A choice experiment to evaluate small-holder farmers' preference for improved native chili pepper variety traits in the Northern coast of Peru

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Danish Choice Modelling Day

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Overall setting

Project (2010-2012): ***"Unraveling the potential of neglected crop diversity for high-value differentiation and income generation for the poor: The case of native chili peppers in its center of origin (Peru and Bolivia)".***

Peru and Bolivia are considered the center of diversity of chili peppers (over 3,000 varieties). Many are becoming extinct.

Chili peppers are rich in vitamins, antioxidants, and capsaicin, a component used for medicinal applications.

Farmers face many problems associated to increased pest attacks and higher yield variability (related to climate change).

Evaluate the possibility of developing improved seeds to stimulate pro-poor growth and on-farm biodiversity conservation.

Introduction

- **Conventional plant breeding** has been used to produce improved crops (open pollinated or hybrid varieties) for thousands of years.
- Conventional breeding methods can be reduced in two steps:

1) Identifying parent traits that complement each other (the strengths of one parent moderate the shortcomings of the other).
2) Selecting among the offspring for individuals that combine the most useful traits of the parents with the fewest of their failings.

- **Pros:** It is relatively inexpensive (if breeding time is not considered), technically simple, and free of government regulation.
- **Cons:** constrained genetic variation, and it requires multiple generations to find individuals that combine the best qualities.

Introduction

Conventional breeding generally cannot produce all the plant traits that breeders/ farmers desire at the same time.

When plants are crossed, many traits are transferred along with the traits of interest – including undesirable effects on yield potential.

The local partner (INIA) wanted to know the farmers' trade-off between potential lower yields and other crop traits of interest, in particular pest resistance and crop production stability (feasibility to start a new chili pepper conventional breeding program).

Objective:

Evaluate farmers' potential trade-off between the amount of yield and:

a) pest and disease crop tolerance.

b) crop production stability.

Farmer preferences for crop traits

- Asrat *et al.* (2004) used a choice experiment to evaluate farmers' trade-offs between productivity, environmental adaptability, yield stability, and farmers' on-gate prices of sorghum and teff in Ethiopia.
- Random parameters model with uncorrelated parameters. They found ASC, estimates, & standard deviations to be positive and significant.
- Environmental adaptability > yield stability > productivity.
- Other related studies:

  Baidu-Forson *et al.* (1997) evaluated farmers' preference for groundnut traits in Niger (leaf spot resistance > pod yield > short cycle plant > haulm yield)

  Blazy *et al.* (2011) assessed farmers' preference for banana cultivation characteristics in The Caribbean (fallow period > intercropping > variety).

Sampling procedure

- Complete sample: we interviewed all the 107 members (yellow chili growers) of the farmer community “Los Ejidos de Piura” in 2011.

Questionnaire design

- The questionnaire was mainly designed to collect data about the cost and benefits of farmers as part of a chili pepper value chain analysis.
- Questionnaire parts:

(I) General information
(II) Detailed production costs
(III) Marketing and transportation costs
(IV) Social capital and opinions
(V) Changes in chili pepper production during the last years
(VI) Choice experiment
(VII) Household characteristics and other sources of income
(VIII) Vulnerability and shocks
(IX) Risk aversion

Choice set design

Attributes and levels of the choice experiment

Attributes	Levels
Yield (Quintal /Hectare)	120, 140, 160, 180, 200
Pests and diseases tolerance (Does not require chemical pesticides)	Yes, No
Production stability (Similar yield year after year regardless of average climate conditions)	Yes, No

Example of choice set

We are going to present you three different options of yellow chili pepper seeds. Please, select the option that you would prefer the most to cultivate in your agricultural plot. There is no correct or incorrect answer. Assume that the attributes that are not mentioned remain the same.

	Option A	**Option B**	**Option C**
Yield (Quintal /Hectare)	180	160	140
Pests and diseases tolerance (Does not require chemical pesticides)	No	Yes	Yes
Production stability (Similar yield year after year regardless of average climate conditions)	Yes	No	Yes
Mark your selected option (with an X)			

About the opt-out alternative

- Farmers had to choose among one of the alternatives. There was no possibility of opting out ("I prefer none of the options").
- Other CE studies without opt-out alternative include: Asrat *et al.* (Ecological Economics, 2010), and Carlsson *et al.* (AJAE, 2007).
- Non opt-out alternative when:

(a) The focus of the study is not related to measure the potential purchase or market share of new seeds/ products.

(b) The focus is exclusively in the trade-offs among the characteristics.

- In our case, the seeds would be distributed for free by the governmental organization and farmers would end up cultivating them (easier to do than to collect their own seeds).

Econometric model results

Variable	With ASC			Without ASC		
	MNL	RPL uncorrel.	RPL correl.	MNL	RPL uncorrel.	RPL correl.
Yield (Quintal /Hectare)	0.0076 (0.0063)	0.0133 (0.0135)	0.0118 (0.0148)	-0.0058*** (0.0013)	-0.0061*** (0.0016)	-0.0126*** (0.0032)
S.D. Yield (Quintal /Hectare)	-	0.0484*** (0.0161)	0.0661 (0.0445)	-	0.0048 (0.0031)	0.0171*** (0.0060)
Pests & disease tolerance	1.3924*** (0.2764)	2.6964*** (0.7547)	2.8742*** (0.8879)	1.1500*** (0.1948)	1.3366*** (0.2527)	2.1955*** (0.5513)
S.D. Pests & diseases tolerance	-	3.4302*** (1.3500)	4.1263** (1.7745)	-	0.9676 (1.0907)	2.5404*** (0.8805)
Production stability	0.7422*** (0.2642)	1.4319*** (0.5456)	1.5067** (0.6158)	0.3719** (0.1905)	0.3711 (0.2567)	0.6557* (0.4088)
S.D. Production stability	-	3.5251*** (1.3580)	1.9329 (1.5296)	-	1.8970** (0.7735)	3.6887*** (1.0722)
ASC	-0.0228 (0.1547)	0.1804 (0.2731)	0.2272 (0.3170)	-	-	-
McFadden Ps R^2	0.1218	0.1862	0.1956	0.0967	0.1077	0.1336
AIC	1.9527	1.8538	1.8613	2.0082	2.0167	1.9880

Significant at: *** 0.01, ** 0.05, *0.10. Number of respondents =107. Number of observations = 213.

Beharry-Borg & Scarpa (2010) did not include ASC in the model, because it was not significant.

Results

Cholesky decomposition matrix

	Production stability	Yield (Quintal /Hectare)	Pests and diseases tolerance
Production stability	3.6887*** (1.0722)	0	0
Yield (Quintal /Hectare)	0.0127* (0.0075)	0.0114** (0.0045)	0
Pests and diseases tolerance	-0.8192 (1.2578)	-1.9555*** (0.7318)	1.3994 (1.1371)

Significant at: *** 0.01, ** 0.05, *0.10

Mean of the trade-off between attributes

Attribute	Average trade – off value	
	Using only mean values of coefficients	In percentage of yield
Production stability / Yield	52	26
Pests and diseases tolerance / Yield	174	87

As calculated by Hu *el al.* (2005)

Note: Daly *et al.* (2012) suggest that neither the mean nor the distribution of a ratio of random coefficients may have finite moments.

Results: Estimates by type of farmer

		Production stability	Yield (Quintal /Hectare)	Pests and diseases resistance
Gender	Male	1.7676	-0.0107	1.2404
	Female	0.3556	-0.0123	2.3149
Education	0-5 years	0.1387	-0.0112	2.1884
	6-10 years	0.3457	-0.0117	2.1620
	≥ 11 years	1.2210	-0.0160	2.7143
Agricultural plot area (hectares)	≤ 0.5	0.2401	-0.0119	2.2516
	>0.5 ≤1	0.4406	-0.0109	2.0161
	>1	0.7951	-0.0146	2.6098
Yellow chili pepper area	≤ 150 m^2	0.1827	-0.0118	2.2563
	> 150 m^2	0.7002	-0.0129	2.2966
Productivity (Quintal/Ha)	≤ 200	1.2169	-0.0150	2.4355
	> 200	0.4975	-0.0126	2.2986
Expenses in pesticides per m^2 of chili	S/ 0-0.25	0.2659	-0.0114	2.1759
	> S/0.25	0.8454	-0.0148	2.5721

Preliminary conclusions

- The farmers are in average around three times more concerned with pesticide usage than with obtaining a stable production. Farmers show heterogeneous preferences for yields.

- Accounting for heterogeneity creates a problem in the calculation of the individual level trade-off values, when yield is used as denominator (some values explode when yield coefficients are close to zero).

- Next step: re-parameterising the model in WTP space so that the individual-level distribution of WTP is estimated directly rather than derived (Daly *et al.*, 2012).

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Thank you!!!