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Fertilizer Subsidy Impact on Sorghum and Maize Productivity in the Sudanian Savanna of Mali

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Motivation

Agricultural intensification is one of the top priorities of the Malian government. Following the food and oil price crisis in 2007-08, the Malian government have since launched a fertilizer subsidy program. The main objectives of the program are to boost national agricultural productivity through increased use of fertilizer and thereby, improve food and nutrition security. The program specifically targets cotton, maize, millet, sorghum, wheat and rice crops. Fertilizer subsidies are the largest expense items, accounting for about 25% of the total rural and agricultural budget (Theriault, Smale, and Assima, Forthcoming). Yet, there is little empirical evidence of the impact of the fertilizer subsidy program on any outcomes, including fertilizer use and productivity.

Data

We utilize a cross-sectional dataset of 623 farm households, cultivating about 700 plots of sorghum and 500 plots of maize in the Sudanian Savanna of Mali during the crop year 2014/15. The dataset includes information on production, farm input use, including on the participation in fertilizer subsidy program, along with household and plot manager characteristics. [See Smale et al. (2015) for a detailed description of the dataset, including the sampling strategy.]

Key Findings

- Positive impacts on fertilizer use and productivity
- Need to expand the analysis to other crops, zones, and outcomes.

Methods

We employ a propensity score matching (PSM) technique to estimate the impact of the fertilizer subsidy program on fertilizer use and productivity on both maize and sorghum crops. The PSM technique allows us to control for potential selection bias by comparing the outcome- fertilizer use and productivity- of beneficiary farmers with those of

non-beneficiary farmers who have similar observed characteristics, with the sole exception of their participation status in the fertilizer subsidy program. A propensity score with a probit model is first used to match comparable beneficiary farmers with non-beneficiary farmers based on a set of variables, such as plot manager, plot, and household characteristics. Then, the PSM imputes the unobservable potential outcome for each farmer by using the average outcome of comparable farmers from the other participation regime. From the analysis, we obtain the average treatment effect among farmers who benefit from the subsidy program. Different matching techniques are used to ensure the robustness of the results. [See Theriault, Smale, and Assima (forthcoming) for more details on the econometric analysis.]

Results

In theory, all maize and sorghum farmers are eligible to the subsidy program. However, in reality, not all of them benefit from it. Plot managers who belong to a farmer organization, and especially male household heads, are more likely to participate in the subsidy program. In fact, beneficiary farmers are 12% more likely to be members of a farmer organization. Table 1 reports the average treatment effects on those who benefit from fertilizer subsidies. On average, beneficiary farmers apply an additional 12 to 18 kg of nitrogen per hectare on their maize plots and 4 to 5 kg of nitrogen per hectare on their sorghum plots. These represent a 17% to 25% and 50% to 60% increase in fertilizer use on maize and sorghum plots, respectively. Maize and sorghum yields are also significantly higher for farmers who benefit from subsidized fertilizer. Those beneficiary farmers obtain yields that are 190 to 205 kg/ha higher for maize and 84 to 98 kg/ha higher for sorghum. These are approximately equivalent to a 10% and 13% productivity increase for maize and sorghum, respectively. Note that these results are also robust to unobservable characteristics.

Table 1. Impact of the fertilizer subsidy program on fertilizer use and yields.

	Maize	Sorghum
Fertilizer Use	12-18 kg of N	4-5 kg of N
Yields	190-205 kg/ha	84-98 kg/ha

Assuming farm-gate prices of 78 FCFA/kg and 104 FCFA/kg for maize and sorghum (FAOSTAT 2017), the benefit from participating in the fertilizer subsidy program can be translated into gross income increase of about 15,000 FCFA (~ U.S $25) and 8,600 FCFA (U.S. $14) per hectare of maize and sorghum plots.

Policy Implications

We bring some empirical evidence that participation in the fertilizer subsidy program leads to significant positive impacts on fertilizer use and yields for maize and sorghum farmers located in the Sudanian Savanna of Mali. However, there is much need to conduct more evidence-based analysis on the impact of the fertilizer subsidy program on farmers located in other agro-ecological zones and growing other crops that are eligible for subsidized fertilizers, such as cotton and rice. Also, the impact of the fertilizer subsidy program on price, income, and nutrition outcomes of farm household members merits some attention. Once more evidence has been assembled at the farmer level, it would be important to look at the macroeconomic impact of the program through a cost-benefit analysis, comparing the total costs of the program to its overall benefits. Together, such empirically-based evidence can inform policymakers about the intended and unintended impacts of the program.

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