



# Determinants of variety choice among potato growers in the Bolivian highlands

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- Michael Castelhano, Virginia Tech
- Jeffrey Alwang, Virginia Tech
- Ruben Botello, PROINPA, Bolivia
- Nick Kuminoff, Virginia Tech



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# Background

- Potato producers in the Bolivian highlands adopt many varieties of potatoes
- Variety selection depends on attributes of the potato, including yield, tastes, disease and pest resistance, and resistance to frost and drought
- Variety choice also depends on producer attributes, such as education, household labor availability, and access to information; access to and performance of markets may be critically important
- When markets are not available, farmers would be more likely to select varieties for taste and storage characteristics; remote farmers may plant highly diversified variety profiles due to individual tastes and preference and exposure to different risks (market and others)
- Variety development should include considerations of farmer demand for attributes

# Objectives

- To understand the role of variety specific risk characteristics in potato variety selection decisions made by farmers in Bolivian highlands
  - Describe risk-related and other characteristics of alternative varieties
  - Analyze farmer household characteristics, risk concerns and demand for potato attributes
  - Analyze the determinants of “demand” for potato attributes
- Provide information for potato researchers relative to farmer preferences for different variety attributes

# Methods

- Review of literature of variety studies:
  - Dalton (West Africa-rice); DeFalco, Chayas and Smale (Ethiopia-wheat); Smale (various Malawi & Ethiopia); a number of studies by Renkow (Honduras-maize)
  - Shively and friends (adoption of soil conservation-Philippines)
  - Edmeades & Smale (plantain in Uganda)
- Major points:
  - Risk attributes may be a strong deterrent to adoption of variety and techniques
  - Distance to market has been found to affect the risk/return tradeoffs



# Methods

- Interviews with scientists and extension personnel (November 2008):
  - Identify varieties and their attributes
  - Describe current research program: main constraints being addressed through potato research
- Survey of farmers (November 2008):
  - Survey instrument: initial design at VT, review and revisions in consultation with Fundacion PROINPA
  - Based on previous SANREM work (baseline surveys) in Bolivia and Ecuador, but modified to account specifically for variety characteristics and exposure to risk
  - Implementation: three villages in Cochabamba Department, 145 total interviews
- Research (data collection) was designed to increase variation in climatic and market conditions

# Household Survey Locations

- Toralapa (20):
  - High altitude, dry, frost-prone
  - Good road access (major paved road nearby goes right to Cochabamba city).
  - Problem with Toralapa is that a single variety predominates due to market integration and preferences for uniform varietal characteristics
- Colomi (68):
  - More moisture (typically) than Toralapa
  - Much more diversity in potato plantings
  - Less frost (more blight)
  - Good paved road access, many cobbled roads in smaller villages; major road to Cochabamba is nearby
- Morochata (57):
  - More moisture than Toralapa; warmer by reputation (no weather station)
  - Home to PROINPA-supported breeding program
  - Relatively poor road conditions - necessary to travel on steeply sloped areas to get around; washouts frequent on many roads; to reach Cochabamba it's necessary to cross Andean ridge; fairly remote

# Colomi





# Road to Morochata



# Potato Market in Colomi





# Methods: Theory and Econometric Model

- Basic modeling focus: households make decision about how much to plant of each of variety encountered (choice set). Implicit assumption is that household could plausibly plant each variety (technology set is available to all)
- Expected utility maximization subject to variety availability constraints (risk averse, safety first framework) and stochastic production and prices
- Decision is modeled as a function of variety characteristics and household characteristics
- We observe many zero values for the dependent variable
  - Many farmers plant zero acreage of many varieties
  - No farmer plants every variety

# Econometric Model

- Tobit model used to account for truncation in the dependent variable:

- $$E(V|X; Y \geq 0) = XB + E(U_V | U_V \geq X_V B_V)$$

- where:

- $V$  = area planted to a single variety ( $0 \leq V \leq 4$ )

- $Y$  = Unobserved latent variable representing demand for variety

- $X$  = variety and household characteristics

- $B$  = vector of parameters

- Each variety characteristic will have one coefficient

- Each household characteristic will have eleven coefficients (one for each variety)

- Desired results of the project:

- How do variety characteristics impact potato planting decisions?
- Coefficients of variety characteristics will quantify farmers revealed preferences for different characteristics

# Results: Potato Varieties

- During interviews with PROINPA researchers and field visits, we identified a total of 11 varieties (8 or more observations of variety adoption)
- Blight tolerance is the most common “improved” characteristic; others include shorter growing season, differential water tolerance
- Very little insect resistance (possibly related to ease of obtaining pesticide in region) in any of the varieties
- Varieties studied cover about 90% of potato planting area in the three study communities (Colomi 86%; Morochata 93%; Toralapa 98%)
- All 11 varieties are present in Colomi; 5 in Toralapa; 8 in Morochata

# Results: Potato Varieties

- 53 names recorded for varieties in 145 surveys
- Waych'a by far the most common (124 obs.)
  - Average area planted 0.4 Ha.
  - Moderately tolerant/resistant to nematodes, frost, drought and hail
  - Performs well in poor soil; fairly high yielding
  - Heavily marketed in cities (restaurants, intermediaries, etc.)
  - Often used as a benchmark for comparison (most familiar) of new varieties
- HH (also called Runa Toralapa) (52 obs, on average 0.24 Ha.)
  - Blight resistant (most common blight resistant cultivar in survey)
  - High yields (comparable to Waych'a)
  - Price was generally lower than Waych'a in 06-07
- -Pinta Boea: occurs often (50 obs.), but in small plantings (on average .09 Ha.)
  - Lower yielding, less resistance to pests, disease, climate
  - Traditional to serve to guests, friends/family and on Easter Holiday
  - Larger portion of crop planned for home consumption (average 40% of crop is home-consumed) than other common varieties

# Results: Variety Attributes

- Most plantings and varieties are planned for multiple end-uses (consumption and sale)
- Farmers generally do not differentiate between varieties in terms of their input requirements (including agro-chemicals)
  - Example 1: one question asked about fertilizer use, and MANY farmers were only able to provide information on total quantity of fertilizer purchased and stated that it was spread evenly throughout the farm
  - Example 2: most farmers stated that they sprayed all the varieties evenly for pests/disease; even resistant varieties were reportedly sprayed for late blight (for those farmers who sprayed for late blight)
- Risk characteristics are categorical: highly susceptible, moderately susceptible, moderately tolerant, highly tolerant. (moderately susceptible is base category)
  - Information on risk tolerance comes from PROINPA personnel and publications (particularly Julio Gabriel)



# Results: Summary Statistics

		Colomi		Morochata		Torolapa	
		Mean	Srd	Mean	Srd	Mean	Srd
Household Characteristics							
Household Size		5.8	2.4	5.4	2.5	5.4	2.2
Head's Age		42.9	14.7	43.5	12.9	39.4	11.6
Head Primary Education		0.8	0.4	0.9	0.4	0.7	0.5
Head Secondary Education		0.06	0.24	0.05	0.23	0.05	0.2
Members Participating in Potato Activities		3.2	1.7	3.1	1.8	3	1.5
Members Participating in Non-farm Income Generation		0.5	1.1	0.2	0.7	0.1	0.3

# Results: Summary Statistics

		Colomi		Morochata		Torolapa	
		Mean	Std	Mean	Std	Mean	Std
Area Planted to Potato		0.65	0.4	0.52	0.64	1.17	1.18
Pct Certified Seed		0.31	0.47	0.32	0.47	0.3	0.47
Number Varieties Planted		5.22	2.27	2.07	1.15	1.75	1.02
Pct Receiving Credit		0.22	0.42	0.05	0.23	0.2	0.41
Pct Farmer Organizations		0.56	0.5	0.95	0.23	0.9	0.3
Pct Visiting Market Weekly		0.79	0.4	0.23	0.42	0.85	0.22
Pct Hiring Labor		0.54	0.5	0.32	0.47	0.65	0.37

# Results: Summary Statistics

- Household size and age very similar across regions
  - Landholdings differ, but total numbers of household members participating in potato production is similar
- Most participation in off-farm activities is found in Colomi (access to transportation and nearby labor markets)
- Large difference in number of varieties planted
- Differential access to credit, possibly related to access to markets. Eg.: very little credit availability in Morochata
- Strength of farmer organizations varies: most isolated farmers are more likely to participate in organizations
- Farmers outside of Toralapa visit the market less frequently
- More agricultural market and labor market participation in Toralapa

# Preliminary Results: Model Estimation

- Not yet ready for prime time
- Yield attributes do not appear to be as important determinants of variety selection as are disease resistance and taste; risk management is an important consideration when choosing potato varieties
  - Yield is more important in Toralapa and least important in Colomi
  - Quantitative tradeoffs between different attributes are measured: substitutability is increased in towns that are closest to markets; distance also affects substitutability within towns (more remote  $\rightarrow$  less substitutability)
  - Substitutability between attributes varies by location: less substitution in remote areas
- No statistically significant relationship between landholding size and degree of diversity in variety adoption.
- Household labor availability is significant; tradeoffs between labor and timing of harvest
- Farmer education (weakly) associated with adoption of fewer varieties
- Access to markets associated with fewer varieties being adopted; the most remote households are the most diversified

# Summary and Conclusions

- We have quantitative information about tradeoffs Bolivian highland potato farmers make between attributes like yield, taste and risk
- These tradeoffs depend on farmer location, land farmed and education, with location being the most important determinant
- Information can be used to guide variety development; there is a clear need to have a number of varieties with different attributes
- Information from this study can be incorporated into an outreach program