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# Identification Strategy: A Field Experiment on Dynamic Incentives in Rural Credit Markets



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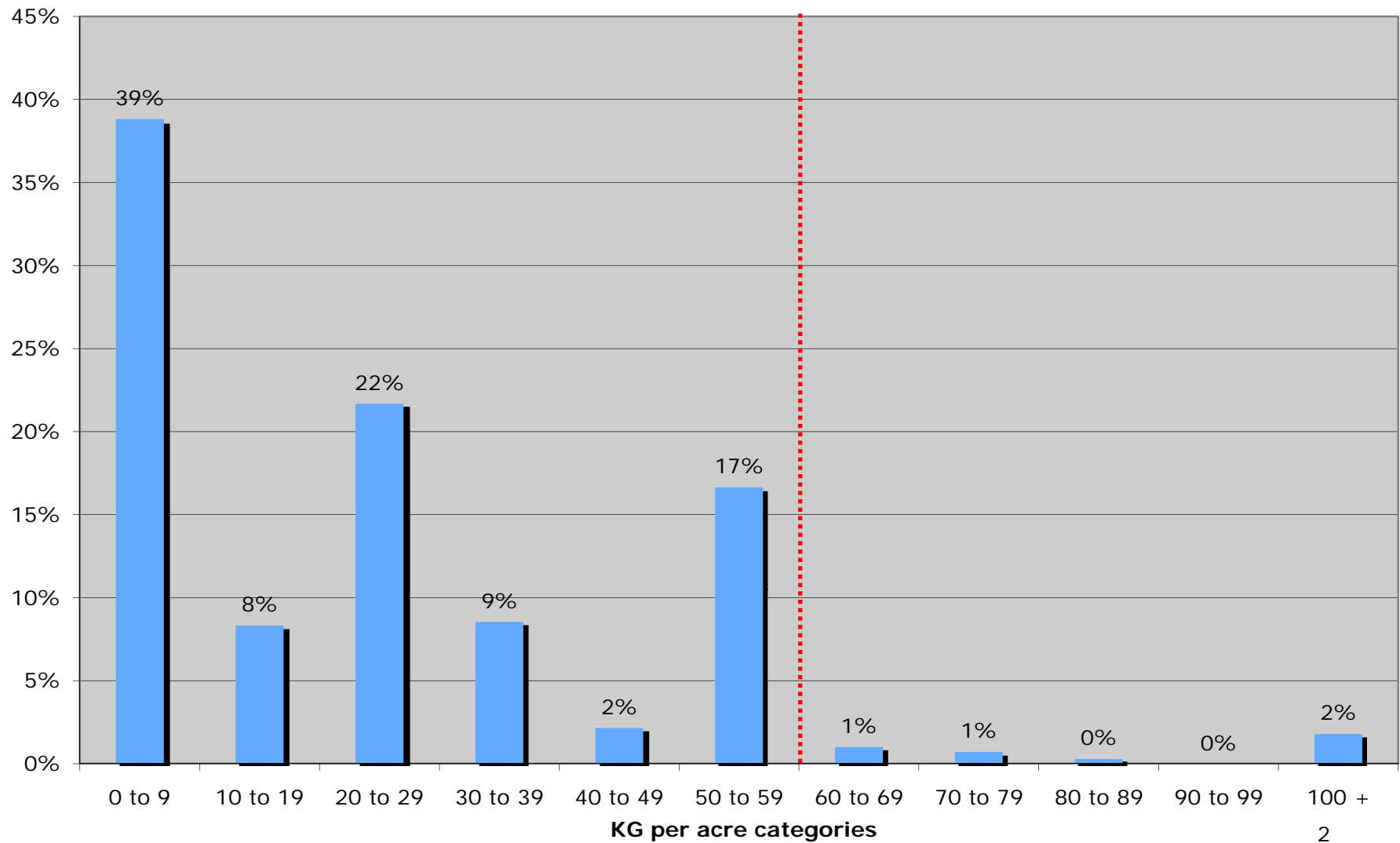
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# Fertilizer per acre on maize

## Urea per Acre of Maize



Note: Per-hectare fertilizer recommendation for central Malawi is 150 kg urea and 100 kg 23:21 (per acre: ~60kg urea, ~40 kg 23:21).

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## Raising farm output with rural finance

- Facilitate **credit** to buy fertilizer
  
- Encourage farmers to **save** for their own fertilizer purchases

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  - Improve repayment via biometric identification
- Encourage farmers to **save** for their own fertilizer purchases
  - Help farmers to save by offering “commitment” savings accounts

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## **Fact: Low credit supply**

- Most farmers cannot obtain credit because lenders find rural lending unprofitable
- 74% of farmers we surveyed have not borrowed from a bank/MFI in the last 10 years

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## One Reason: Identification problems

- A key problem: lack of a national identification system
- Difficulties in identification lead to repayment problems for MFIs:
  - Cannot sanction defaulters by excluding them from future lending nor reward good borrowers
    - Defaulters try to borrow anew using other names
    - Good borrowers can't prove they are reliable
- Easier when multiple lenders operate in same area

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# The Solution: Biometric Technology

- Fingerprinting can serve as a basis of identification, in absence of a national ID system
- Helps lenders identify past defaulters
  - Within own institution
  - Across banks (if fingerprint database is shared)
- **Key Questions:**
  - **Can fingerprinting, by making the threat of future credit denial credible raise financial discipline among borrowers?**
  - **What asymmetric information problems are being solved?**
- Prospect: may raise lending profitability and encourage lenders to expand rural lending



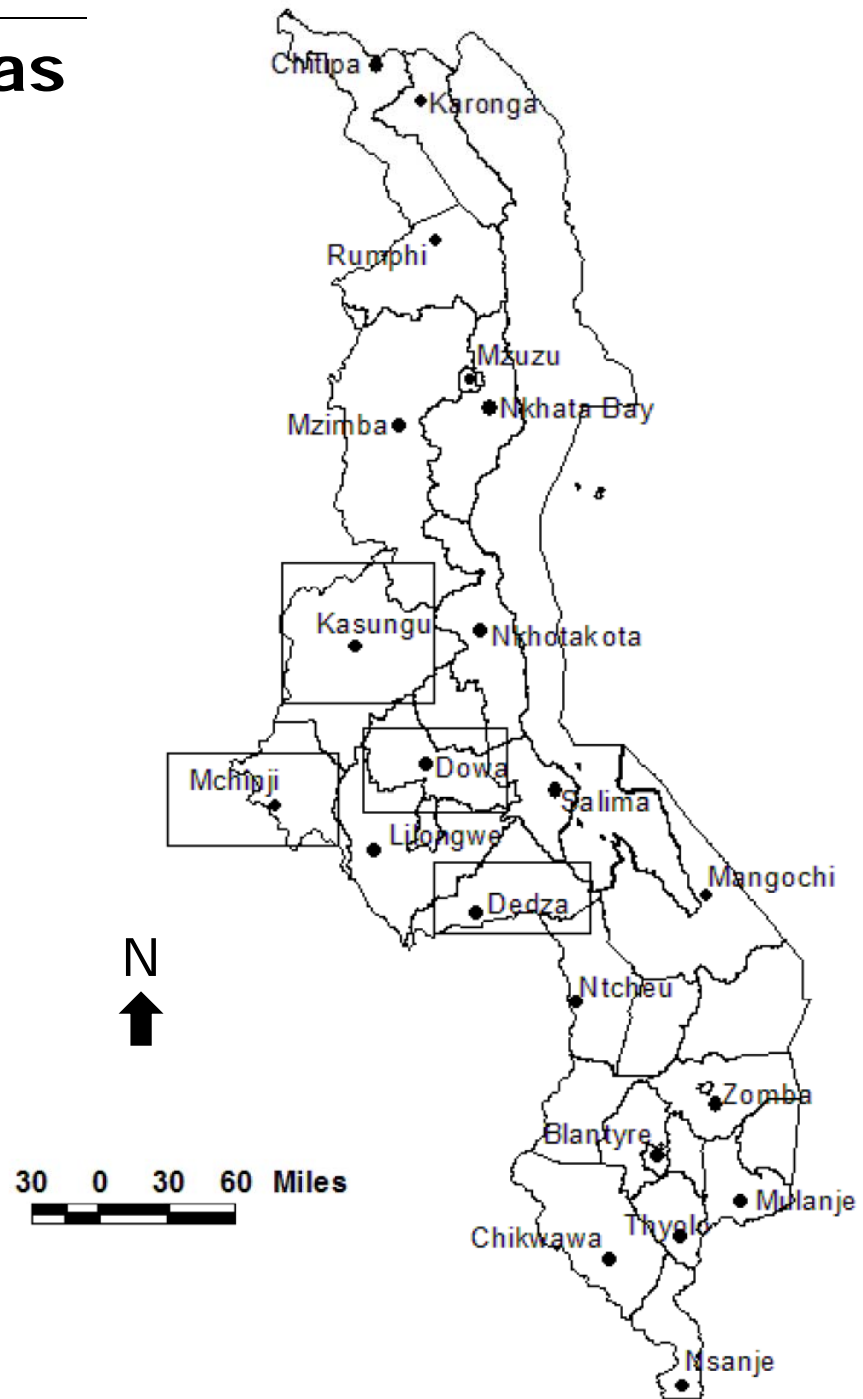
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## Project set up

- Loans to 1,147 paprika farmers in central Malawi
  - Dowa, Dedza, Mchinji, Kasungu
  - Malawi Rural Finance Company (MRFC) provides loans of ~MK 17,000 for paprika seeds, fertilizer and chemicals
  - Farmers have some ability to modify loan size
- All farmers educated about importance of credit history
- 50% of paprika clubs are randomly selected to be fingerprinted
  - Use of fingerprints explained to farmers
  - Aids in identification of defaulters as well reliable borrowers
- Funded by World Bank and USAID

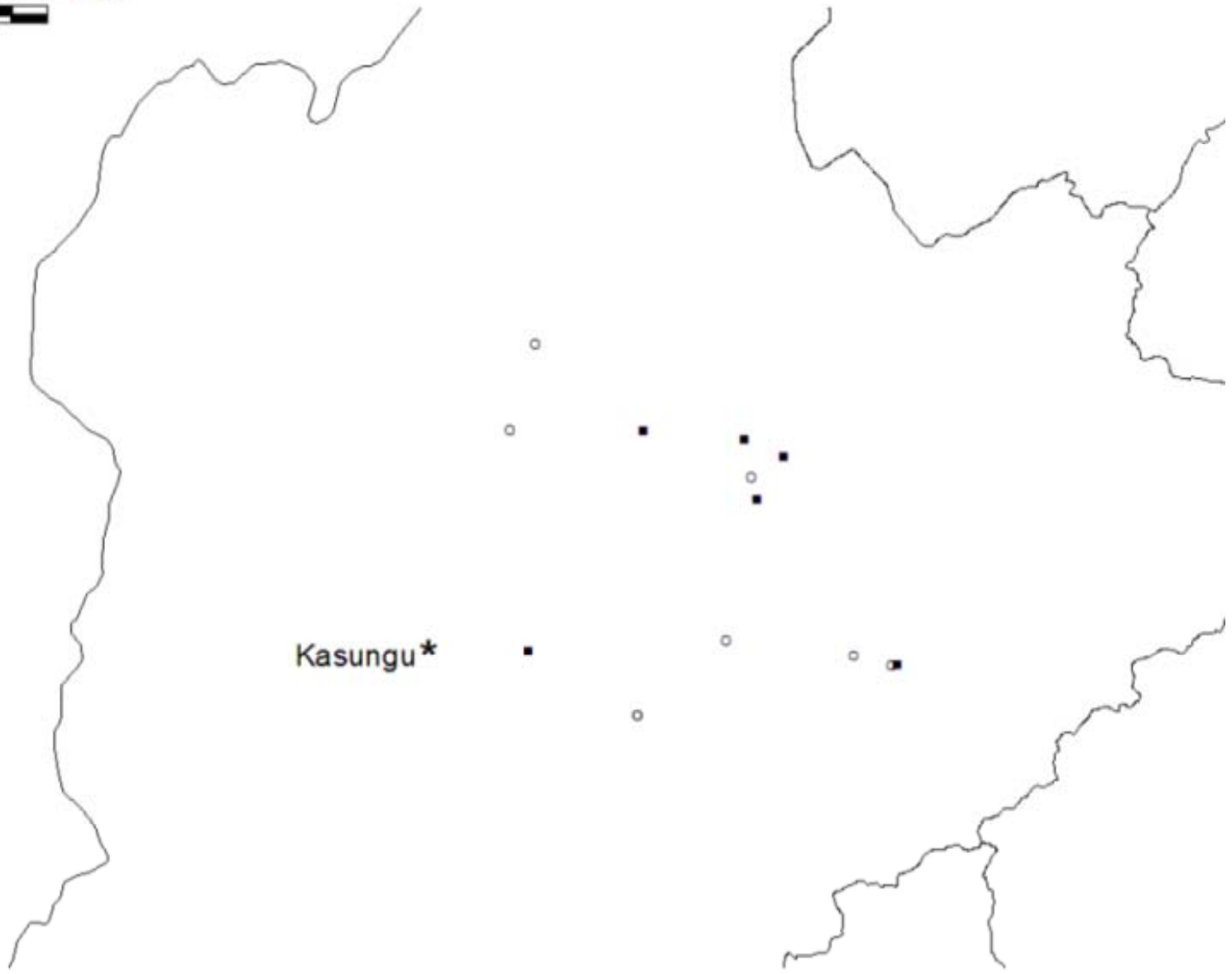
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# Project study areas



# Spatial Distribution of Clubs

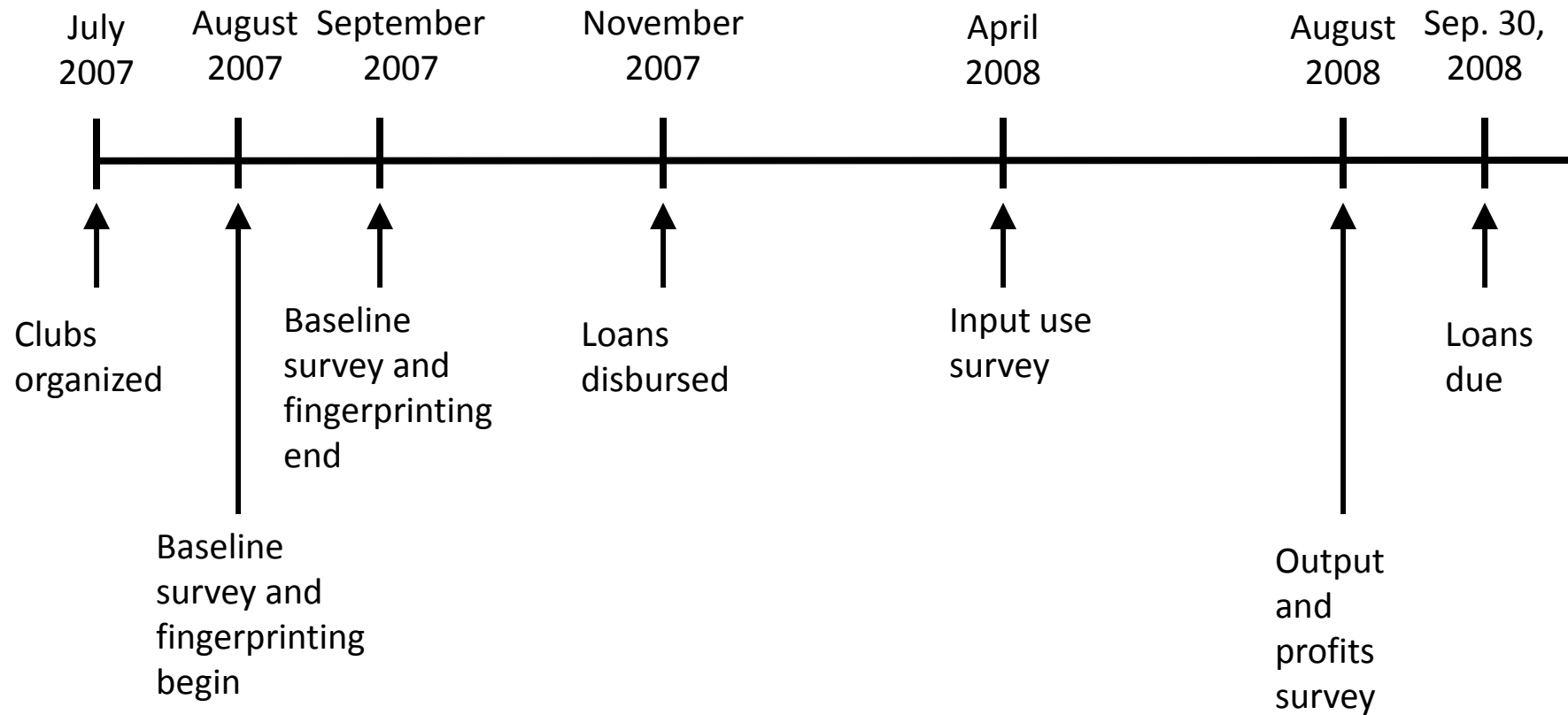
2 0 2 4 6 8 Miles



Kasungu\*

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# Project Timeline



# Fingerprinting

- Aug-Sep 2007



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## Demonstrating fingerprint identification



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## Treatment vs. control comparisons

- Treatment group: farmers fingerprinted in August-September 2007 (prior to loan application)
- Control group: all other farmers in sample
- Note: *all* farmers were given same education module emphasizing importance of credit history

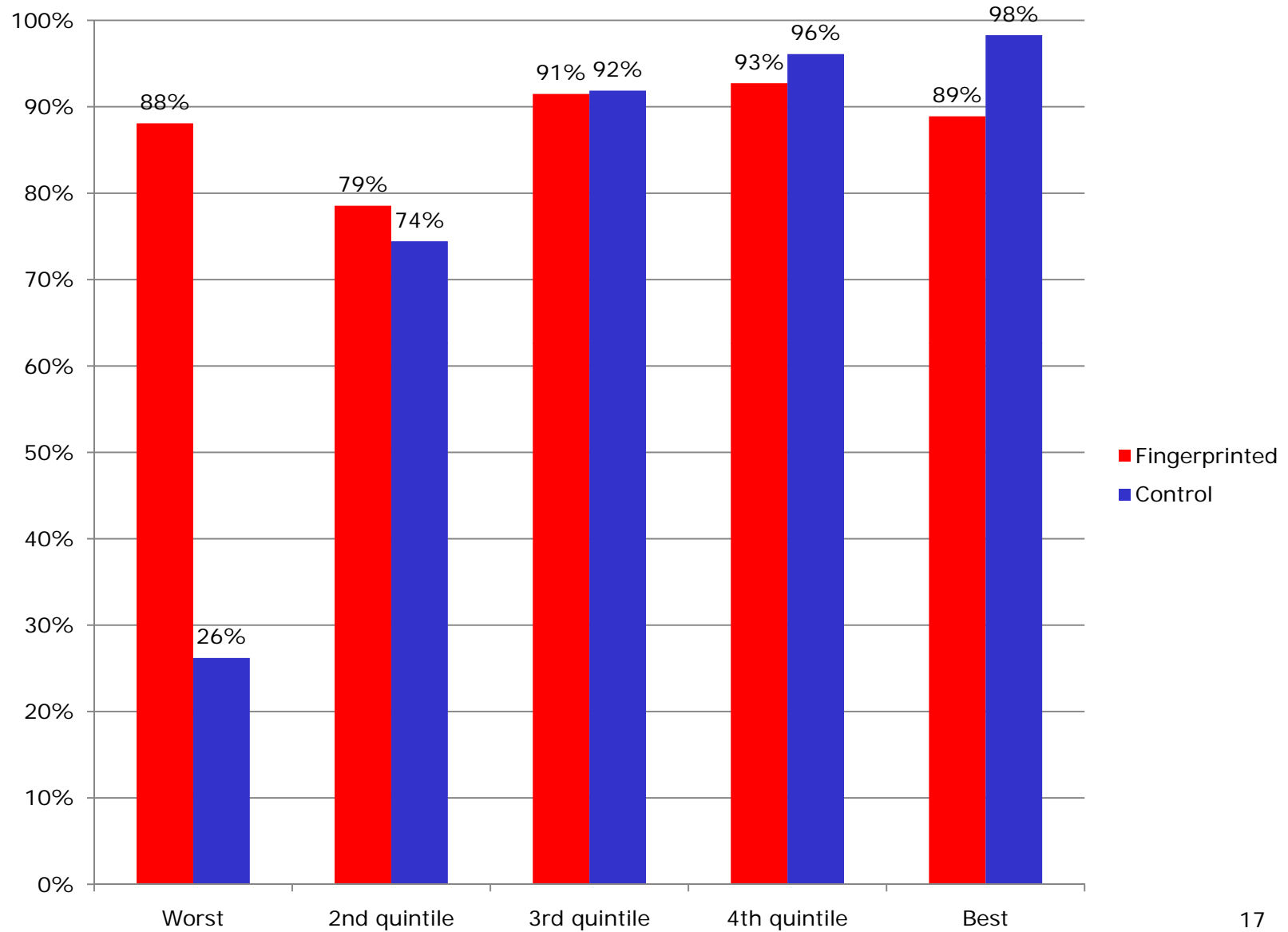
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## Who is affected by fingerprinting?

- Fingerprinting should affect borrowers differently based on their likelihood of repaying the loan
- Borrowers with low likelihood of repayment may be more likely to be affected
- Use control group to create an index of how likely someone is to repay the loan including:
  - Age, gender, risk indicators, performance on previous loans, income volatility, years of experience growing paprika, MRFC portfolio officer



# Repayment: % of balance paid by Sep. 30



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## Regression specification

For farmer  $i$  in group  $j$ :

$$a) \quad Y_{ij} = \alpha + \beta F_j + \phi X_{ij} + \varepsilon_{ij}$$

$$b) \quad Y_{ij} = \alpha + \beta F_j + \gamma(F_j * R_{ij}) + \kappa R_{ij} + \phi X_{ij} + \varepsilon_{ij}$$

$$c) \quad Y_{ij} = \alpha + \gamma_1(F_j * DumR_{1ij}) + \gamma_2(F_j * DumR_{2ij}) \dots \\ + \kappa_1 DumR_{1ij} + \kappa_2 DumR_{2ij} + \dots + \phi X_{ij} + \varepsilon_{ij}$$

- $Y_{ij}$  = dependent variable
  - $F_j$  = indicator: treatment (fingerprinted)
  - $R_{ij}$  = predicted repayment
  - $DumR_{zij}$  = indicator: predicted repayment in quintile  $z$
  - $X_{ij}$  = vector of baseline control variables
- Standard errors clustered at club level and bootstrapped when predicted repayment (generated regressor) is used

# Take-up

	(1)	(2)	(3)
<u>Sample:</u>	All Respondents		Loan Recipients
<u>Dependent variable:</u>	Approved	Any Loan	Total Borrowed (MK)
<b><u>Panel A</u></b>			
Fingerprint	0.038 (0.053)	0.051 (0.044)	-696.799* (381.963)
<b><u>Panel B</u></b>			
Fingerprint	0.207 (.161)	0.108 (.145)	-2812.766 (2371.685)
Predicted repayment * fingerprint	-0.219 (.197)	-0.074 (.168)	2630.653 (2555.167)
<b><u>Panel C</u></b>			
Fingerprint * Quintile 1	0.093 (.115)	0.075 (.111)	-2721.780* (1666.068)
Fingerprint * Quintile 2	0.180* (.096)	0.102 (.086)	-258.179 (828.500)
Fingerprint * Quintile 3	-0.030 (.082)	0.061 (.073)	-458.924 (596.109)
Fingerprint * Quintile 4	-0.001 (.086)	-0.037 (.082)	-101.028 (575.968)
Fingerprint * Quintile 5	-0.017 (.100)	0.039 (.089)	-400.620 (784.509)
<b>Observations</b>	3206	3206	1147
<b>Mean of dependent variable</b>	0.63	0.35	16912.60

Stars indicate significance at 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels.

# PO interaction with clubs

	<u>Means</u>			<u>P-value of</u>
	<u>All</u>	<u>E</u>	<u>NE</u>	<u>T-test of</u>
	(1)	(2)	(3)	<u>(2)=(3)</u>
				(4)
<b><i>Credit Officer reports</i></b>				
PO Knows treatment status of club (1=yes)	0.37	0.54	0.22	0.16
PO Knows office bearer of club (1=Yes)	0.47	0.46	0.48	0.88
Abs. Diff. between actual and PO report of number of loans	1.6	1.3	1.9	0.47
<b><i>Member reports</i></b>				
Number of times PO visited club to request loan repayment	0.32	0.38	0.26	0.34
Number of times club borrower spoke to PO since April 2008	2.02	1.98	2.06	0.64
Difficulty in locating MRFC PO (1=easy 2=moderate 3=difficult)	1.43	1.43	1.43	0.93

# On-time repayment: full borrower sample

(1) (2) (3)

Sample:

Loan recipients

<u>Dependent variable:</u>	Balance, Sept. 30	Frac. Paid by Sept. 30	Fully Paid by Sept. 30
<b><u>Panel A</u></b>			
Fingerprint	-996.430 (754.301)	0.073* (0.040)	0.096 (0.062)
<b><u>Panel B</u></b>			
Fingerprint	-9727.739** (4199.085)	0.716*** (.110)	0.842*** (.178)
Predicted repayment * fingerprint	10855.103** (4499.549)	-0.799*** (.121)	-0.928*** (.196)
<b><u>Panel C</u></b>			
Fingerprint * Quintile 1	-7202.647** (2969.045)	0.499*** (.127)	0.543*** (.147)
Fingerprint * Quintile 2	-1028.696 (1871.298)	0.066 (.105)	0.163 (.160)
Fingerprint * Quintile 3	-297.918 (901.013)	0.005 (.048)	-0.004 (.091)
Fingerprint * Quintile 4	775.231 (883.076)	-0.037 (.046)	-0.045 (.078)
Fingerprint * Quintile 5	1404.812 (951.535)	-0.078* (.046)	-0.084 (.074)
<b>Observations</b>	1147	1147	1147
<b>Mean of dependent variable</b>	2080.86	0.84	0.74

Stars indicate significance at 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels.

# On-time repayment: 8/08 survey sample

	(1)	(2)	(3)	(4)	(5)	(6)
<u>Sample:</u>	Loan recipients			Loan recipients included in August 2009 survey		
<u>Dependent variable:</u>	Balance, Sept. 30	Frac. Paid by Sept. 30	Fully Paid by Sept. 30	Balance, Sept. 30	Frac. Paid by Sept. 30	Fully Paid by Sept. 30
<b><u>Panel A</u></b>						
Fingerprint	-996.430 (754.301)	0.073* (0.040)	0.096 (0.062)	-875.314 (670.297)	0.073* (0.044)	0.085 (0.069)
<b><u>Panel B</u></b>						
Fingerprint	-9727.739** (4199.085)	0.716*** (.110)	0.842*** (.178)	-8931.946* (5162.708)	0.684*** (.196)	0.759*** (.213)
Predicted repayment * fingerprint	10855.103** (4499.549)	-0.799*** (.121)	-0.928*** (.196)	10046.221* (5446.717)	-0.761*** (.206)	-0.841*** (.240)
<b><u>Panel C</u></b>						
Fingerprint * Quintile 1	-7202.647** (2969.045)	0.499*** (.127)	0.543*** (.147)	-8016.543* (4347.488)	0.566*** (.195)	0.599*** (.198)
Fingerprint * Quintile 2	-1028.696 (1871.298)	0.066 (.105)	0.163 (.160)	1799.143 (1914.282)	-0.098 (.111)	-0.071 (.168)
Fingerprint * Quintile 3	-297.918 (901.013)	0.005 (.048)	-0.004 (.091)	-586.977 (871.625)	0.038 (.055)	0.052 (.105)
Fingerprint * Quintile 4	775.231 (883.076)	-0.037 (.046)	-0.045 (.078)	549.532 (821.086)	-0.029 (.053)	-0.065 (.113)
Fingerprint * Quintile 5	1404.812 (951.535)	-0.078* (.046)	-0.084 (.074)	289.061 (804.733)	-0.006 (.054)	0.007 (.110)
<b>Observations</b>	1147	1147	1147	520	520	520
<b>Mean of dependent variable</b>	2080.86	0.84	0.74	1439.16	0.89	0.79

Stars indicate significance at 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels.

# Inputs on paprika

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<u>Dependent variable:</u>	Seeds (MK)	Fertilizer (MK)	Chemicals (MK)	Man-days (MK)	All Paid Inputs (MK)	KG Manure	Times Weeding
<b>Panel A</b>							
Fingerprint	74.107 (47.892)	733.419 (1211.905)	345.328* (190.262)	-395.501** (181.958)	757.354 (1389.230)	29.649 (32.593)	0.019 (0.147)
<b>Panel B</b>							
Fingerprint	262.116* (146.417)	11115.814** (5660.459)	466.677 (594.037)	411.043 (579.097)	12255.650** (5987.210)	52.882 (144.033)	0.182 (.466)
Predicted repayment * fingerprint	-234.438 (183.931)	-12946.332** (6245.378)	-151.316 (701.923)	-1005.720 (732.887)	-14337.806** (6700.416)	-28.970 (161.334)	-0.203 (.591)
<b>Panel C</b>							
Fingerprint * Quintile 1	188.703** (95.018)	5871.126 (4062.716)	374.260 (406.741)	106.406 (347.367)	6540.496 (4210.469)	78.234 (111.980)	0.445 (.367)
Fingerprint * Quintile 2	78.717 (95.343)	3597.540 (3026.725)	244.449 (414.863)	-236.338 (454.498)	3684.368 (3362.245)	27.058 (81.930)	-0.443 (.338)
Fingerprint * Quintile 3	124.548 (97.766)	-585.618 (2250.453)	500.669 (427.366)	-348.598 (458.033)	-309.000 (2602.025)	58.670 (94.443)	-0.191 (.333)
Fingerprint * Quintile 4	-10.190 (110.489)	-1790.213 (2503.022)	283.962 (430.040)	-1065.690** (537.142)	-2582.132 (2952.953)	-25.080 (73.404)	-0.254 (.348)
Fingerprint * Quintile 5	18.589 (110.367)	-2444.617 (2201.579)	264.620 (445.234)	-315.018 (572.589)	-2476.427 (2635.638)	21.879 (93.481)	0.564 (.379)
<b>Observations</b>	520	520	520	520	520	520	520
<b>Mean of dependent variable</b>	247.06	7499.85	671.31	665.98	9084.19	90.84	1.94

Stars indicate significance at 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels.

	(1)	(2)	(3)	(4)
<b>Profits</b>				
<u>Dependent variable:</u>	Market sales (Self Report, MK)	Value of Unsold Harvest (Regional Prices, MK)	Profits (market sales + value of unsold harvest - cost of inputs, MK)	Ln(profits)
<b><u>Panel A</u></b>				
Fingerprint	7246.174 (8792.055)	5270.320 (14879.349)	14509.457 (16679.311)	0.060 (0.095)
<b><u>Panel B</u></b>				
Fingerprint	69102.211 (49177.370)	-29468.424 (85252.270)	24207.068 (90535.890)	0.651 (.423)
Predicted repayment * fingerprint	-77131.415 (51232.390)	43317.493 (103316)	-12092.441 (108112.600)	-0.737 (.501)
<b><u>Panel C</u></b>				
Fingerprint * Quintile 1	30766.147 (36850.940)	7940.835 (50587.570)	31915.287 (63206.880)	0.401 (.363)
Fingerprint * Quintile 2	41981.091 (33084.250)	6364.782 (75026.680)	45650.027 (81848.520)	0.283 (.264)
Fingerprint * Quintile 3	-20925.441 (17938.730)	-14911.454 (59934.020)	-26932.651 (63400.760)	-0.202 (.227)
Fingerprint * Quintile 4	-12785.841 (14733.930)	7481.854 (57096.050)	3609.228 (60385.110)	-0.038 (.231)
Fingerprint * Quintile 5	1053.151 (15282.460)	33336.147 (71891.840)	34125.843 (74254.990)	-0.054 (.240)
<b>Observations</b>	520	520	520	520
<b>Mean of dependent variable</b>	65004.30	80296.97	117779.16	11.44
<b><i>Mean of dependent variable (US \$)</i></b>	464.32	573.55	841.28	n.a.

Stars indicate significance at 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels.



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# Summary

- Biometric fingerprinting raises loan repayment rates
  - Overall, repayment rises from 80% to 88%
  - Particularly for borrowers with the lowest likelihood of repayment (the “worst” borrowers)
  - For the worst borrowers, repayment rate rises by *50 percentage points* (!)
- What is behind this effect? For “worst” borrowers:
  - Less adverse selection (smaller loan sizes)
  - Less ex-ante moral hazard (different farming practices, higher farm incomes)
- Still to come:
  - Cost-benefit calculation