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Farmers' preferences for chemical versus biological pest control methods: Evidence from choice experiments conducted in Burkina Faso

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Study Rationale

- Insect pests -- main biotic stress affecting cowpea production in Burkina Faso.
- For some insects (e.g., *Maruca vitrata*), conventional plant breeding has not been effective.
- To minimize insect pest damage, farmers are applying synthetic pesticides, which are expensive, unsustainable, and pose serious health and environmental risks
- Recognizing these challenges, IPM specialists have identified biological pest control strategies — involving natural enemies (parasitoids) combined with botanical biopesticides —as affordable, more effective, and non-toxic alternatives.
- In this paper we use choice experiment (CE) method to:
  - Elicit farmer's stated preferences for biological pest control strategy compared to existing pest control methods based on synthetic/chemical pesticides; and
  - Understand the effect of sharing the information about the health and environmental impacts of alternative pest control method on farmer's preference for biological versus chemical pesticides

Method

- Discrete Choice Experiment
  - Based on the Random Utility Theory that states that in a discrete choice problem, an individual derives utility from attributes of a chosen alternative
  - This method allows researchers to observe the probability of individuals choosing alternatives (stated preference) with different levels of attributes
- We designed and implemented a choice experiment (efficient design) that presented a farmer with 12 scenarios of different combinations of following attributes:
  - Type of pest control method (synthetic, organic, none)
  - Cost of pest control per 0.5 ha of cowpea area
  - Labor input
  - Production
- Resulting data are used to estimate farmers' willingness to pay for organic methods of pest control (mixed logit model)

Example of Scenarios

Scénario 2: Bloc 1

Les trois OPTIONS suivantes sont à votre disposition pour lutter contre les ravageurs sur un terrain de 0,5 ha cultivé en niébé

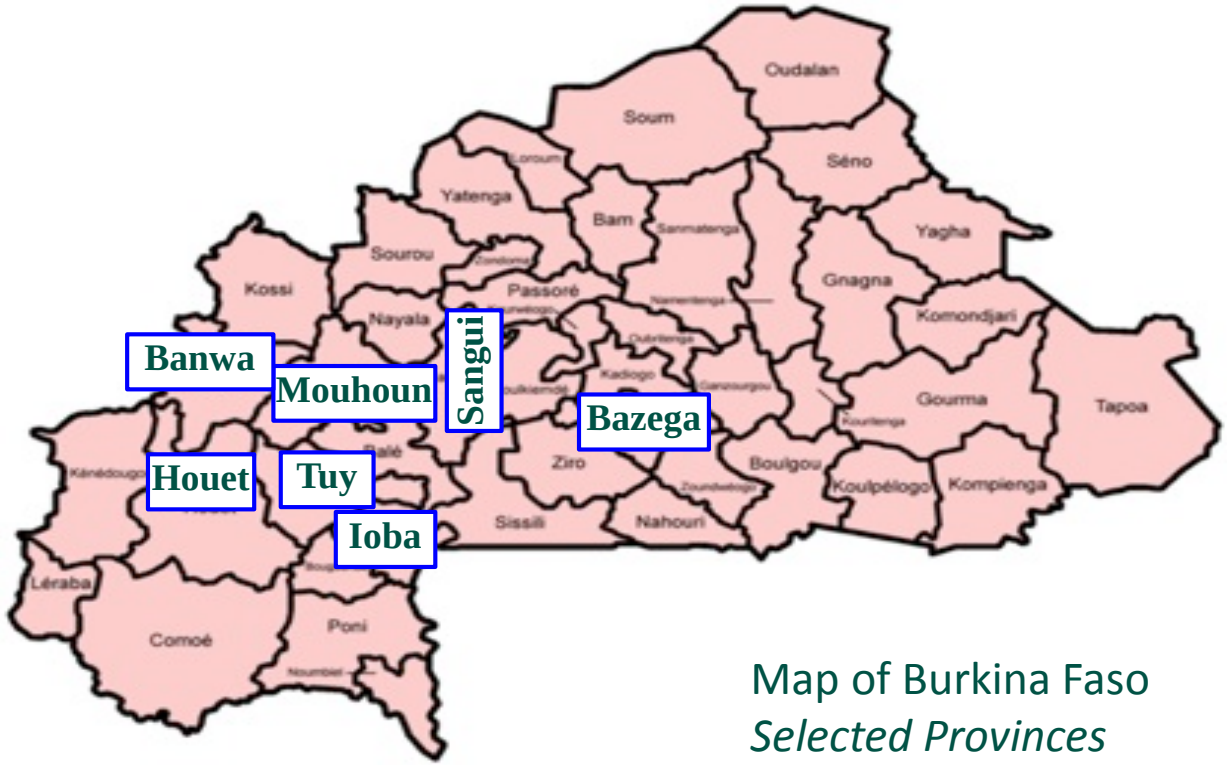
	Option A	Option B	Option C
Type de méthode de lutte contre les ravageurs	Pesticides Organiques (Bio-pesticide/Bio-contrôle) 	Pesticide chimique 	Je n'utiliserai aucune méthodes de lutte les ravageurs
Coût	1000 CFA 	5000 CFA 	0
La main d'œuvre 	3000 CFA 	3000 CFA 	0
la production du niébé 	100 KG 	200 KG 	100 KG 
Z1. Quelle option choisiriez-vous? *Noter la réponse dans la questionnaire*	○	○	○

Scénario 9: Bloc 1

Les trois OPTIONS suivantes sont à votre disposition pour lutter contre les ravageurs sur un terrain de 0,5 ha cultivé en niébé

	Option A	Option B	Option C
Type de méthode de lutte contre les ravageurs	Pesticide chimique 	Pesticides Organiques (Bio-pesticide/Bio-contrôle) 	Je n'utiliserai aucune méthodes de lutte les ravageurs
Coût	13000 CFA 	9000 CFA 	0
La main d'œuvre 	2500 CFA 	3000 CFA 	0
la production du niébé 	400 KG 	100 KG 	100 KG 
Z1. Quelle option choisiriez-vous? *Noter la réponse dans la questionnaire*	○	○	○

Data: Farmer Survey



Map of Burkina Faso
Selected Provinces

- 33 villages from seven provinces were selected from the pool of villages surveyed in 2011
- In each village 16 households were surveyed
  - 10 farmers from the baseline sample
  - Additional 6 farmers selected by the enumerators
  - Total sample size—33*16 = 528 households

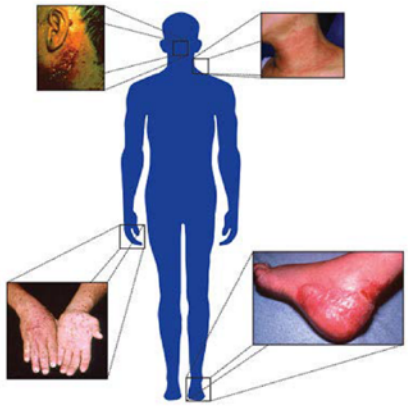
Information treatment

- To understand the effect of sharing the information about the health and environmental impacts of alternative pest control method on farmer's preference for biological versus chemical pesticides, the sample was divided into three random sub-samples
- Farmers in each randomly assigned sample were administered one of the following information treatments: i) health effects ii) environmental effects, and iii) both
- All farmers were presented the same 12 scenarios (in random order) before (block 1) the after (block 2) the information treatment

Environmental Effects of Alternative Pest Control Methods

Pesticide chimique/synthétique			Méthodes organiques (Bio-pesticide / Bio-contrôle)	
		VS.	  	
	Pollution dévastateur sur l'environnement -- Air, sol et eau	1	Ne causent pas de pollution	
	Dangereux aux espèces non-visées	2	Compatibles aux espèces non-visées	
	Les ravageurs finissent par devenir résistants	3	Les ravageurs ne développent jamais de résistance	

Health Effects of Alternative Pest Control Methods

Pesticide chimique/synthétique		Méthodes organiques (Bio-pesticide/ Bio-contrôle)
	VS.	
	Le corps humain est vulnérable aux effets toxiques, en particulier les enfants	1 Ne sont pas toxiques aux adultes et aux enfants
	Provoque l'irritation de la peau et d'autres types de problèmes liés à la peau	2 Ne sont pas dangereux à l'utilisation
	Peut causer des effets chroniques sur la santé, y compris de nombreux types de cancers	3 Ne provoquent pas d'effets négatifs sur la santé

Results

(Work in progress)

Farm characteristics (N=528)

Area devoted to cowpea (last season) (ha)	
Mean	0.98
Median	0.75
Total quantity of cowpea produced per household (kg)	356
Used pesticide in the last season (% yes)	87
Used biopesticides (% of those that applied)	3.4
Number of applications (those that applied)	3.8
Cost of pesticides used per ha (CFA)	
Average per HH	7,235
Median value	4,000
Pesticide cost as percentage of value of production	5.8

Farm characteristics (cont'd)

Severity of the damage caused by these insect pests in the last cowpea season (2016) (% of farmers)	Very severe or somewhat severe Not severe	49 51
Severity of the damage caused by these insect pests in the last cowpea season (2016) (% of farmers)	% of farmers reporting cowpea as the top two most important crop on which they applied chemical pesticides in 2016 season	78
Did you know that Neem oil biopesticide currently available kills all cowpea pests but NOT *Maruca* caterpillars?	% Yes	15
Have you heard about plant-based biopesticides that can be prepared from…..? (%)	Neem leaves Neem seeds	41 49
Knowledge of beneficial insects	% Yes	15
Knowledge of viruses	% Yes	2
Received training on IPM	% Yes	33
Do you think pesticides are harmful/toxic to people if they are exposed to them?	% Yes	99
Does anyone you know (friend or family) have died due to pesticide poisoning?	% Yes	52
Does anyone you know (friend or family) have been sick due to pesticide poisoning?	% Yes	69

Choice Experiment: Descriptive Results

Number of farmers choosing the following option (before/after information)		
	Before	After
Synthetic pesticides	33%	10%
Organic pesticides	57%	79%
None	10%	10%
Mean cost level chosen (CFA/0.5 ha)	5,236	5,537
Mean prod level chosen (kg/0.5 ha)	208	165
Certainty of choice (%)	87%	91%

Choice Experiment Preliminary Results: Mixed Logit Model

Willingness to pay (WTP) for organic method (biopesticides/biocontrol) relative to synthetic pesticides (CFA per 0.5 ha)

Type of information provided	N (number of farmers)	Mean max. WTP		Treatment effect
		WTP Before	WTP After	
Environment	174	12,940	58,320	4.5 x
Health	177	13,820	55,200	4.0 x
Both	177	21,540	56,480	2.6 x

Conclusions and implications

- Survey results indicate that about 6% of the market value of harvested cowpea grains is allocated to purchasing chemicals for pest control. For cash-constrained farm households, this expenditure is nontrivial.
- Cowpea farmers in Burkina Faso are aware of health hazards from chemical pesticides but continue to use out of necessity;
  - Lack of awareness of safe alternative pest control methods (i.e., biocontrol, viruses)
  - Lack of knowledge on how to prepare/access biopesticides

Conclusions and implications (cont'd)

- In general, farmers are willing to pay higher cost and lower production for more safer pest control method relative to synthetic pesticides → There is high potential for biocontrol strategy to be widely accepted
- Information on environmental and health effects of pest control methods was highly effective in increasing farmers' willingness to pay for organic pesticides relative to synthetic pesticides →
  - Systematic campaigns to increase awareness and to provide technical knowhow on the preparation, use and availability of biopesticides, are needed to improve adoption of these alternative methods
  - Incorporating the information on the environmental and health effects of alternate pest control methods in these campaigns can significantly improve

Next steps

- Refine logit model estimations
  - Estimate WTP for each farmer
- Calculate market shares of pest control

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Thanks

Welcome questions and feedback