Evaluating the Impact of Training on Farmer Productivity: The MCA Ghana Programme

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Outline

- An Introduction
  - MCA – Ghana Programme:
- Approach
  - Key hypotheses
  - Design
  - Surveys
- Results
  - Summary statistics
  - Impact Analysis
- Conclusions

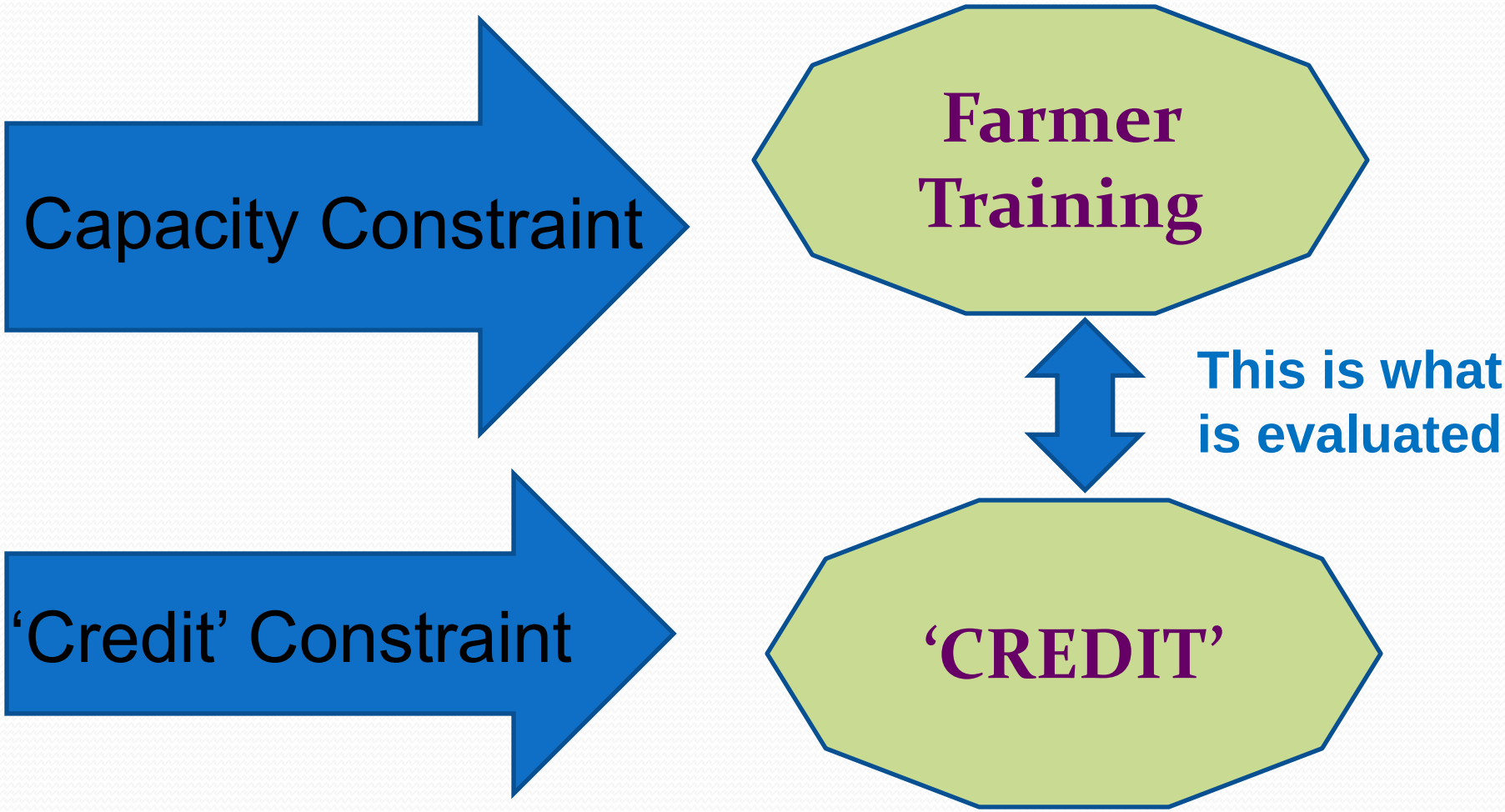
Introduction

- The overall goal of the MCA-Ghana programme is to reduce poverty through agriculture transformation
- This is being done by addressing two sub-goals
  - Increasing production and productivity of high-value cash and staple food crops
  - enhance the competitiveness of horticulture and other traditional crops of Ghana
- The programme is being implemented under three projects
  - Agricultural Project
  - Transportation Project
  - Rural services Project

Intro - Contd

- The Agriculture Project has the following components
  - **Farmer and Enterprise Training in Commercial Agriculture**
  - Irrigation development
  - Land tenure facilitation
  - Improving post harvest handling
  - **Improve credit services**
  - Feeder roads improvements
- The MCA-Ghana programme covers 30 districts (initially 23 but changed with a re-demarcation exercise)

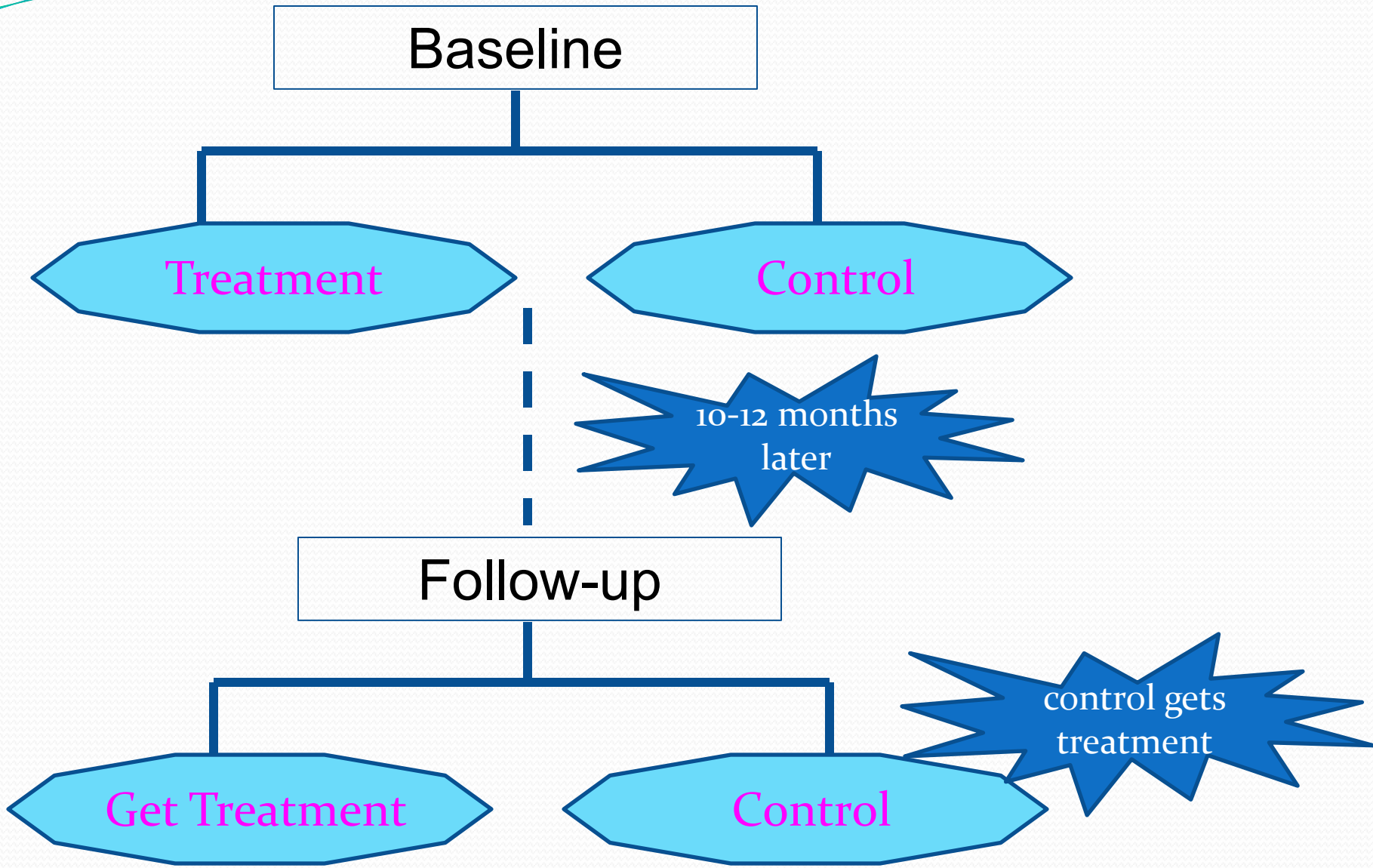
What do we seek to evaluate?



Approach

- The evaluation is done at two levels
  - I – how does the training + starter pack' impact on farmers in terms of key outcomes
    - Yields
    - Crop incomes (profits)
  - II – how does training + credit impact on farmer behaviour
- To answer these questions we used a randomised phasing-in of beneficiaries

Approach – contd.

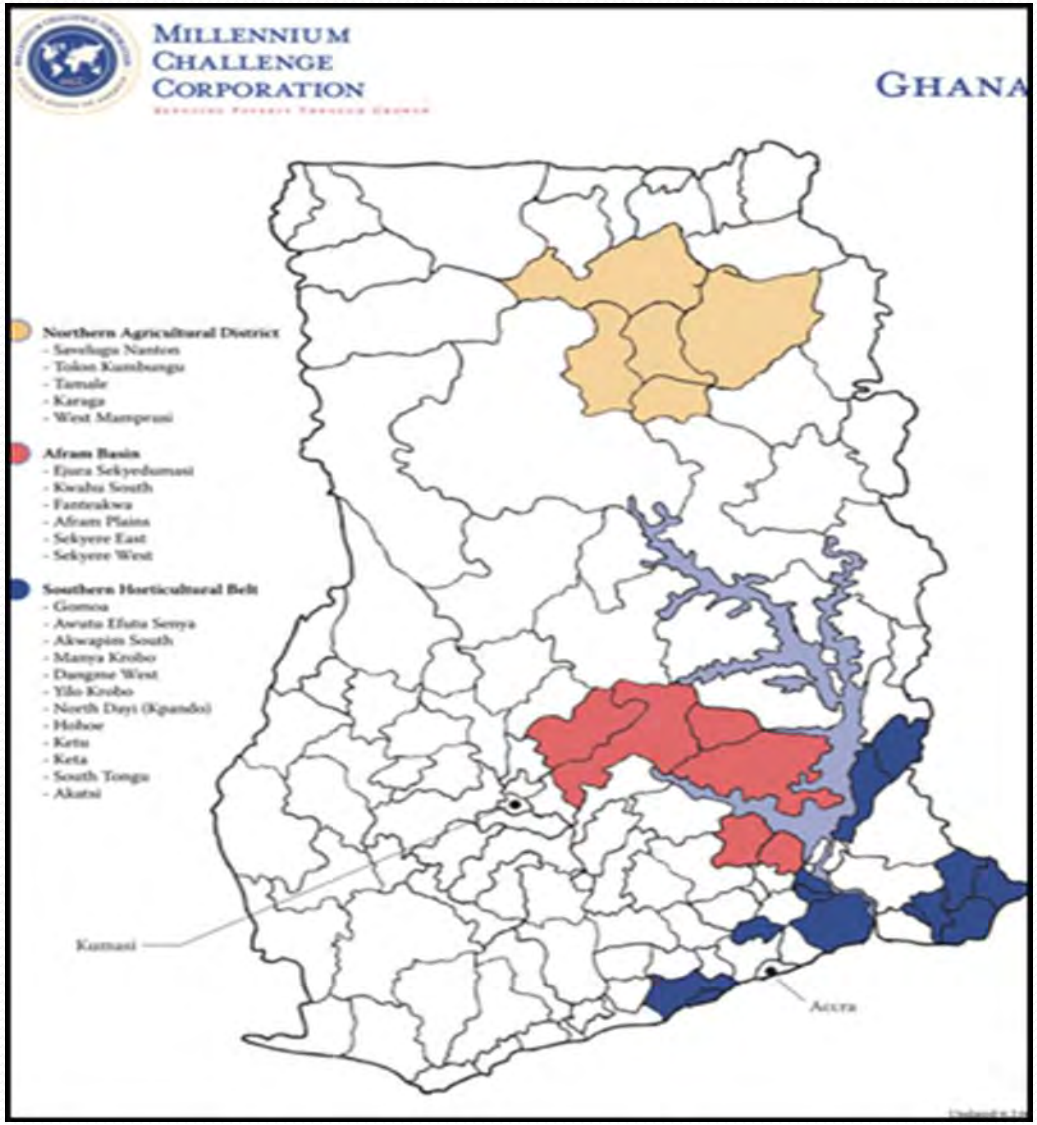


Approach – contd.

- Training of farmers is being done at the FBO level, so
  - Of 1200 FBOs we select 5 farmers from each to get a total of 3000 farmers
  - The FBOs are randomly selected into treatment and control groups (this was done in a participatory way to deal with initial ethical issues that arose)
  - For practical purposes the data was collected for two batches (of 600 each)

- Used a Household survey instrument covering
  - Demographic Characteristics, Household membership and FBO activities
  - Educational characteristics of households
  - Household Health
  - Activity status of household members
  - Migration
  - Transfers in and out of the households
  - Information seeking behaviour of households

- Household assets as well as their borrowing, savings and lending behaviour
- Housing characteristics of households
- Household agriculture activities including land ownership and transactions and agriculture processing
- Non-farm enterprises of households


MILLENNIUM
CHALLENGE
CORPORATION
GHANA
Northern Agricultural District
- Savelugu Nanton
- Tolon Kumbungu
- Tamale
- Karaga
- West Mamprusi
Afram Basin
- Ejura Sekyedumasi
- Kwadu South
- Fantenkwa
- Afram Plains
- Sekyere East
- Sekyere West
Southern Horticultural Belt
- Gomoa
- Awutu Efutu Senya
- Akwapim South
- Manya Krobo
- Dangme West
- Yilo Krobo
- North Dayi (Kpando)
- Hohoe
- Ketu
- Keta
- South Tongu
- Akatsi
Kumasi
Accra

MiDA Training and Starter Pack

- Training
  - Business capacity
  - Technical
  - Marketing
- Starter Pack (GH¢400=US$230)
  - Fertilizer
  - Seeds (for one acre)
  - Protective clothing
  - GH¢30 (US$22)

BASLINE SURVEY: SUMMARY OF KEY FINDINGS

Distribution of sample by Batch and Treatment Group

	Early Treatment	Late treatment	Total
Batch 1	2,808	2,508	5,316
Batch 2	2,829	2,875	5,704
Total	5,637	5,383	11,020

Distribution Farmers in Sample by Zone

MiDA Zone	Average household size	Number of persons	Number of households
Batch I Round II Sample			
Southern Horticulture	5.7	3,541	625
Afram Basin	5.2	5,173	992
Northern	7.6	5,882	776
Total	6.1	14,596	2,393
Batch II Round II Sample			
Southern Horticulture	5.1	3,927	771
Afram Basin	4.9	5,238	1,070
Northern	7.2	7,254	1,001
Total	5.8	16,419	2,842

Crop Yields Batch 1

	Treatment	Control		Treatment	Control	
VARIABLES	Mean	Mean	P-value	Mean	Mean	P=value
Cassava	4.7	3.6	0.2158	3.5	3.5	0.9875
Groundnut/ Peanut	0.7	0.8	0.3954	0.9	1	0.1357
Sorghum	0.5	1.3	0.0861	0.6	1	0.2123
Maize	1.5	1.5	0.9415	1.6	1.6	0.9925
Millet	0.9	1.2	0.1646	0.9	1	0.6996
Pepper	1.7	1.4	0.6487	2.4	0.9	0.1394
Pineapple	22.6	23.9	0.7973	18.4	9.5	0.2456
Rice	0.8	0.9	0.4745	1.5	1.6	0.8862
Soybean	0.8	0.8	0.7699	0.6	0.6	0.6691
Yam	2.6	3.2	0.0858	5.6	6.3	0.2818

- Yields are highest for pineapples at about 23tons/ha
- Of the grains rice and sorghum seem to have the lowest yields

Crop Yields Batch 2

	Treatment	Control		Treatment	Control	
VARIABLES	Mean	Mean	p-value	Mean	Mean	p-value
Cassava	4.4	3.3	0.067	2.7	2.6	0.7836
Groundnut/Peanut	1	1.1	0.7899	1.3	1.4	0.886
Sorghum	1.1	0.7	0.4025	0.8	0.9	0.3772
Maize	1.6	1.5	0.2237	1.2	1.2	0.4565
Millet	0.7	0.9	0.5301	0.6	0.6	0.3753
Pepper	1.5	0.9	0.4735	0.7	1.1	0.4969
Pineapple	15.1	4.1	0.1863	31.3	9.6	0.0074
Rice	1.6	1.3	0.0438	1.6	1.4	0.1413
Soybean	0.7	0.6	0.6277	0.8	0.6	0.0841
Yam	6.9	6.2	0.4465	5.7	5.8	0.9489
Observations	2,479	2,718		2,305	2,489	

- Baseline Yields are similar across the batches

Crop Incomes Batch 1

	Treatment	Control		Treatment	Control	
VARIABLES	Mean	Mean	P-value	Mean	Mean	P-value
Maize	543	344.9	0.1278	760.7	712.5	0.5747
Cassava	473	196.8	0.2885	270.7	684.4	0.1104
Soya	153.8	92.8	0.1675	161.1	97.8	0.2955
Yams	497	360.3	0.4029	1,568.30	957.3	0.1523
Rice	278.6	403.1	0.2372	887.4	788	0.6958
Millet	153	49.6	0.0097	180.2	75.5	0.3475
Groundnuts	299	244.3	0.5365	378.6	370.7	0.9154
Pineapples	1,318.40	769.1	0.2952	1,531.20	3,920.30	0.2412
Pepper	988.4	321.7	0.2251	1,012.10	396.6	0.069
Average Total	617.5	395.6	0.0104	847.8	800.1	0.6311

- Crop incomes are highest for the export oriented crops
- For this batch one observes that crop incomes increase over the two periods

Crop Incomes Batch 2

	Treatment	Control		Treatment	Control	
VARIABLES	Mean	Mean	P-value	Mean	Mean	P-value
Maize	625.1	636.9	0.869	786.1	748.1	0.572
Cassava	843.3	1,790.80	0.2422	491.6	415.3	0.6941
Soya	187.7	118.7	0.0837	185	303.8	0.2089
Yams	1,453.20	1,504.50	0.9132	1,239.10	1,366.20	0.7681
Sorghum	208.3	1,118.70	0.04	450.6	718.2	0.5106
Rice	604.1	502.8	0.2297	1,125.00	974.5	0.4524
Millet	295.2	300.8	0.9569	462.7	550.3	0.7801
Groundnuts	264.7	283.5	0.7111	495	612.6	0.2088
Pineapples	1,733.80	3,901.30	0.4366	2,340.20	3,225.90	0.6583
Pepper	571.9	607.5	0.9087	466.6	248.7	0.1317
	692.4	802.6	0.2037	855.2	911.8	0.4545
Average Total	692.4	802.6	0.2037	855.2	911.8	0.4545

- For this batch one observes that crop incomes increased over the two periods

IMPACT EVALUATION:
SOME PRELIMINARY RESULTS

Yields (tonnes/ha)

	(1) Yield	(2) Income	(3) Revenue	(4) Cost
VARIABLES	lyield	lincome	lrev	lcost2
Period 2	0.1***	0.5***	-0.0	-0.9***
Period 3	0.1	1.0***	0.3**	-1.0***
Treatdum	0.0	0.1	0.0	-0.0
Treattime	-0.1	-0.2	-0.1*	-0.0
Batchdum	-0.2***	-0.2**	-0.2**	0.1
Constant	-0.0	4.9***	6.3***	6.1***
Observations	10,706	4,006	4,006	4,006
R-squared	0.0	0.0	0.0	0.1

- Training and starter pack does not impact on crop yield and income

Inputs use

	Size	Chemical	Seeds	Lab_Total
VARIABLES	lsize	lchem	lseed	TLab
Period 2	-0.2***	0.5***	0.3***	-422.2***
Period 3	-0.2***	0.5***	0.2***	-846.1***
Treatdum	-0.1***	-0.1	-0.2***	-141.0*
Treattime	-0.0	0.3***	0.1**	163.2
Batchdum	0.0	-0.1**	-0.0	213.4**
Constant	0.6***	4.5***	4.3***	1,138.4***
Observations	3,612	7,008	8,066	8,974

- Programme increases the value of chemical and seeds costs by 30 and 10 % respectively
- There is however no effect on cultivated area

Labour Use

VARIABLES	TLabLP	TLabFM	TLabH	TLabPH
Period 2	-491.3***	35.5	-27.0	60.6***
Period 3	-575.0***	-104.1	-165.8***	-1.2
Treatdum	-18.9	-110.7***	-9.3	-2.1
Treattime	31.0	95.7*	19.7	16.8
Batchdum	27.7	140.8***	15.7	29.3*
Constant	627.8***	196.8***	270.8***	43.0***
Observations	8,974	8,974	8,974	8,974

- Labour use for field management increased by about 96 hours as a result of the programme

Main findings

- This study evaluates the impact of the training component on crop yields and income and finds that
  - The training has had no impact on crops yields and crop incomes
  - However, expenditures by farmers on seed and chemical use were positively impacted
  - We conclude by noting that although no impact is found for crop yields and income, farmer behaviour seems to have been impacted positively. Part of this however, may have been due to the starter pack

- Thank You

Ownership Structure and Economic Outcomes: The Case of Sugarcane Mills in India

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Motivation 1

- Market failure/ market structure issues in agriculture
  - Raw produce takes time to grow, but must be processed immediately: threat of hold-up
  - Economies of scale in production (producer coops)
  - Economies of scale in marketing (marketing boards)
- Government response: subsidize agricultural cooperatives/ nationalize processing plants
  - Protecting small farmers often stated objective
  - Indian context - farmer suicides big news
- Yet these subsidies are often subject to political capture (Bates 1981, Sukhtankar 2011)
- Are these subsidies justified?

Motivation 2

- Large theoretical literature on costs and benefits of privatization and scope of government
  - Hart-Shleifer-Vishny 1997, Boycko-Shleifer-Vishny 1996, Hart 2003
- Lots of empirical evidence
  - Yet difficulties with appropriately identifying causal effect
  - While most of it supports private enterprises as more efficient, critics claim this is at expense of consumer (Megginson-Netter 2001)
- What is the cost of efficiency? Are small farmers harmed by private monopolies?

Background

- Sugarcane biggest cash crop, grown all over India
- Ideal test case
- Constraints imposed by production technology and infrastructure
    - Cane must be crushed immediately after harvesting -¿ cannot sell cane too far away
    - Large economies of scale in crushing cane
    - Hence sugar mills = natural monopolies
- Sugar coops promoted as counterpoint to colonial/ industrial private sugar mills

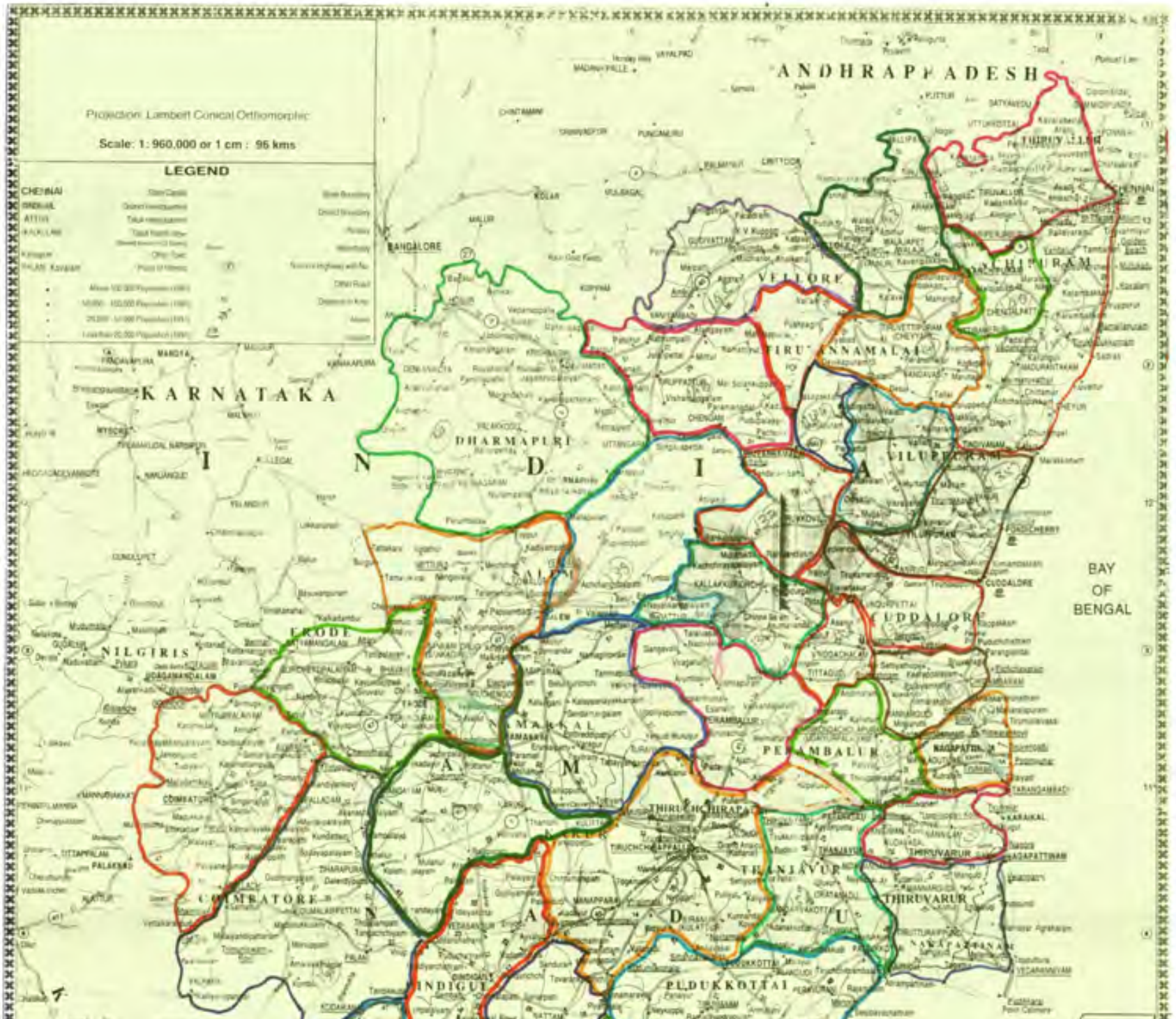
Command Area System

"With the adoption of a zone system, that is to say, with an area given over to the miller to develop in sympathy with the small holder, there should follow at once an association of agriculture and manufacture for the common benefit of both interests. It will be the object of the mill to reduce the price of the raw material and this can best be done by increasing the production per acre, and with an increment in the yield the net income of the small holder will increase even with a decrease in the rate paid per unit of raw material."

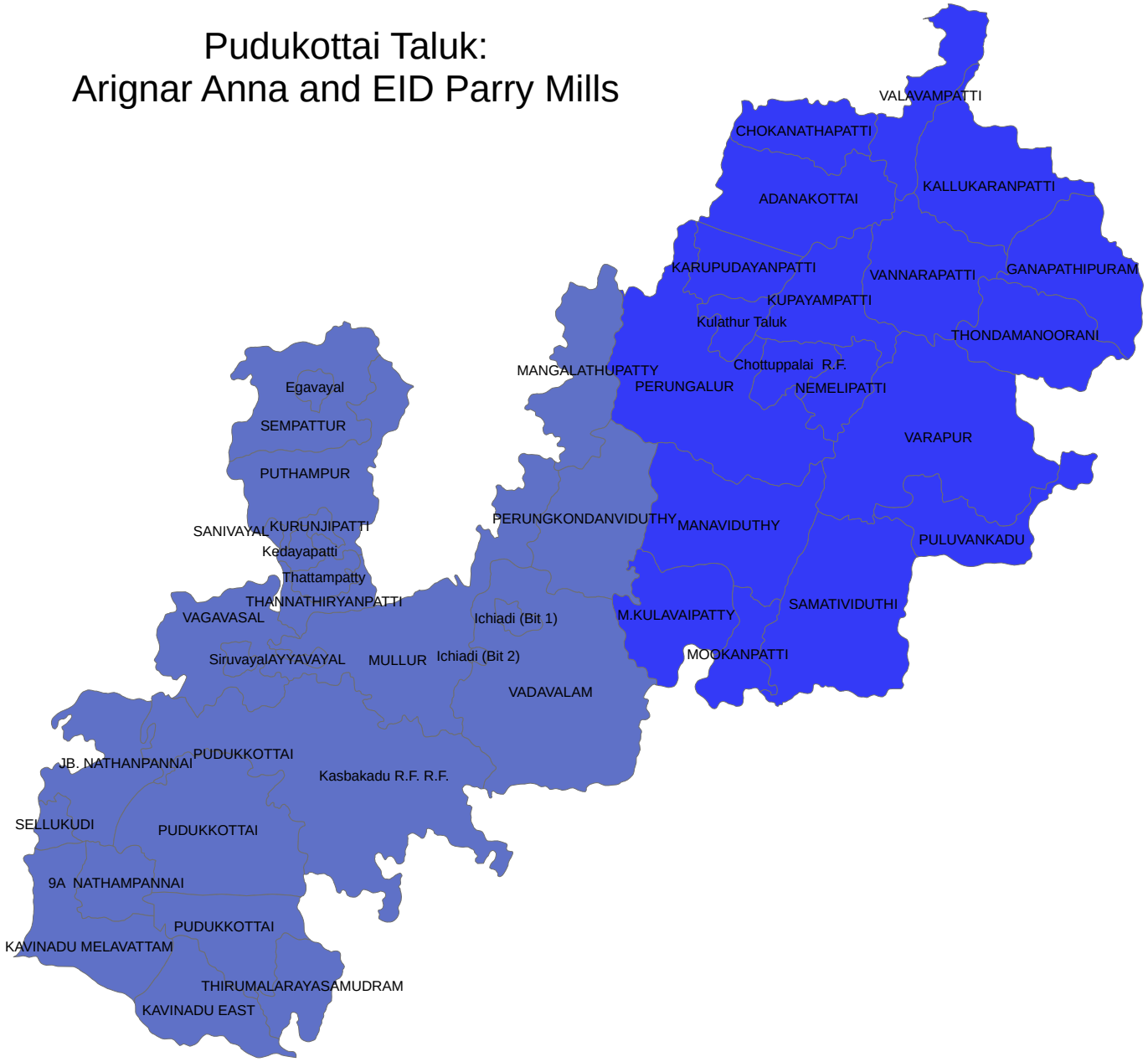
- Command area system old solution to secure supply of cane for mills
  - Combined with cane price regulation to protect farmers from monopsony power
- Still exists in Tamil Nadu, somewhat amended in other states
- Allows us to identify causal effect of ownership structure via "regression discontinuity" design

Basic Idea of Study

- Compare border regions of command areas where private mill on one side and coop/govt mill on other
- Outcomes we are interested in
  - Crop choices, i.e. whether farmers grow sugarcane or not
  - Farmer welfare outcomes - consumption, harvest income, etc
- Measurement
  - Directly observe crops by overlaying satellite images on GIS maps of borders
  - Two separate farmer surveys
  - Soil tests


Projection: Lambert Conical Orthomorphic
Scale: 1: 960,000 or 1 cm : 96 kms
LEGEND
ANDHRA PRADESH
KARNATAKA
INDIA
BAY OF BENGAL
BANGALORE
VELLORE
TIRUVANNAMALAI
DHARMAPURI
SALEM
ERODE
NILGIRIS
COIMBATORE
DINDIGUL
PERAMBALUR
TIRUCHIRAPPALLI
THANJAVUR
THIRUVARUR
PUDUKKOTTAI
CUDDALORE
VILUPPURAM
PONDICHERRY

Pudukottai Taluk:
Arignar Anna and EID Parry Mills



Empirical Strategy

- Discontinuity in which mill farmers sell to - private or coop/govt - other variables continuous
- Boundaries of command areas historically set by sugar commissioner's office
  - Two new mills, will control separately
- Some along geographic features: ignore
- Some along district/sub-district borders: consider separately
- Main results restricted to within sub-district borders
- Checks
  - Discontinuity in ownership
  - Soil quality

First stage

- Possible that law is flouted in practice
- Strong incentives for mills to ensure that farmers don't flout law
- In practice, complex relationship cane farmer needs to have with mill to procure seed, fertilizer, credit, pesticide etc effectively binds her to current mill
- Check that farmers sell only to mill on their side in short survey

Figure: Proportion of Farmers Selling Exclusively to Own Mill

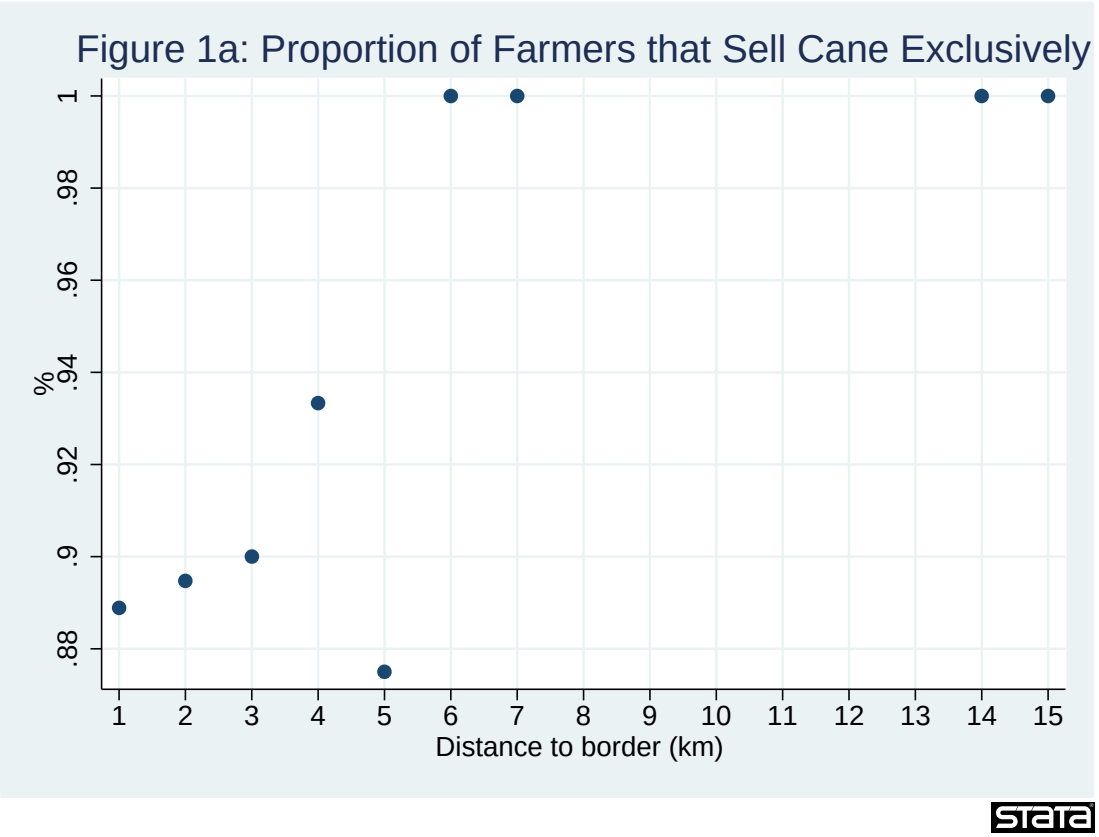
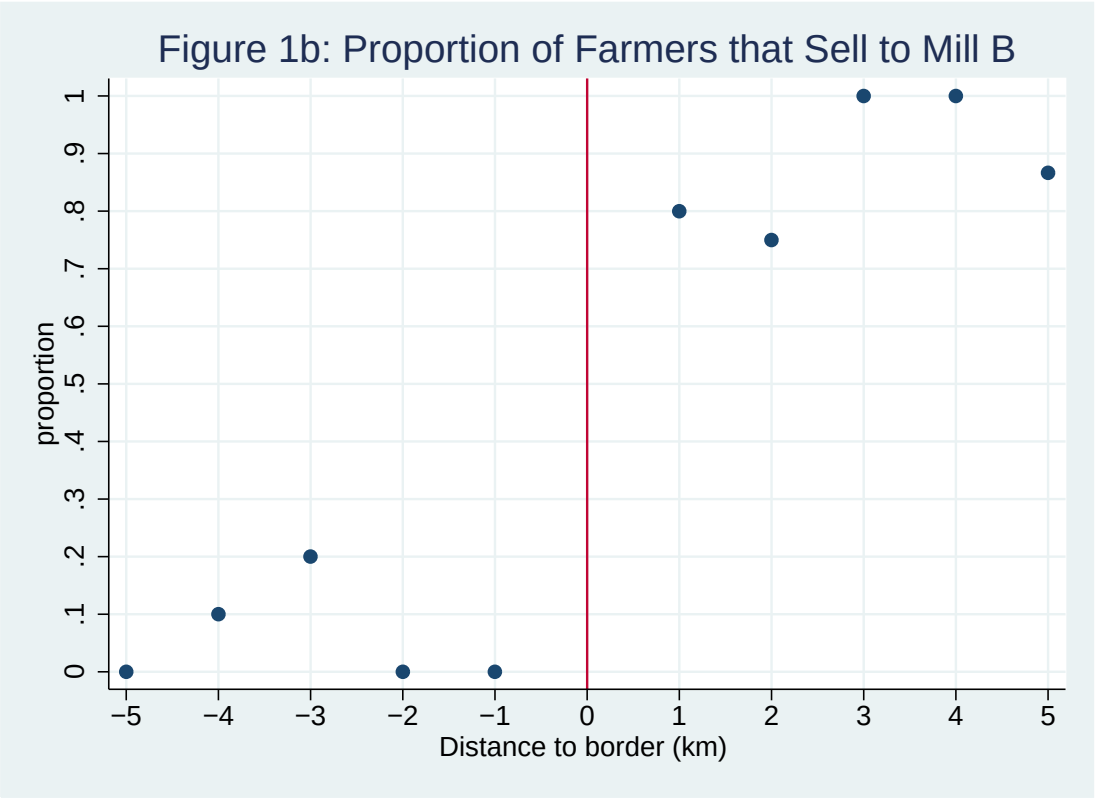


Figure: Proportion of Farmers Selling to Mill B



Threats to RD validity

Lee-Lemieux (2009) suggest consideration of following questions for research designs that include geographical discontinuities

1. Process of boundary creation
   - Boundaries of command areas historically set, clearly delineated, and unlikely to be endogenously placed
2. Endogenous location of farmers
   - Interpretation issue, not threat
   - Ask about land sales
3. Other differences between regions
   - Test soil quality across borders

External validity unlikely to be issue here

Soil Testing

- Two aspects to soil quality
  - Intrinsic type of soil, granularity of grain, etc
  - Attributes that can be affected by farmer effort
- Collected soil samples from subset of farmers surveyed
- Texture, type of soil, NPK content (Nitrogen, Phosphorus, Potassium)
- No significant differences across border: effects $< 5\%$ of standard deviation
- Nitrogen result is equivalent to Rs. 32 in yearly harvest income, or 0.03%

Data collection

- From universe of borders, ignore those along canals, rivers, mountains etc
- Two rounds of surveys
  - First round at sub-district borders; sampling farmers
  - Second round at within sub-district borders; sampling plots
- Potentially satisfy different types of endogenous border placement concerns, although first survey has other problems
- GIS data on command areas
- Satellite images of the entire state from NRSA/ LandSat

Survey 1

- Identified set of borders (29 borders, 18 with different ownership structure)
- Sampled 3 villages (= 3 pairs) along borders
- Sampled 10 households per village that either owned or rented land near borders
- 1037 households in "different" sample

Survey 2

- Identified borders that lay within sub-districts (20 mill pairs)
- Sampled 2-3 villages along borders depending on number of total villages (= 2 or 3 village pairs)
- Within these villages, obtained census of all plots within 1 km of border from Village Administrative Officers
- Sampled *plots*, oversampling supposed sugarcane plots
- All regressions re-weighted to account for differential sampling probabilities

Estimating equations

Instead of estimating:

$$Y_{ij} = \alpha + X'_{ij}\beta + A'_j\gamma + \delta Private_j + \epsilon_{ij} \tag{1}$$

Y outcome of interest for farmer i in area j, X individual farmer characteristics, A area characteristics, δ dummy variable indicating area served by private mill, we estimate:

$$Y_{ib} = \alpha + X'_{ib}\beta + \sum_{1}^{B} \gamma_b + \delta Private_b + \epsilon_{ib} \tag{2}$$

b particular border, γ control for characteristics at border. Instead of indicator variables for border, we could include indicator variables for village pairs, and estimate:

$$Y_{ipb} = \alpha + X'_{ipb}\beta + \sum_{1}^{P} \nu_p + \delta Private_b + \epsilon_{ipb} \tag{3}$$

where p refers to village pair.

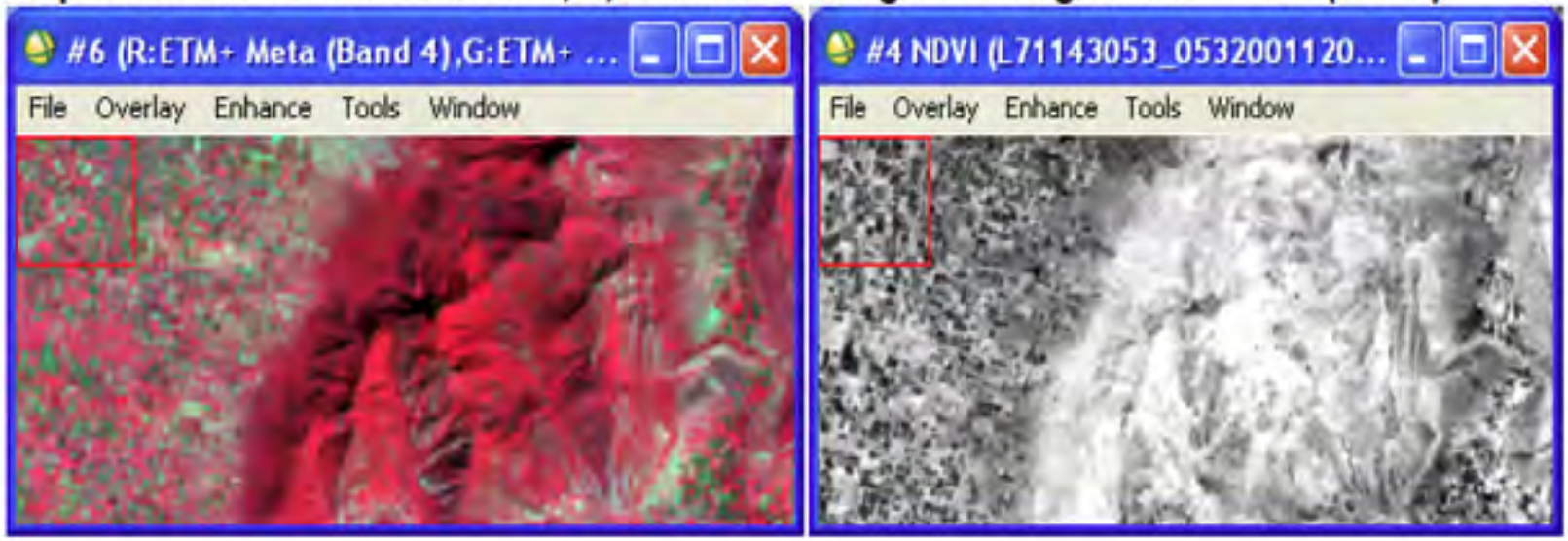
Cane cultivation

- Still trying to interpret overall results
- Private mills encourage sugar production
  - Both proportion of land devoted to cane and whether one grows cane or not higher
- Supported by satellite data analysis

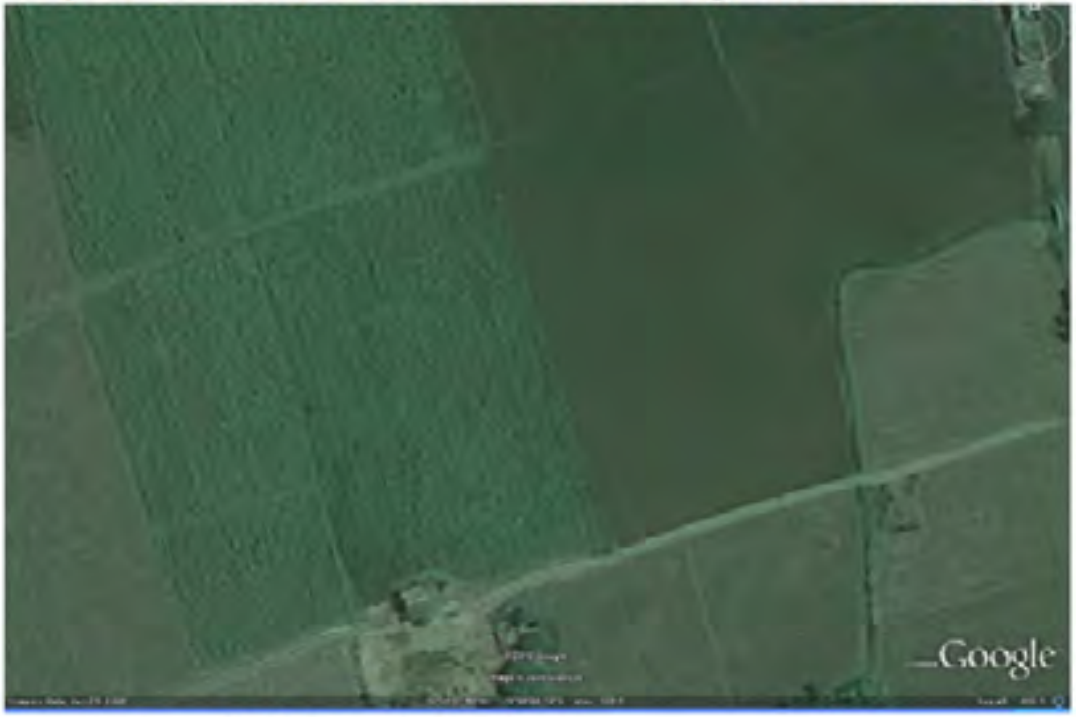
Satellite analysis

- Multi-spectral images (23m resolution) taken in September/October 2008 and August 2009
- Transformed into Normalized Difference Vegetation Index (NDVI) using infra-red and red wavelengths
- Calibrate values of sugarcane to range on NDVI by referencing actual fields
- Sugarcane lies between 0.3-0.6; other crops nearby can easily be distinguished
- Cultivable land lies between (0,1]

Step 1: Convert Infrared Band 4, 3, 2 satellite image into vegetation Index (NDVI)



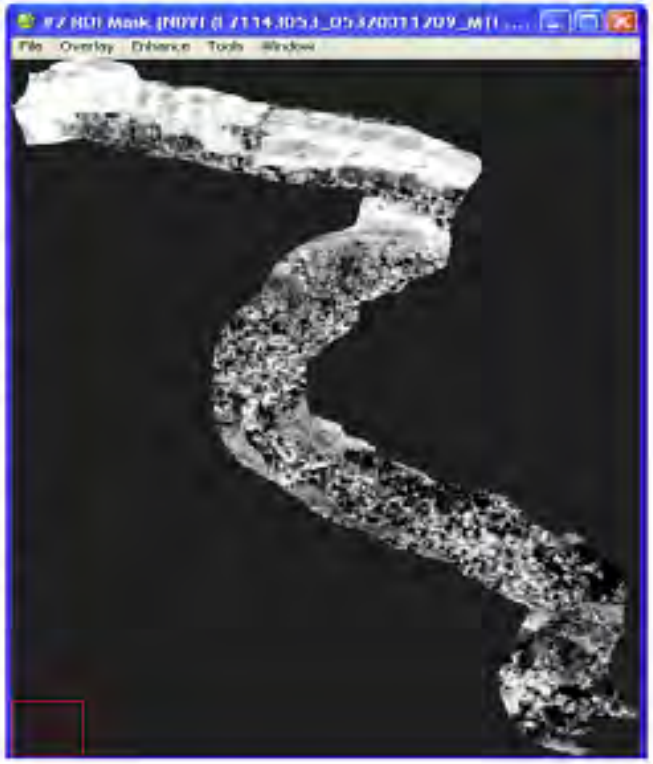
Step 2: Calibrate NDVI values of sugarcane using GPS coordinates of actual fields



Sugarcane field on left

Step 3: Use GIS shapefiles of border areas and create 2km buffer around border

Step 4: Overlay border buffer areas on NDVI image



Step 5: Divide pixel count of sugarcane NDVI range by pixel count of cultivable land NDVI range

Other Results

- Surveys differ on education, land-holdings of marginal farmer
- Some evidence that consumption, harvest income of farmers higher in private mills
  - Lots of missing data in Survey 1
- Some evidence that farmers more likely to get loans from private mills
  - Poorer farmers actually more likely to get loans from private mills

Understanding the results

- Contrary to popular perception, monopoly power does not seem to hurt poor farmers, nor lead to underprovision of cane
- Why is there no hold-up?
  - Repeated game between farmers and mills
  - Reputation matters; mills have made large investment in crushing capacity
- Loans matter for sugarcane production
  - Lumpy crop cycle
  - Why aren't cooperatives providing loans?

Implications

- Governments inclined to intervene in agricultural markets to "protect" small farmers
- Perhaps this protection is unnecessary
- Cannot necessarily extrapolate results to other areas
- However, suggest need for further examination of government intervention in other important realms
    - Producer price supports and purchasing of foodgrains by FCI
    - Protection of retail sector