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No. 2019-02 | September 2019

MRR INNOVATION LAB EVIDENCE INSIGHT

INNOVATIONS FOR DROUGHT RESILIENCE TWO WAYS IN MOZAMBIQUE AND TANZANIA

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Drought-tolerant seeds are designed to protect farmers from moderate, mid-season drought, but can still fail when conditions are severe. In Tanzania and Mozambique we paired drought-tolerant maize (DTM) with index insurance designed to protect farmers when even drought-tolerant seeds fail. The project generated resilience in two ways. DTM effectively maintained yields during mid-season droughts. After severe droughts, DTM bundled with insurance helped farmers recover from their losses and return production to even higher levels than in the year before the drought.

Since 2006, the International Maize and Wheat Improvement Center (CIMMYT) and the International Institute for Tropical Agriculture (IITA) have developed DTM varieties to address a widespread risk of drought in Sub-Saharan Africa. These varieties were bred to maintain high yields even in a moderate, mid-season drought.

Our analysis of CIMMYT on-farm trial data showed that DTM had higher yields overall than other improved varieties. This advantage increased with drought. In years of average rainfall of about 650 mm, DTM yielded nearly 12 percent more. In years with only 400 mm of rain, the yield advantage increased to about 20 percent.

We further found that this yield advantage is concentrated when drought comes in the middle of the season. The presence of early drought completely wipes out this advantage. This confirms that while DTM seeds are drought tolerant, they are not drought-proof.

While these results are impressive, they are not as large as what was observed under

- For farmers without drought-tolerant maize (DTM), yields fall by 15% after a mid-season drought, with higher food insecurity in the following year.
- DTM seeds offer a modest 12% yield advantage in normal years and insulate farmers against the negative consequences of mid-season drought.
- For farmers without DTM, yields decline by 40% and food insecurity jumps by 45% following a severe drought not attributable to low mid-season rainfall.
- While DTM seeds do not insulate farmers against severe shocks, farmers with DTM seeds resiliently bounce back following a severe shock. This is especially true for farmers with insured DTM seeds.

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the carefully controlled environments where the varieties were first bred and tested. There is also evidence that field trial benefits mainly accrue to farmers with above average productivity. This raises the question of how DTM performs for the average small-scale maize farmer.

Testing Drought Interventions

To test DTM with average farmers, and its complementarity with index insurance, we conducted a randomized controlled trial (RCT) in Mozambique and Tanzania. The insurance, which added 20 percent to the seed cost, replaced seeds in the season following severe droughts if yield losses reached 35 percent. We divided our sample of 3,004 farm households into three groups. DT farmers were offered only DTM seeds. DTII farmers were offered DTM seeds bundled with the insurance. A control group was offered neither.

Farmers in our sample all managed small, rainfed maize plots exposed to moderate to high drought risk. We collected yearly data after maize harvest from 2016-18. Seed and insurance marketing took place in partnership with five local seed companies and two local insurance companies prior to planting for the 2016-17 and 2017-18 seasons.

A Lack of Resilience

Control-group farmers, who were not offered any DTM seeds, experienced low levels of productivity that were very sensitive to drought. Figure 1 illustrates these dynamics using the econometric results from the RCT data. In seasons with normal rainfall, control-group farmers averaged about 960 kg/ha in maize yields, which is a small fraction of the yields achieved in CIMMYT on-farm trials. In moderate mid-season droughts, yields fell to 830 kg/ha, a nearly 15 percent decline. In severe droughts not attributable to mid-season rainfall failure, average yields declined by 40 percent to 600 kg/ha.

While control-group farmers were generally able to recover from moderate shocks, they were unable to recover from severe shocks. Figure 1 illustrates a striking lack of resilience. Even when a severe shock is followed by a normal year, yields are estimated to average only 650 kg/ha, which is far below the prior normal-year average of 960 kg/ha. We cannot rule out even longer-term effects because our data do not allow us to test for them.

In line with these findings, we estimate that food insecurity among control-group farmers increased following mid-season and severe droughts. Using the HFIAS food insecurity scale, we estimate that food insecurity increased 12 percent following mid-season droughts and 45 percent following severe droughts.

Figure 1

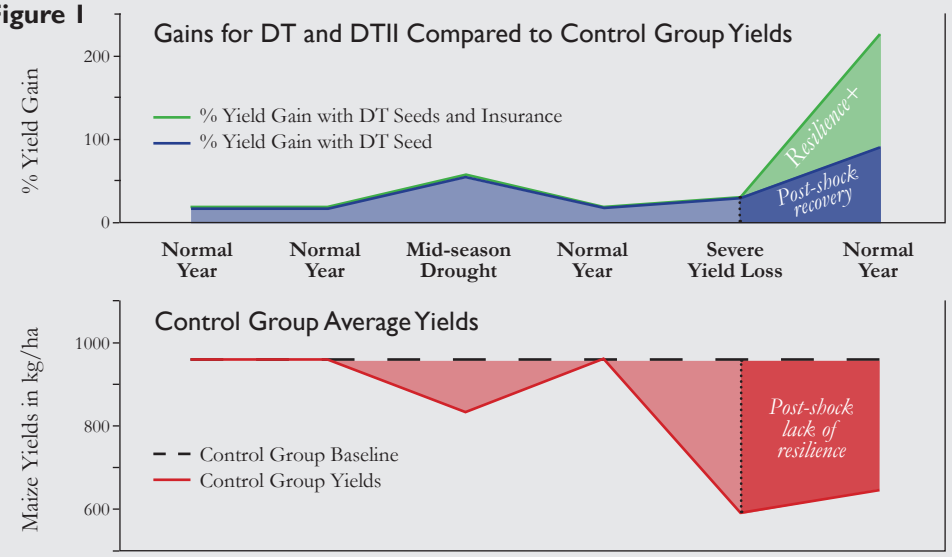

Figure 1 shows impacts DT maize and insurance had on yields in a sequence of years that range from normal to severe drought. Yield gains are relative to control-group yields for the type of year shown.

Resilience Two Ways

Data from the RCT show that DTM seeds increased yields in normal years and stabilized yields during mid-season droughts. We estimate that DTM seeds increased yields by about 12 percent in normal years and nearly 50 percent in years with mid-season drought. DTM almost completely offset drought losses due to mid-season drought. These benefits are similar to those we found for farmers in CIMMYT on-farm field trials. While the evidence is less precise, DTM seeds also appear to offset increases in food insecurity induced by mid-season droughts.

In years when severe shocks were not caused by mid-season drought, yields for DTM farmers also fell precipitously. But, as Figure 1 shows, in the wake of these severe shocks, farmers with insured seeds more than fully recovered from the prior season's shock and even achieved higher yields. This indicates that the insurance payouts encouraged farmers to deepen their investments in maize production.

Complementary Drought Innovations

USAID defines resilience as the capacity to anticipate, prepare for and recover from shocks and stressors. Resilience+ results from investments shifted to productive uses when effective tools for managing risk are available.

DTM promotes resilience, but bundling it with insurance promotes Resilience+ in seasons after farmers suffer significant losses. As seeds are a primary form of capital for many small-scale farmers, this paired intervention can transform how families recover from a shock like drought in areas where food security is driven by rain-fed agriculture.

For more information, visit ***https://basis.ucdavis.edu.***

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID) cooperative agreement 7200AA19LE00004. The contents are the responsibility of the Feed the Future Innovation Lab for Markets, Risk and Resilience and do not necessarily reflect the views of USAID or the United States Government.

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