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Group insurance for cotton producers in Mali

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Farmers' subsistence in the region of Bougouni, Mali depends heavily on their cotton revenue. While cotton is a profitable activity on average, bad yields often leave small cotton growers in debt with no other alternative but to sell draft animals or withdraw their children from school. Instruments that would help farmers to better smooth their income over time could substantially increase their welfare. In this context, we designed an area based yield insurance product for cotton producers with the objective to reduce farmers' income fluctuation.

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An insurance product linked to credit and targeted toward cooperatives

The cotton sector in Mali is characterized by a strong involvement of the state. A parastatal agency, the Compagnie Malienne du Coton et des Textiles (CMDT), is in charge of distributing cotton inputs including seeds, fertilizers and pesticides. To finance these inputs, farmers benefit from loans from the state bank, Banque Nationale de Developpement Agricole (BNDA). The CMDT is the only buyer of cotton at the national level. It pays farmers directly on bank accounts they hold at the BNDA, and the cotton revenue then serves in priority to pay back input loans farmers held at the BNDA[1].

To benefit from the services of these state agencies, farmers have to be organized in cooperatives. Cooperatives centralize input demand, organize the pick-up of cotton in the villages and, most importantly, are compulsory intermediaries to obtain a BNDA loan. Members of the same cooperative share joint liability on the loans they obtain from the BNDA. In other words, the BNDA use the overall cooperative cotton revenue to pay back the sum of the loans taken by cooperative members.

The area based yield insurance product we propose is targeted towards cooperatives of producers and is linked to the cooperatives' credit contracts. Once a cooperative opts for insurance, the total area in cotton grown by members of the cooperative is insured. The premium is prefinanced like a regular input by the BNDA. The level of average yield in the district triggers the payment of indemnities. If insurance payments are made, they are deposited on the cooperative's account at the BNDA. Insurance payments serve first to pay back cooperative loans[2].

1. In small parts of the country another parastatal agency is in charge of managing the same type of system, the Office de la Haute Vallée du Niger (OHVN).
2. The exact geographical area used is the "zone de production agricole" (ZPA).

The design of an innovative contract

We consider several types of contracts before settling for a district based yield contract. We first investigated two broad types of indexes: an area yield index and satellite based index (SBI). For a given area, an area yield index is better correlated with an individual farmer's yield than a climatic or satellite based index. However if satellite images have finer resolution and enable to estimate yields for smaller geographical units than the ones used for average yields, SBI may dominate an area based yield index.

Our preliminary exploration of these options revealed that a district based yield index implies less basis risk for farmers and therefore performs better. To construct the district based yield contract, we first estimate the probability structure of yield using historical data. We then propose a specific schedule of payments and finally compute the actuarially fair premium. Two innovations characterize the contract finally adopted: payouts depend on a double geographical trigger and, when payouts occur, they are lumpsum.

The double-trigger as a tool to reduce basis risk

An average yield index insurance product implies basis risk for a cooperative in the sense that a cooperative's yield only imperfectly correlates with the district yield. Two types of unfortunate situations may occur:

– the coop yield is above the district strike-point but the insurance pays out (we call this "false positive")

– the coop yield is below the district strike-point but no payment are made because the district yield is above the strike-point (we call this "false negative").

Reducing the geographical area used to compute the index would reduce basis risk but in-

crease the scope for moral hazard[3]. A double-trigger structure provides a solution to this dilemma by enabling to reduce basis risk while remaining immune to perverse incentives. The idea is to keep the district trigger and to add a coop trigger so that insurance pays out only if two conditions are fulfilled: the district yield is below the district strike-point and the coop yield is below the coop strike point. Formally:

$$p_{izt} = \begin{cases} 0 \text{ if } y_{zt} \geq S_z \text{ or } y_{izt} \geq S_i \\ L \text{ if } y_{zt} < S_z \text{ and } y_{izt} < S_i \end{cases}$$

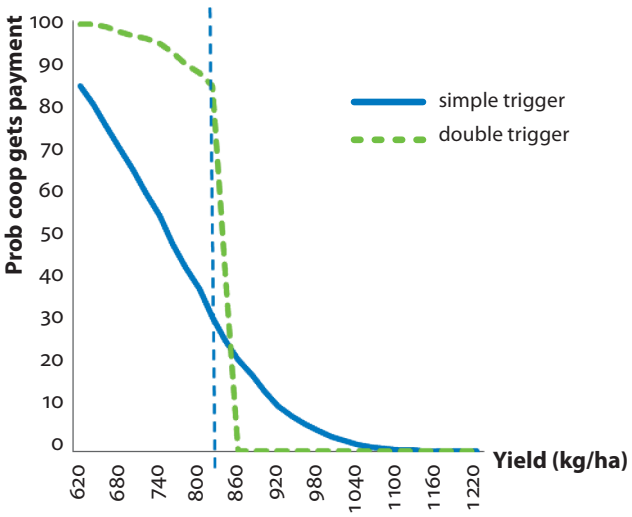
Where p denotes the payment received, i denotes the coop, z denotes the district, t denotes the time period, y denotes average yield, S_z and S_i denote predetermined strike points, and L denotes a lump-sum payment.

The following example illustrates the advantage of this contract structure. The example is based on a high yield district in our project area. Table 1 presents the strike-points for both types of contract when we hold the probability of payment constant at 10%. Moving to a double-trigger contract enables to increase the district strike-point substantially and reduces the occurrences of both false negative and false positive. Graph 1 illustrates this point: For each contract, we represent the probability of payout conditional on the cooperative level yield. The double-trigger contract completely eliminates "false positive" or situations where the cooperative yield is above the strike point but the cooperative gets a payout, as the probability of payout is null if the cooperative yield is above the cooperative trigger. Simultaneously the double-trigger considerably decreases the occurrences of "false negative" or situations where the cooperative yield is below the strike-point but the cooperative does not get a payout since the ZPA yield is above the strike-point. In fact, as coop yields get very small the probability of payout tends to 100%!

3. If the index was simply based on the coop yield, it would eliminate false positive and false negative but coops would have incentive to reduce their yield just to obtain payments.

	Single trigger	Double trigger
Coop trigger (kg/ha)		805
ZPA trigger (kg/ha)	837	1000
Probability of payout	10%	10%
Pure premium (kg/ha)	55.9	55.9
Price (FCFA/ ha)	9501	9501

Table 1: Single versus double trigger contract with a 10% probability of pay-out



Graph 1: Conditional probabilities of payout under single and double trigger-contract

The appeal of a lump-sum payment schedule

A final original feature of the contract we adopted in Mali is a lump-sum payment schedule. This type of contract had been tested in Peru where it encountered great success (Carter et. al., 2007). In workshops with farmers in Mali, we discuss the opportunity to use a lump-sum contract rather than a classic linear payment schedule (where insurance payments are proportional to the difference between the strike-point yield and the realized yield). Farmers unanimously expressed preferences for a lump-sum schedule and we chose that option.

While this preference appears surprising at first since a linear schedule seems to enable greater income smoothing, several arguments can explain the superiority of this type of con-

tract (Gelade, 2011). First, they are extremely simple and this is a major advantage when the targeted population has low levels of financial literacy. Second, if farmers lack of trust in the yield measure and believe that average yield may be manipulated, a lump-sum contract may imply less scope for cheating[4].

Finally, depending on the relevant framework to describe farmers' decision making process under uncertainty, different theoretical arguments apply to explain this preference. In an expected utility framework the preference for the lump-sum contract cannot be explained in the absence of basis risk (since the linear schedule perfectly smoothes income.) However in a situation where basis risk is increasing with yield, the probability to obtain very low incomes may be greater under the linear than under the lump-sum contract and the lump-sum contract may be superior to a linear one (Gelade, 2011).

In a prospect theory framework, if farmers' reference point is above the strike-point they may prefer the lump-sum contract (even in the absence of basis risk). If their reference point is "far enough" above the strike-point we can show that they will prefer the lump-sum contract (Gelade, 2011). The intuition behind this result is simple: below the reference point, the utility function is convex, implying that the individual behaves as a "risk seeker" and thus prefers the "non-smooth" income.

4. Suppose farmers believe that average yield may be overestimated by a maximum of 250kg/ha. With a lump-sum contract this problem is only relevant for realized average yields between the strike-point minus 250 and the strike-point. For lower yields, it will not affect pay-out. This is not true with a linear contract.

Future steps

The insurance product has been distributed for the first time in 2011 and future steps of our project include the analysis of the impacts of insurance. In particular we will investigate whether insured cotton producers increase their area planted and their revenue and whether some farmers start planting cotton. If the answer to the later question is positive, we wish to understand the mechanism at play: is the cooperative accepting them now that the credit contract involves less risk? Or are they directly induced to participate by the insurance contract? Finally we are curious to investigate financial market impacts of the insurance product and see whether credit contract terms evolve.

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