all of which are male-managed, are 40 kg per ha, which is a different order of magnitude than that applied to sorghum.

**Table. Fertilizer use rates on plots, by relationship of plot manager to head**

Relationship to head	All plots	Sorghum	Maize
	N nutrient (kg/ha)	N nutrient (kg/ha)	N nutrient (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	
<b>Total</b>	<b>19.5</b>	<b>6.41</b>	<b>39.8</b>

Source: Authors. N=1,122. Female plot managers in sample grew only sorghum.

When we control for these and other factors, and especially for land quality as measured by soil nutrients, we find little evidence that intra-household allocation of fertilizer is inefficient. Gender and generation gaps in productivity persist but lessen as we introduce land quality variables into the model. Findings suggest that women's fields may be less fertile, but may also reflect distinctive objectives and modes of production. Indeed, we find distinct production functions for plots managed by men and women, although estimated marginal products of fertilizer lie within the same statistical confidence interval.

## Policy Implications

Despite these findings, we remain concerned that fertilizer may not be cooperatively allocated within households in Mali because it remains a scarce input whose use is largely governed by programs. How

agricultural policies and programs are designed and implemented greatly influences fertilizer use and the use of other inputs intended to support the food security of rural households. Understanding adoption and intensification of food crop production within and among households is important for the future of dryland farming in Mali and in other similar farming systems of West Africa. By what mechanism should the engagement of women and junior household members (sons, daughters-in law) be expanded as part of existing programs geared to raising productivity and farm income? In the short-run, improving involvement of female farmers in input programs may be helpful, but input programs in and of themselves are not a viable means of raising overall fertilizer use over the longer-term. Agricultural policies should focus on removing constraints for all farmers, including women and youth.

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