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## Educational Outreach for Area Yield Insurance: Lessons from a Pilot Program in Peru

# Outline

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- Index insurance: The challenge of farmer comprehension
- Agro-Positiva: Index insurance for cotton farmers in Pisco Valley, Peru
- Education strategy: Learning through games
- Results and lessons learned

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# Agricultural Risk and Rural Poverty: Causes

- Farmers everywhere face significant risk from multiple sources
  - ▣ Natural: Weather and pests.
  - ▣ Price: Commodity prices highly volatile.
  - ▣ Market: Contracts may not be honored.
  - ▣ Political: Strikes, violence, abrupt policy changes affect yields and profits.
- Risks are magnified for farmers in developing countries
  - ▣ Poverty is concentrated in rural areas.
  - ▣ Weak infrastructure (physical, communication, legal) amplifies farmers' vulnerability.
  - ▣ Low human capital reduces capacity to manage risk.

# Agricultural Risk and Rural Poverty: Consequences

- Missed opportunities
  - ▣ Many farmers forego high return technologies or crops because they are too risky.
- Credit markets undermined
  - ▣ Lenders reluctant to make unsecured loans (supply-side).
  - ▣ Farmers reluctant to risk assets as collateral (demand-side).
- Increased inequality
  - ▣ Wealthier farmers, who are better able and willing to accept risk, are more likely to take advantage of profitable opportunities.
  - ▣ Poorer farmers stuck in “traditional” low return activities.

# Index Insurance: Towards a Solution

- What is Index (parametric) Insurance?
  - ▣ Insurance payouts based on an external index that is correlated with farmers' yields.
  - ▣ Primary objective is to mitigate *covariate risk* (i.e., risks that simultaneously affect many farmers in a region).
- What are common indices?
  - ▣ Weather events such as rainfall, air temperature, and surface-water temperature (El Niño).
  - ▣ Satellite imagery (vegetative index).
  - ▣ Area yields (avg. yields in a specified area).

# Advantages of Index Insurance

- Protects against covariate shocks...which are the major source of risk to farmers.
- No moral hazard or adverse selection.
  - ▣ Index is not affected by actions or characteristics of farmers.
- Low-cost.
  - ▣ Does not require assessment of individual losses.

# Index Insurance in LDC's: Recent Experience

- Promoted by international community in last ten years.
- High expectations that Index Insurance will...
  - ▣ Facilitate technology adoption
  - ▣ “Crowd-in” credit supply and demand
  - ▣ Extend micro-credit “revolution” to agriculture
- Numerous pilot projects undertaken.
- But...
  - ▣ ...with the exception of India
  - ▣ ...limited success



# Challenges to Index Insurance

## □ **Data availability**

- Do there exist data of sufficient quantity and quality?

## □ **Value**

- Is the index tightly correlated with farmer's yields?
- If not → Basis risk reduces value to farmer

## □ **Institutions**

- Are there any institutions willing and able to market and deliver insurance to small farmers?

# Challenges to Index Insurance

- Data availability
- Value
- Institutions
- **Comprehension**
  - Even if all of the above challenges are met, sustainability requires clear understanding of costs and benefits by the farmer.
  - Under-estimating value → low demand now
  - Over-estimating value → conflict and future collapse
- Rural poverty complicates comprehension
  - Most small farmers have never had insurance (of any type)

# Specific Challenges to Comprehension

- Insurance is a stochastic product
  - ▣ Farmer always pays the premium, but infrequently receives an indemnity payment.
  - ▣ If farmer does not understand “preventive” nature of insurance she may become disillusioned if she pays but doesn’t receive anything.
- Index insurance implies basis risk
  - ▣ Farmer may not receive an indemnity payment even though her yields are low.
  - ▣ If farmer does not understand this, she will be angry (expects but not receive payment).
- Insurance has inter-temporal benefits
  - ▣ Receiving indemnity payment when conditions are bad prevents negative long-term impacts.
    - Selling-off productive assets (land, livestock).
    - Default → loss of future credit access.
  - ▣ Farmer will under-estimate value if these benefits are not considered.

# Learning by Playing

- How do we promote farmer comprehension?
- Game to simulate farmer's credit and insurance decisions.
  - ▣ Methodology drawn from experimental economics.
  - ▣ Play for real money, so that farmers take their decisions seriously
  - ▣ Framed field experiment (make the game as realistic as possible).
  - ▣ Use real numbers from insurance premium, yields, cost of production, etc.
  - ▣ Facilitates farmer's translation of game learning to real life.
- Farmers learn how the contract works (costs and benefits).
- Provider (researcher) learns about potential demand .
- Part of a research program to design, implement and evaluate the impact of area-yield insurance in Peru.

# The Context: Pisco Valley, Peru

- 25,000 irrigated hectares
- Smallholder cotton dominates
  - ▣ 3,500 cotton farmers
  - ▣ 13,000 hectares
- Natural risks
  - ▣ Drought
  - ▣ Excess rain (El Niño)
  - ▣ Temperature/pests

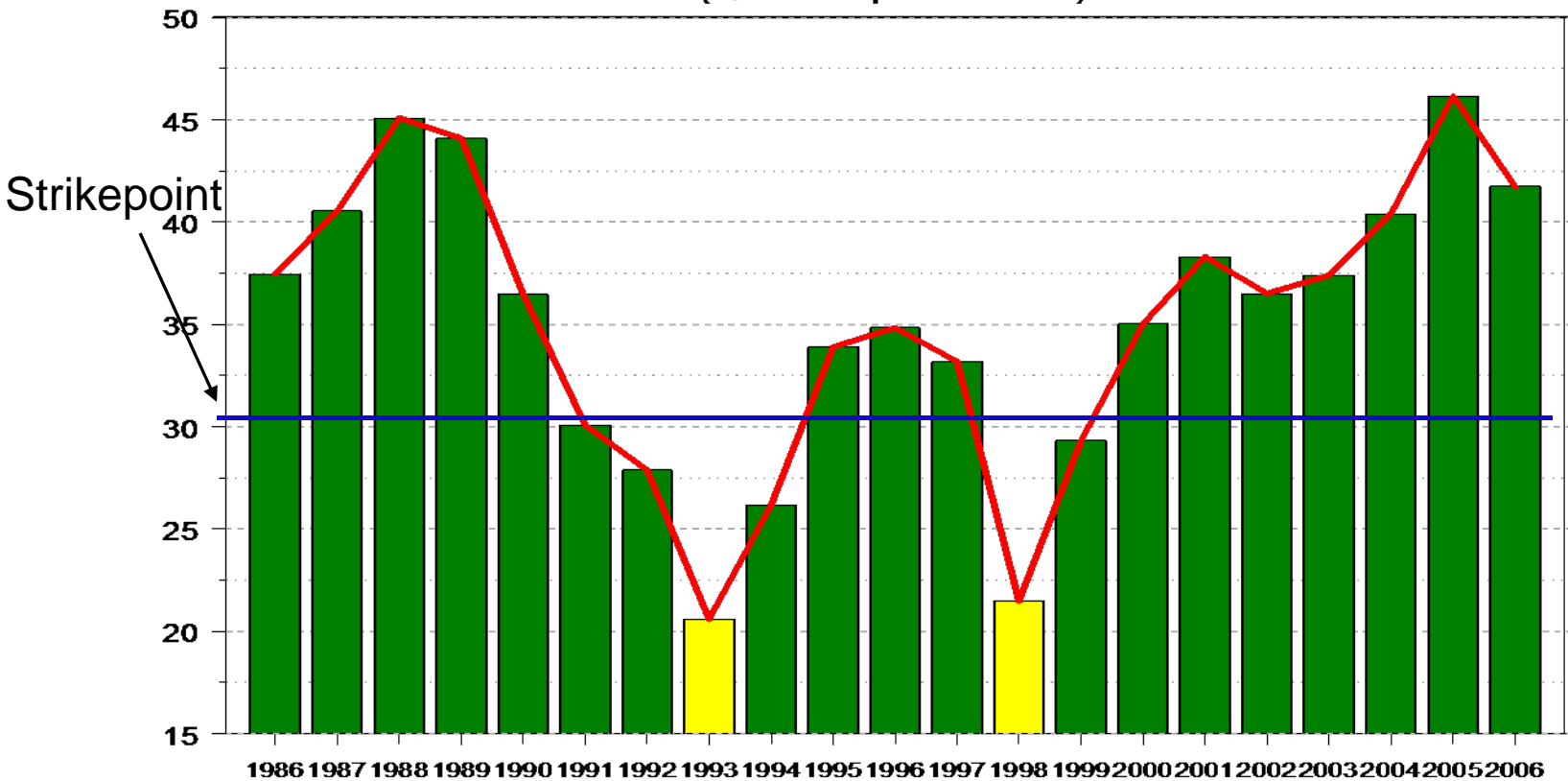


# The (real) Area-Yield Insurance Contract

- Index is average cotton yield in Pisco Valley
- Premium: \$47 per insured hectare (3-5% of production costs)
- Strikepoint is 31 quintales (3,100 lbs) per hectare


# Historical Valley-Average Yields (quintales per hectare)

Rendimientos de algodón en la provincia de Pisco: 1986-2007  
(Quintales por hectarea)



# Payoff Structure

Announced average valley yield (qq/ha.)	Indemnity payment per insured hectare (Soles)
More than 31	0
30 – 30.99	61
29-29.99	186
28-28.99	311
27-27.99	436
26-26.99	561
25-25.99	686
24-24.99	811
23-23.99	935
22-22.99	1,060
21-21.99	1,185
20-20.99	1,310
19-19.99	1,435
Less than 19.99	1,435





# The Area-Yield Insurance Contract

- Index is average valley yield
- Premium: \$47 per insured hectare (3-5% of production costs)
- Strikepoint is 31 quintales (3,100 lbs) per hectare
- Triangular institutional structure
  - ▣ Insurance Company: La Positiva
  - ▣ Delivered by MFI: Caja Rural Señor de Luren
  - ▣ Reinsurance: HanoverRe
- Insurance linked with loan
- Borrower receives interest rate discount (3.25% instead of 3.5%) if she purchases insurance.

# Educational Sessions: Overall Logistics

- Cotton planting/loan decisions occurs August – October.
- 24 game sessions held in 12 locations throughout the valley in June and July.
- Invitations to “Insurance information session” distributed to 40 cotton farmers per session
- An average of 20 farmers participated per-session.
- Structure of Session
  - ▣ Arrival and entry survey
  - ▣ Game 1: Baseline Game
  - ▣ Game 2: Insurance Game
  - ▣ Post-game question and answer session
  - ▣ Exit survey
  - ▣ Farmers receive winnings
- Average Session time = 3 hours

# Baseline Game

- This first game simulates credit and technology decisions without insurance.
- In each round (season), farmer chooses between two projects:
  - Project A: Intensive cotton technology with loan (high return/high risk)
  - Project B: Low-intensity, cotton/food crop , self-finance (low return/low risk)
- Farmer's Payoff in each round depends on
  - Project chosen
  - Weather (covariate) shock and Individual shock
  - Credit history
- Play 6 low-stakes rounds (to learn the game)
- Play 6 high-stakes rounds

# Insurance Game

- In each season, farmer chooses between:
  - ▣ Project A: Intensive cotton technology with loan (high return/high risk)
  - ▣ Project B: Low-intensity, self-finance cotton (low return/low risk)
  - ▣ Project C: Intensive cotton technology with loan AND area-yield insurance
- Payoffs in each round again depend on:
  - ▣ Project chosen
  - ▣ Weather and individual shocks
  - ▣ Credit history
- Play 6 low-stakes rounds
- Play 6 high-stakes rounds

# Farmer's Earnings

- Farmers earn real money.
- Earnings based on payoffs of 4 randomly chosen rounds:
  - ▣ 1 from low stakes baseline game
  - ▣ 1 from high stakes baseline game
  - ▣ 1 from low stakes insurance game
  - ▣ 1 from high stakes insurance game
- Average earnings = \$8 (days ag. Wage)



# Determination of Payoffs

- Farmers placed in “Valleys”(3-5 people)













# Determination of Payoffs

- Farmers placed in “Valleys” (3-5 people)
- Each farmer owns one hectare of land.
- At the beginning of each round (season), each farmer chooses a project.
- End-of-season payoff determined by:
  - ▣ Farm income, which depends on:
    - Project chosen
    - Weather shock → determines average yield in valley
    - Individual luck → implies variation around valley average (*basis risk*)
  - ▣ Land value:
    - Land worth “\$1,000 dollars” if farmer maintains good credit history
    - Land values falls to “\$500” if farmer defaults
- If default, farmer denied future loans → Intensive cotton (projects A & C) no longer feasible.

# Weather Shock

## Average Valley Yield (WEATHER) Chips

Chip Color	Average Valley Yield	Number of Chips
Black	Very Low (23 QQ)	1 
Red	Low (30 QQ)	2  
White	Normal (37 QQ)	4    
Blue	High (43 QQ)	2  
Green	Very High (48 QQ)	1 

- After all farmers choose project, ONE farmer chooses a poker chip from the “Average Valley Yield” bag.
- Represents covariate shocks such as weather and pests
- Each color represents a different level of Average Valley Yield.
- Determines average yield for ALL farmers in the “valley”.
- Chip distribution based on historical valley yields.



# Will it be a good or bad year for the valley...????






Black Chip → Very Bad!!



# Individual Luck

## Individual Luck Balls


























Ball Color	Luck	Number of Balls
Purple	Bad	1 
Green	Normal	2 
Yellow	Good	1 

- Each farmer draws an individual luck ball
- Determines heterogeneity within valley (simulates basis risk)
- Ball distribution based on panel data set of cotton farmers



# Payoffs for Project A

## Project A: Intensive Cotton With a Loan

		Average Valley Yield											
		Very Low		Low		Normal				High		Very High	
													
Luck		0 (Debt)			250		800			1350		2000	
		0 (Debt)			600		1400			2100		2700	
		0 (Debt)			900		1900			2800		3400	
		0 (Debt)											

Worst Outcome:

When weather is very bad, cannot repay loan even with good individual luck.

Avg. Payoff = 1,350

Best Outcome

# Payoffs for Project B

## Project B: Self-Finance Cotton

		Average Valley Yield													
		Very Low			Low			Normal				High		Very High	
Luck		300			400			600				900		1350	
		350			450			650				1000		1500	
		400			500			700				1100		1650	

Worst Outcome

Avg. Payoff = 790

Best Outcome

# Baseline Game: Project A vs. Project B

## Project B: Self-Finance Cotton

		Average Valley Yield				
		Very Low	Low	Normal	High	Very High
Luck		300	400	600	900	1350
		350	450	650	1000	1500
		400	500	700	1100	1650

## Project A: Intensive Cotton With a Loan

		Average Valley Yield				
		Very Low	Low	Normal	High	Very High
Luck		0 (Debt)	250	800	1350	2000
		0 (Debt)	600	1400	2100	2700
		0 (Debt)	900	1900	2800	3400

B is better when things are really bad.

A is better otherwise.

# Baseline Results: % Farmers choosing A versus B

	<b>Project A (Cotton w/Loan)</b>	<b>Project B (Self-finance)</b>
Mean Payoff	1,350	790
Std. Dev.	1,080	430
All	75%	25%
Men	76%	24%
Women	71%	29%
Education		
None	56%	44%
Some primary	76%	24%
Some secondary	77%	23%
Farm Size		
< 2 ha	67%	33%
2 – 5 ha.	75%	25%
5 – 10 ha.	74%	26%
> 10 ha.	86%	14%

# Insurance Game

- Farmers start with “clean slate.”
  - ▣ Clean credit history.
  - ▣ Original (high) land value.
- Can choose from Projects A and B (as before) and new Project C.
- Project C is intensive cotton production with a loan **and** area-yield insurance.
- Insurance “contract” based on real area-yield product
- Logistics of Insurance.
  - ▣ Premium = 150 S/. (about \$50)
  - ▣ Indemnity paid if average valley yields are “Low” or “Very Low”  
→ thus avoids default.

## Project A: Intensive Cotton With a Loan

•When Avg Yields are Normal, High, or Very High:  
 •No insurance payment made  
 •Farmer's income higher *without* insurance  
 •Difference = Premium (150)

		Average Valley Yield											
		Normal				High				Very High			
Luck		800		1350		2000							
		1400		2100		2700							
		1900		2800		3400							

## Project C: Intensive Cotton with Loan and Insurance

		Average Valley Yield																			
		Very Low				Low				Normal				High				Very High			
Luck		150		150		650		1200		1850											
		500		500		1250		1950		2550											
		850		850		1750		2650		3250											



## Project A: Intensive Cotton With a Loan

		Average Valley Yield													
		Very Low			Low			Normal				High		Very High	
Luck		0 (Debt)			250			800				1350		2000	
		0 (Debt)			600										
		0 (Debt)			900										
		0 (Debt)													

- When Avg Yields are Low:
  - Insurance payment made
  - Payment is less than premium
  - Farmer's income again higher *without* insurance

## Project C: Intensive Cotton with Loan and Insurance

		Average Valley Yield													
		Very Low			Low			Normal				High		Very High	
Luck		150			150			650				1200		1850	
		500			500			1250				1950		2550	
		850			850			1750				2650		3250	

## Project A: Intensive Cotton With a Loan

		Average Valley Yield													
		Very Low			Low			Normal				High		Very High	
Luck		0 (Debt)		2000		2700				3400		2000			
		0 (Debt)		6000		12500				19000		25500			
		0 (Debt)		9000		15500				22000		28500			
		0 (Debt)		12000		19000				25500		32000			

- When Avg Yields are Very Low:
  - Large Insurance payment made
  - Payment allows farmer to repay loan
  - Farmer's income higher *with* insurance
  - And maintain good credit history
  - Without insurance, farmer defaults and earns 0

## Project C: Intensive Cotton with Loan and Insurance

		Average Valley Yield													
		Very Low			Low			Normal				High		Very High	
Luck		150		150		650				1200		1850			
		500		500		1250				1950		2550			
		850		850		1750				2650		3250			
		850		850		1750				2650		3250			

# Insurance Game Results:

## % Farmers Choosing Each Project

	<b>Project A (Loan)</b>	<b>Project B (Self-finance)</b>	<b>Project C (Loan &amp; Insurance)</b>
Mean Payoff	1,350	790	1,300
Std. Dev.	1,080	430	820
All	34%	14%	55%
Men	32%	13%	55%
Women	33%	15%	52%
Education			
None	43%	24%	33%
Some primary	35%	17%	49%
Some secondary	29%	8%	63%
Farm Size			
< 2 ha	30%	11%	59%
2 – 5 ha.	31%	14%	54%
5 – 10 ha.	37%	15%	47%
> 10 ha.	36%	11%	54%

# “Impact” of Insurance

		Insurance Game		
Baseline Game		A (loan)	B (self-finance)	C (loan & insurance)
	A (loan)	34%	8%	58%
	B (self-finance)	30%	28%	42%

- Of those that chose A (loan) in baseline game 58% purchased insurance (C) when it was offered.
- Of those that chose B (self-finance) in baseline game 42% purchased insurance when it was offered.
  - Index insurance can bring farmers afraid of risk into the credit market

# Summary

- In theory, index insurance is promising means of:
  - ▣ Reducing covariate (aggregate) risk in agriculture
  - ▣ Strengthening agricultural credit markets
- Lack of farmer understanding of insurance contracts is a significant barrier to demand.
- Educational strategies are key to market development.
- Experimental games offer hands-on, pro-active means to:
  - ▣ Educate farmers;
  - ▣ Evaluate potential demand.
- Peru pilot project suggests significant potential demand (50%)
- Will this translate into demand for real product?
  - ▣ Check back in one month.
- At least farmers will make informed choice.

# Lessons Learned

- Understanding of contract still imperfect.
  - ▣ *After games, 24% of farmers believed insurance payout depended on individual luck (based on exit survey)*
- Notion of Average-Yield is difficult.
  - ▣ Farmers do not trust government average yield figures
  - ▣ Farmers focus on potential yields (what the land should produce), instead of mathematical average
  - ▣ Both affect the way farmers play the game
- Spatial yield heterogeneity creates confusion
  - ▣ Yields vary significantly by zones *within* Pisco Valley.
  - ▣ Farmers in areas with higher than average yields felt insurance was not valuable because average yields in their zone unlikely to fall below strike-point.
  - ▣ Must convey point that co-movement of yields, not absolute level of yields, is what matters.

# ...in other words...

- We still have lots of work to do.
- Would like to learn from your outreach experiences.
- Thank You!

