



Marc Bellemare Michael Carter Catherine Guirkinger

GROUP INSURANCE FOR COTTON PRODUCERS IN MALL

Catherine Guirkinger, University of Namur, Belgium



Institutional setting

Contract design: concrete steps to the design of an area yield index contract

□ Appeal of a lump-sum payment schedule

Advantage of a double-trigger contract

□ Future steps

Institutional setting



The cotton sector in Mali: a strong involvement of the state

- The "Compagnie Malienne des Textiles" (CMDT) is the only buyer.
- CDMT is for most farmers the only source of seeds, fertilizers and pesticides.
- Prices are fixed at the start of the season.

Credit contracts: group contract with strong joint liability rules

- □ Cotton producers are organized in cooperatives (1 or 2 per village).
- The cooperative receives a group loan in kind: seeds, fertilizers and pesticides (on a per ha of cotton basis).
- Individual farmers are paid for the cotton they sell to the CMDT into a bank account they hold at the state bank (BNDA).
- Before individual farmers can withdraw their income, the group loan is directly paid back. Joint liability applies strictly.
- □ Joint liability generates great tensions within cooperatives and villages.

The insurance product: linking insurance to cooperatives' loan

- The insurance contract we propose is subscribed by cooperatives on a per hectare basis, along with the credit contract.
- If insurance payments are made, they are channeled to the farmers' bank accounts at the BNDA.
- They are used in priority to pay back loans.
- It relaxes the joint liability rule, as it reduces the probability of a farmer not being able to pay back his loan.

Practical difficulties

- The communication with our partners in this project is not always easy.
- The cotton sector is going through a privatization movement but nobody seems to know its exact nature.
- Many discussions about whether the insurance should be voluntary or compulsory.
- The pricing of the contract by Swiss Re was delayed and it took several trials to get meaningful figures.

Contract design

Concrete steps to the design of an area yield index contract

Contract design

Average area yield versus satellite based index (SBI): we first investigated both possibilities.

For the same area, an average area yield index provides more precise estimates.

But if satellite images have finer resolution then precision can exceed that of an average area yield index.

We developed average area yield contracts

Contract design

Three steps to design the contract:

- Estimate the probability structure for average area yield (the geogra)phical unit considered is the ZPA zone de production agricole)
- Propose a contract
- Price it
- The contracts we considered:
 - Linear payment schedules
 - Lump-sum payment schedules (with single and double strike points)
 - Refinement to keep premium low: single vs dual strike point
 - Refinement to reduce basis risk: single vs double-trigger strategy

Linear payment schedule

$$p_{izt} = \max(S_z - y_{zt}, 0)$$

- p denotes the payment received,
- \Box i denotes the coop,
- z denotes the agricultural production zone,
- \Box t denotes the time period,
- y denotes average yield,
- Sz denotes a predetermined strike point

Area Yield Contract for Bla District

Low Productivity Zone: 812 kg/hecatare



Lump-sum payment schedule

A lumpsum contract is such that

$$p_{izt} = \begin{cases} \text{Oif} y_{zt} \ge S_z \\ L_1 \text{ if} y_{zt} < S_z \end{cases}$$

- p denotes the payment received,
- i denotes the coop,
- z denotes the agricultural production zone,
- \Box t denotes the time period,
- y denotes average yield,
- Sz denotes a predetermined strike point, and
- L1 denotes a lump-sum payment.

Area Yield Contract for Bla District

Low Productivity Zone: 812 kg/hecatare



Refining the contract: single versus dual strike-point contracts

- A dual strike-point offers fixes two thresholds and two levels of indemnities (see example in next table)
- It implies more flexibility and enable to keep the premium lower
- □ BUT: It involves more complexity.

	Linear Indemnity	Lump-sum single strike point	Lump-sum double strike point
First Strike Point	850	750	750
Second Strike Point	-	-	500
Commercial Premium (FCFA/ha)	3,187	5,854	3,208
Cotton Yield (kg/ha)	Indemnity Payment (FCFA/ha)		
900	0	0	0
850	0	0	0
800	11,050	0	0
750	22,100	95,000	50,000
700	33,150	95,000	50,000
650	44,200	95,000	50,000
600	55,250	95,000	50,000
550	66,300	95,000	50,000
500	77,350	95,000	95,000
450	88,400	95,000	95,000
400	99,450	95,000	95,000

Appeal of a lump-sum payment schedule

Appeal of a lump-sum payment schedule

- □ Success during workshops and in Peru.
- In Mali, many farmers indicated that 750 kg/ha was a critical threshold below which they could not repay their 95,000 FCFA/ha input loan
- Simplicity and trust aspects:
 - Payment schedule is very clear
 - If farmers believe the data on average yield may be manipulated, a lump-sum contract implies less scope for cheating.

Appeal of a lump-sum payment schedule: a little theory

Consider two contracts, one linear and one lump-sum with the same unique threshold and the same premium.



(a) The linear contract pays out more if the average yield is lower.



(b) The lump-sum contract always pays out the same amount S.



(c) Income under a linear contract. The dashed line gives income without insurance. Below the threshold, income is perfectly smoothed.

(d) Income under a lump-sum contract. The dashed line gives income without insurance. Income is not smoothed.

Appeal of a lump-sum payment schedule: a little theory

- In an expected utility framework the preference for the lumpsum contract cannot be explained in the absence of basis risk (since the linear schedule perfectly smoothes income)
- If basis risk is increasing with yield, the lump-sum contract may be superior to a linear one
- → The probability to obtain very low incomes may be greater under the linear than under the lump-sum contract

Appeal of a lump-sum payment schedule: a little theory

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 they will prefer the lumpsum contract.

→ intuition: below the reference point, the utility function is convex, implying that the individual behaves as a "risk seeker."

Advantages of a double trigger-contract

Simple versus double-trigger contract

- All of the contracts introduced above imply a trigger at the ZPA level.
- If an individual coop has a yield below the threshold while the average yield in the ZPA is above, no insurance payment is made. (notion of basis risk)
- □ There are two types of unfortunate situations:
 - False positive: the coop yield is above the threshold but payments are made
 - False negative: the coop yield is below the threshold but no payment are made because the ZPA yield is below.

Simple versus double trigger contract

Reducing the geographical area used for the computation of average yield would decrease basis risk but may increase the scope for moral hazard.

> Double-trigger idea

Double-trigger contract

A double trigger contract is such that

$$p_{izt} = \begin{cases} \text{Oif} y_{zt} \ge S_z \text{ or } y_{izt} \ge S_i \\ L_1 \text{ if } y_{zt} < S_z \text{ and } y_{izt} < S_i \end{cases}$$

- \square p denotes the payment received,
- \Box *i* denotes the coop,
- \Box z denotes the agricultural production zone,
- \Box t denotes the time period,
- y denotes average yield,
- \Box S_{z1} and S_{z2} denote predetermined strike point, and
- \Box L₁ denotes a lump-sum payment.

Double-trigger contract

It reduces basis risk for the cooperative.

It remains quite immune to perverse incentives to reduce their yields: pay-offs are made only if the greater area of the ZPA has a low average yield.

As payments are better correlated with individual coop outcomes, the ZPA trigger can be set higher than in the contract considered above.

Double- versus single-trigger



Double-trigger contracts

- They completely eliminate false positive.
- They considerably decrease the occurrence of false negative.
- The have a much higher "success rate": with contract A, 54% of the times a cooperative yield is below the trigger, it recieves a payout. With contract C it is 98%!
- The draw-back is that the concept may be difficult to convey: importance of training!





Where we are in the field

- Farmer training has taken place. The subscription campaign has started on a small scale the first year.
- We had initially wanted to split the coops between 50 control and 50 treatment coops, but the reinsurer refused to price the contract for more than 86 coops that they themselves systematically selected.
- We split our 86 selected coops into a control group of 28 coops and a treatment group of 58 coops.
- We are offering (temporary) random discounts by charging 50, 75, or 100 percent of the actuarially fair premium.
- We offer the contract at the same price within a given zone, varying strike points instead.

Expected impacts

Intensive margin: Do insured cotton producers increase area planted and revenue?

- Extensive margin:
 - Are there farmers who start planting cotton?
 - If yes what are the mechanisms: is the cooperative accepting them now that the credit contract involves less risk?
 - Are they directly induced to participate by the insurance contract?

Financial market impacts: Do credit contract terms evolve?

Evaluation

We plan on conducting a survey in the control and treatment villages

We intend to play games with members of coop to elicit whether they are more willing to enter into risk sharing agreements, how framing of the insurance product matter...