**The Sahel's Silent Maize Revolution:**
**Analyzing Maize Productivity in Mali at the Farm-level**

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# The Sahel's Silent Maize Revolution: Analyzing Maize Productivity in Mali at the Farm-level

Recent work on productivity growth of agriculture in Africa has indeed identified significant increases in productivity in the last decade after some decades of stagnation (Block, 1994; 2010) and increases in maize production have led the way in many parts of Africa (Smale, Byerlee, and Jayne; 2011). But commentators such as Smale et al. (2011) point out a number of disappointing results in maize production across the continent and suggest a key role of fertilizer in determining yield increases and the potential for maize to jump-start a green revolution. According to aggregate data, since 1961 total maize production in Mali has increased more than ten-fold; bringing maize from being a minor crop to one on par with traditional Sahelian crops of millet and sorghum.

What has pushed the great expansion of maize production in Mali? How much is due to expanded use of inputs such as fertilizer versus technical changes in seeds and management? What are the key elements of this technical change? Generally the economics literature shows estimates of high returns to fertilizer in Africa, but that farmers do not adopt fertilizer or they use too little of it (Crawford, Jayne, and Kelly; 2006). The literature has explained this puzzle through the presence of high levels of heterogeneity in the returns to fertilizer use, which poses a problem for the estimation of this impact.

The current work estimates the impact of fertilizer use and explores the heterogeneity in these returns for the Sikasso region in Mali. We use a 12-year panel data set (1994-2006) for over 100 household farms from nine villages located in Mali's southern maize belt. It

focuses on analyzing technological change as both a disembodied technological change and one due to observed as well as unobserved heterogeneity in the returns to fertilizer use. In order to address this unobserved heterogeneity, we apply a control function method first presented by Garen (1984). His method was developed with the purpose of testing for this heterogeneity and of controlling for the bias that this heterogeneity brings. This control function method allows us to control also for the endogeneity that might exist even in the absence of unobserved heterogeneity in the impact of fertilizer use.

The estimations show much stronger evidence for the growth in maize yields having been driven by farmer adoption of higher levels of fertilizer use rather than improvements in seeds and management, disembodied technical change. Once one controls for both observed and unobserved heterogeneity in the returns to fertilizer one sees yield elasticities of about 0.2-0.3 for fertilizer. In addition farmers seem to respond to reduced fertility of their soils, as happens with cotton cultivation (Benjaminsen et al. 2010), with increased applications of fertilizer. This suggests a sophistication in Malian farmer knowledge that goes beyond that commonly suggested in the economics literature. The results show Malian farmers both adopt new technologies and use them well given their constraints. The maize revolution in Mali is shown to be a sequential adoption process (e.g., Aldana et al. 2010).