BASIS BRIEF

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INCREASING SORGHUM TECHNOLOGY ADOPTION IN BURKINA FASO

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In the West Africa Sahel, supply and demand constraints reduce adoption of technology such as improved sorghum seed and micro-dosing techniques. Although pockets and periods of higher adoption have occurred, national area shares, and yields, are generally far less than rice, maize or other specialty crops. Because sorghum is the region's main food staple and most widely cultivated dryland crop small improvements in production techniques would have a large impact on farmers' well-being. Thus, we are seeking ways to enhance production and support the development of local sorghum value chains.

Because neither the private nor public sectors have been able to supply improved seed or fertilizer in reasonable quantities, development organizations and donors have sought alternative means to strengthen the linkages along the agricultural input supply chain. Approaches include training and financing local agro-dealers and seed traders, and enabling farmer unions to supply improved seed and fertilizer micro-packs, a complementary scheme that promotes the application of small amounts of fertilizer (micro-dosing) at planting, which when applied to improved sorghum varieties considerably raises yields.

Yet the challenges of promoting staple cereal seed and fertilizer market development in the West African Sahel are considerable. Since independence, regional governments have largely relied on publicly-funded, state-managed seed corporations to produce seed and on publicly-funded extension services to assess farm-level demand and for seed distribution. Alternative approaches have been implemented and tested, but empirical evidence concerning program impact remains sparse. So which strategies work best to raise yields for sorghum growers in Burkina Faso? Can information about new sorghum growing techniques be better spread through social networks? Would a consistent supply or an

KEY POINTS

As information about technology is a primary adoption constraint, the research team's improved seed and micro-dosing intervention will use social networks to disseminate information.

Since the experiment will randomly vary sorghum seed provision across households, researchers can attribute changes in production practices of other crops to this change in sorghum productivity.

The main intent of our research is find out if demand side or supply side effects place larger constraints on adoption and productivity gains.

This research will be valuable to determining how to tackle raising regional sorghum productivity under such extreme conditions which may contribute to a decrease in the severity of future food emergencies.

offer of credit increase the adoption of improved seed and the micro-dosing technique? And are there any draw backs to introducing new sorghum technologies such as shifts in women's labor allocation that would cause an overall decrease in household nutrition?

CAN SOCIAL NETWORKS INCREASE TECHNOLOGY ADOPTION?

As information about technology is a primary adoption constraint, our improved seed and micro-dosing intervention will use social networks to disseminate information. In February 2014 we conducted a social network census to gather information on individuals who have little access to credit or knowledge-sharing to allow us to estimate the effect of higher connectivity or influence within villages on knowledge diffusion and adoption. The social network census enumerated plot neighbors of farmers, other trusted farmers with whom they communicate regularly, as well as farmers with whom seed exchange, sharing of labor or assets, or joint production is common.

From March 2014 through July 2014 our intervention targeted the seed and micro-dosing packages based on these social networks. The intervention used a randomized control trial approach where new technologies were allocated to farmers with equal probability in various treatment and control groups. In treatment groups A, B, and C (see Figure 1) villagers also received a free training on improved sorghum technology. Free micro-packets were distributed to 20% of farmers randomly in treatment group A, while in treatment groups B and C, free micro-packets were distributed to those farmers with the highest number of contacts within the village or the most influence within their network according to our social network census.

"This study will enable us to provide policy recommendations based on how new technology diffusion occurs and who benefits from different targeting strategies."

This study will enable us to provide policy recommendations based on how new technology diffusion occurs and who benefits from different targeting strategies. We will also be able to determine the productivity effect of the improved seed plus fertilizer plus training and if targeting based on social network characteristics increases adoption spillovers and total productivity gains.

CAN THE BROKEN LINK ON THE SUPPLY SIDE BE REPAIRED?

A consistent supply of technology is also an adoption constraint. Oftentimes the agricultural input supply can

Figure 1

Experimental Design

Demand Side		Supply Side	
Treatment	Seed+Fertilizer Packet + Marketing/Training	Treatment	Marketing/Training
A	20% initial free distribution randomly	D	Early commitment offer at fixed 'market' price
B	20% initial free distribution based on degree	E	Late commitment offer at fixed 'market' price
C	20% initial free distribution based on betweeness	F	Late commitment offer at discounted price
	Control villages No interventions		

be interrupted or simply unavailable in local markets thus disrupting or preventing adoption altogether. Thus prior to planting we will experiment in villages with the reliability and timing of supply from seed breeders, farmer associations, seed traders, and agro-input dealers by offering farmers options to purchase improved sorghum seed and micro-dosing packets either earlier or later in the season in three northern provinces (Bam, Passore, and Sanmatenga), where demand for improved seed and fertilizer is comparatively strong.

Within sub-regions of our three targeted provinces, a village census was conducted to enumerate sorghum plot characteristics and access to seed and fertilizer. After the plot census, a baseline survey including a survey of farmer expectations and preferences, socio-economic and geo-referenced farm characteristics was conducted in March 2014.

This supply experiment will be compared to three other marketing strategies to test whether consistent market supply, credit constraints and farmer commitment explain low adoption and potential supply side marketing mechanisms to increase adoption. The objective of treatments D, E, and F is to disentangle the effect of the farmer's commitment problem due to liquidity constraints from that of the effect of price on adoption. Both price discounts and offers that enable farmers to purchase micro-packets during times of lower liquidity address these two significant supply side adoption constraints. This experiment will be used to determine if commitment mechanisms to relieve credit constraints induce higher adoption than price subsidies and how supply constraints effect adoption and productivity.

POTENTIAL EFFECTS OF SORGHUM TECHNOLOGY ADOPTION

In the ethnically diverse northern region of Burkina Faso men tend to farm sorghum for their own consumption and for sale, while women generally use their individual plots for farming cowpea, other legumes, and vegetables for family consumption. Since our experiment will randomly vary sorghum seed provision across households, we can attribute changes in production practices of other crops to this change in sorghum productivity. If technology adoption diverts women's labor from their own legume crops to sorghum fields, the household's dietary diversity, health and women's income may decline. Women's bargaining power within the household and the amount of time children spend in school versus working in the field might also be negatively affected.

An efficient input allocation would imply that fertilizer would be applied to crops where an additional unit of fertilizer would have the highest marginal product. Yet, in 1996 Udry found that households in Burkina Faso do not necessarily distribute production inputs in this manner. For example, women's plots had lower yields than men's plots. On the other hand, women's plots were comprised of a variety of high value crops, so that the total output per hectare was higher on women's than on men's plots. The differences in yields were primarily attributed to a greater use of fertilizer and labor on men's plots. Thus, if fertilizer and other inputs were reallocated from plots controlled by men to those controlled by women, then total household agricultural production could potentially increase.

Given Udry's earlier findings, the second stage of our research will focus on the welfare consequences of improved seed and fertilizer micro-packet use. In general, we will study how the use of improved sorghum seed affects the allocation of labor and fertilizer to the production of other crops and to overall household productivity. More specifically, we will consider if (i) take-up and new seed usage differs by gender, age, and relation to the household head, (ii) individual household members who are more closely tied to other villagers have higher take-up rates and will they use the packet for their own plots or for the plot controlled by the household head, (iii) potentially higher productivity levels reduce coop-

eration across household members and across different plots, (iv) cooperation outside the household is negatively related to cooperation within the household, (v) one's position in the village social network is related to secure land tenure, (vi) women are deterred from making investments in productive inputs because they fear loss of control over their own plots, or because of credit constraints, (vii) the allocation of women's labor shifts and how this impacts their household bargaining power, and the health and education of children, and (viii) if food availability, household dietary diversity and women's income is reduced.

ANTICIPATED IMPACTS

The main intent of our research is find out if demand side or supply side effects place larger constraints on adoption and productivity gains. In Burkina Faso, we will work with the national agricultural research institute (INERA), farmer associations, and seed sector actors during research design, to discuss preliminary findings, and to disseminate final results. Our outreach activities, led by INERA, will include agricultural policymakers, donors and the Burkinabe agricultural research community. This engagement will enable local Burkinabe researchers and policymakers to better understand the project's final results, and be able to correctly communicate these results at local and regional conferences.

Our research also contributes to national projects that are part of a larger research and policy framework "Guiding Investments in Sustainable Agricultural Intensification in Africa (GISAIA)", funded by the Bill & Melinda Gates Foundation and managed by the Food Security Group at MSU. The project spans eight countries including Mali, Burkina Faso and Nigeria in West Africa and will be implemented over a four-year period. The the project's vision is to respond to the need, expressed by governments across Sub-Saharan Africa, for technical guidance of input program design. Linking to this umbrella effort will enhance our potential to bring credible research findings into high-level policy discussions. The goal of GISAIA, and of this project, is to have tangible impacts on policy, especially on how public investments intended to promote productivity growth among farming households are structured. By linking with GISAIA, we increase the likelihood our research has an impact on such policies.

Our project will engage both the private sector and the agricultural research system in Burkina Faso. By working with agro-input dealers, we will more effectively engage the private sector. By working with INERA scientists to design the experiment, record seed use, and document the benefits to farmers, we will support the agricultural research system. By working with improved, locally-adapted types of sorghum we will promote yield improvement by combating production risk in a climate-smart way. These three project benefits link closely to USAID's current program in Burkina Faso which helps farmers market their products and expands their access to credit, while ensuring appropriate natural resource management under harsh growing conditions and high levels of food insecurity. In March 2012 a disaster was declared due to poor harvests. Since then, the situation has been exacerbated by a growing number of refugees from neighboring Mali. Our research will be valuable to determining how to tackle raising regional sorghum productivity under such extreme conditions which may contribute to a decrease in the severity of future food emergencies.

B A S I S

The BASIS AMA Innovation Lab is a virtual institute hosted at the University of California Davis comprised of researchers from around the globe that aims to improve the agricultural competitiveness and quality of life of the rural poor in the developing world through policy-relevant research that is dedicated to improving access to resources and enhancing the operation of markets.

For more information, please contact basis@ucdavis.edu.

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