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How do coffee farmers adapt to perceived changes in climate? Evidence from Central America

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Introduction

- Small landholders are important
 - In Central America, 41.4% of the population is rural, 10-20% of GDP is dependent on small scale agriculture, agriculture is also main food source
 - Often located in areas of high biodiversity
- Highly vulnerable to climate change
 - Limited capital, income, small land size (<2 ha), and location in marginal or fragile lands
 - Limited access to technical assistance or credit
 - High dependence on ecosystem services (flood control, shade, etc)



Introduction

Two central questions:

- Are coffee farmers perceiving changes in climate?
- Are coffee farmers modifying their farming practices in response to climate change? If so, what changes are they making?

Policy relevance: Without adaptation, climate change will have significant impacts on agricultural production and farmer livelihoods, threatening food security and biodiversity conservation



Methodology





Methodolgy

In previous literature (including Di Falco (2011) in Ethiopia and Roco (2013) in Chile), the following factors have been found to influence farmer adaptation to climate change:

- *Household characteristics:* gender of the head, diversification of income sources, education and experience
- *Farm characteristics:* diversification of activities, land ownership, farm size
- Social capital: participation in organizations
- Access to services: training, credit
- Weather patterns temperature and rain



Methodology

We present preliminary results about adaptation decision using a multivariate method that allows us to relate adaptation decisions to potential explanatory variables, for example:

- 1.Farmer's characteristics
- 2. Current farming practices
- 3.Actual climate and variability
- 4.And access to services

Household data was collected with a survey



Weather data is from world clim (average 1950-2000)

Methodology



- Data was collected in 2014, as part of the CASCADE project, in 4 landscapes of Costa Rica, Guatemala, and Honduras
- A random sample of farmers were selected in each landscape. 490 are coffee growers and sellers
- The instrument has 570 possible questions and a median duration of 60 min

Results





Acatenango, Guatemala

| Median farm area, ha | 1.12 |
|-----------------------------------|-------|
| Median coffee area, ha | 0.70 |
| Mean # fertilizer applications | 1.85 |
| % of farms with maize or beans | 50.40 |

Los Santos, Costa Rica

| Median farm area, ha | 2.90 |
|-----------------------------------|------|
| Median coffee area, ha | 2.10 |
| Mean # fertilizer applications | 2.69 |
| % of farms with maize or beans | 2.50 |

Turrialba, Costa Rica

Median farm area, ha2.00Median coffee area, ha1.00Mean # fertilizer
applications1.59% of farms with maize or
beans9.30

Yoro, Honduras

| Median farm area, ha | 2.79 |
|-----------------------------------|------|
| Median coffee area, ha | 1.40 |
| Mean # fertilizer applications | 1.59 |
| % of farms with maize or beans | 66.7 |

Farmers's perception of changes in climate



2015

Have farmers done something if they have perceived changes in climate?



CLIMATE-SMART Agriculture

Perception of changes in climate

- 91% of the farmers reported an increase in temperature in the last 10 years
- Perceived changes in rainfall:
 - 56% reported a decrease in yearly rain,
 - 24% mentioned that the rain is concentrated in fewer days,
 - 20% mentioned greater uncertainty about the onset of the raining season



Adaptation in Response to Changes in Temperature



19%

14%

51%

14%

CIIMATE-SMAR

Agriculture

Adaptation in Response to Changes in Rain



20%

12%

CIIMATE-SMART

Agriculture

Adaptation may be overestimated

"General answer" may indicate lack of adaptation



Adaptation may be overestimated

"General answer" may indicate lack of adaptation



MEASURES OF ADAPTATION USED IN THE ANALYSIS

Household and farm characteristics and adaptation

| | Households | % Adaptation |
|----------------------------|------------|--------------|
| Education | | |
| No schooling | 60 | 42% |
| More than primary | 87 | 74% |
| Sources head's income | | |
| Farm only | 275 | 55% |
| Mixed | 195 | 64% |
| Head owns livestock | | |
| No | 324 | 57% |
| Yes | 146 | 63% |
| Head rents all coffee land | | |
| Yes | 461 | 58% |
| No | 9 | 77% |



Access to services, social capital and adaptation

| | Household | %Adaptation |
|-------------------------|-----------|-------------|
| Received training | | |
| No | 332 | 53% |
| Yes | 138 | 72% |
| Visited by agronomist | | |
| No | 314 | 54% |
| Yes | 155 | 69% |
| Access to weather fored | ast | |
| No | 39 | 31% |
| Yes | 431 | 61% |
| Belong to organization | | |
| No | 349 | 54% |
| Yes | 121 | 74% |



Selected factors in multivariate analysis

| Head of household | |
|-----------------------------------|------|
| % Head is female | 16.3 |
| Mean age of head | 52.5 |
| % No education | 11.2 |
| % More than primary education | 18.0 |
| Mean experience | 34.1 |
| % Head works off farm | 41.6 |
| % Head has a mobile phone | 84.1 |
| Farm characteristics | |
| % Coffee area less than 1 ha | 38.4 |
| % Has at least 3 other activities | 40.0 |
| % Owns animals | 28.6 |
| % Rents all coffee land | 1.9 |
| Access to services/Social Capital | |
| % Visited by agronomist+trained | 42.9 |
| % Has a loan | 25.3 |
| % Particpates in organization | 36.7 |
| Weather data | |
| Mean mean temperature (C) | 20.0 |
| Mean annual precipitation (mm) | 2358 |



Do farmers make any adaptations in response to either changes in temp or rain?

| Variable | Sing | Signific |
|------------------------------------|------|----------|
| Household characteristics | | |
| Head is female | - | |
| Age of head | - | * |
| Head does not have education | - | |
| Head has more than primary educ | + | |
| Experience | + | *** |
| Head works off farm | + | |
| Head has a mobile phone | + | |
| Farm characteristics | | |
| Coffee area less than 1 ha | - | *** |
| Has at least 3 other activities | + | |
| Owns animals | + | |
| Rents all coffee land | + | |
| Access to services and soc capital | | |
| Visited by agronomist+trained | + | |
| No access to weather forecast | - | *** |
| Has a loan | + | |
| Particpates in organization | + | *** |
| Weather data | | |
| Mean temperature | + | * |
| Mean precipitation | - | |
| Coef variation precipitation | _ | |

Note: Fixed effect logit

Significant at: * 10%, ** 5%, ***1%, observations: 455, Pseudo R2=0,22

| Do farmers make |
|--------------------|
| any adaptations in |
| response to either |
| changes in temp or |
| rain? |

| Variable | Sing | Signific |
|------------------------------------|------|----------|
| Household characteristics | | |
| Head is female | - | |
| Age of head | - | * |
| Head does not have education | - | |
| Head has more than primary educ | + | |
| Experience | + | *** |
| Head works off farm | + | |
| Head has a mobile phone | + | |
| Farm characteristics | | |
| Coffee area less than 1 ha | - | *** |
| Has at least 3 other activities | + | |
| Owns animals | + | |
| Rents all coffee land | + | |
| Access to services and soc capital | | |
| Visited by agronomist+trained | + | |
| No access to weather forecast | - | *** |
| Has a loan | + | |
| Particpates in organization | + | *** |
| Weather data | | |
| Mean temperature | + | * |
| Mean precipitation | - | |
| Coef variation precipitation | - | |

Note: Fixed effect logit

Significant at: * 10%, ** 5%, ***1%, observations: 455, Pseudo R2=0,22

Do farmers make any adaptations in response to changes in temperature?

| Variable | Sing | Signific |
|------------------------------------|------|----------|
| Household characteristics | | |
| Head is female | - | |
| Age of head | - | * * |
| Head does not have education | - | * * |
| Head has more than primary educ | + | * |
| Experience | + | *** |
| Head works off farm | + | |
| Head has a mobile phone | + | ** |
| Farm characteristics | | |
| Coffee area less than 1 ha | - | *** |
| Has at least 3 other activities | + | |
| Owns animals | + | |
| Rents all coffee land | + | |
| Access to services and soc capital | | |
| Visited by agronomist+trained | + | |
| No access to weather forecast | - | ** |
| Has a loan | + | |
| Particpates in organization | + | *** |
| Weather data | | |
| Mean temperature | + | |
| Mean precipitation | - | |
| Coef variation precipitation | + | |

Note: Fixed effect logit

Significant at: * 10%, ** 5%, ***1%, observations: 446, Pseudo R2=0,20

Do farmers make any adaptations in response to changes in temperature?

| Variable | Sing | Signific |
|------------------------------------|------|----------|
| Household characteristics | | |
| Head is female | - | |
| Age of head | - | ** |
| Head does not have education | - | ** |
| Head has more than primary educ | + | * |
| Experience | + | *** |
| Head works off farm | + | |
| Head has a mobile phone | + | ** |
| Farm characteristics | | |
| Coffee area less than 1 ha | - | *** |
| Has at least 3 other activities | + | |
| Owns animals | + | |
| Rents all coffee land | + | |
| Access to services and soc capital | | |
| Visited by agronomist+trained | + | |
| No access to weather forecast | - | ** |
| Has a loan | + | |
| Particpates in organization | + | *** |
| Weather data | | |
| Mean temperature | + | |
| Mean precipitation | - | |
| Coef variation precipitation | + | |

Note: Fixed effect logit

Significant at: * 10%, ** 5%, ***1%, observations: 446, Pseudo R2=0,20

| | Variable | Sing | Signific |
|--------|------------------------------------|------|----------|
| ako | Household characteristics | | |
| Ianc | Head is female | - | |
| ons in | Age of head | - | |
| | Head does not have education | - | |
| | Head has more than primary educ | + | |
| | Experience | + | * |
| in: | Head works off farm | + | |
| | Head has a mobile phone | + | |
| | Farm characteristics | | |
| | Coffee area less than 1 ha | - | * |
| | Has at least 3 other activities | - | |
| | Owns animals | + | |
| | Rents all coffee land | + | |
| | Access to services and soc capital | | |
| | Visited by agronomist+trained | + | * |
| | No access to weather forecast | - | |
| | Has a loan | - | |
| | Particpates in organization | + | *** |
| | Weather data | | |
| | Mean temperature | + | *** |
| 1% | Mean precipitation | - | ** |
| 14 | Coef variation precipitation | - | * |

Do farmers make any adaptations in response to changes in rain?

Note: Fixed effect logit Significant at: * 10%, ** 5%, ***1 observations: 429, Pseudo R2=0,1

| | Variable | Sing | Signific |
|---------------------------------------|------------------------------------|------|----------|
| Do farmers make any adaptations in | Household characteristics | | |
| | Head is female | - | |
| | Age of head | - | |
| | Head does not have education | - | |
| response to | Head has more than primary educ | + | |
| changes in rain? | Experience | + | * |
| | Head works off farm | + | |
| | Head has a mobile phone | + | |
| | Farm characteristics | | |
| | Coffee area less than 1 ha | - | * |
| | Has at least 3 other activities | - | |
| | Owns animals | + | |
| | Rents all coffee land | + | |
| | Access to services and soc capital | | |
| | Visited by agronomist+trained | + | * |
| | No access to weather forecast | - | |
| | Has a loan | - | |
| | Particpates in organization | + | *** |
| | Weather data | | |
| Note: Fixed effect logit | Mean temperature | + | *** |
| Significant at: * 10%, ** 5%, ***1%, | Mean precipitation | - | ** |
| observations: 429, Pseudo R2=0,14 | Coef variation precipitation | - | * |

Do farmers any adaptat response to changes in r

Conclusions





Conclusions

Our preliminary analysis suggests that:

- having greater experience and greater social capital (i.e. being a member of a community organization) are related to an increase in the the likelihood of making at least one adaptation to climate change
- having less than one ha of coffee and having no access to weather reports are related to a lower likelihood of making a climate change adaptation

We found mixed evidence of the effect of access to extension services and training on the probability of adaptation



Recommendations

- With the preliminary results we have, recommendations are far from being final
- We found between 42 to 56% of farmers mention they have perceived changes in temperature and rain and done something
- But reported adaptation is concentrated in few practices, improving training and extension seem relevant
- Improving social capital and access to weather information may encourage farmers to adapt to climate change



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