Identifying and addressing barriers to low adoption of agricultural inputs in Burkina Faso

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FOR ASSETS AND MARKET ACCESS

Guiding Investments in Sustainable Agricultural Intensification in Africa

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Motivation

- What are the most effective ways to encourage 'the right' farmers to take-up productivity enhancing technologies?
  - Microdosing has potential agronomic and environmental advantages. Costs and distribution of benefits within the household may not be the same for all farmers.
  - Variability in profitability implies that not everyone should take up new technologies
  - We observe low take-up rates for many technologies across countries.
    - Profitability: Is this because the technology is not profitable or is too risky?
    - Diffusion: Is it because farmers don't know about the technology?
    - Adoption: Is it because farmers are constrained either by market organization, initial endowments (land, labor, capital)?

Key questions and findings

- This paper addresses agricultural technology adoption questions by:
  - varying the targeting approach based on a farmer's social network.
    - We find household adoption rates vary based on network size (26 pp increase) and influence targeting (23 pp increase) relative to random targeting (7 pp increase).
    - No evidence that randomly targeted farmers catch-up over 3 year time horizon.
  - examining how plot and farmer characteristics affect input use and yield.
    - Male farmers with small plots experienced 31-37% increase in yield depending on whether they were using fertilizer at baseline.
    - Female farmers with larger plots who did not use fertilizer at baseline increased yields by 50%.
  - testing alternatives to extension and subsidies to promote private fertilizer market development.
    - We find early input fairs using purchase orders with small deposits improve input adoption (18 pp increase) relative to subsidies (6 pp increase).

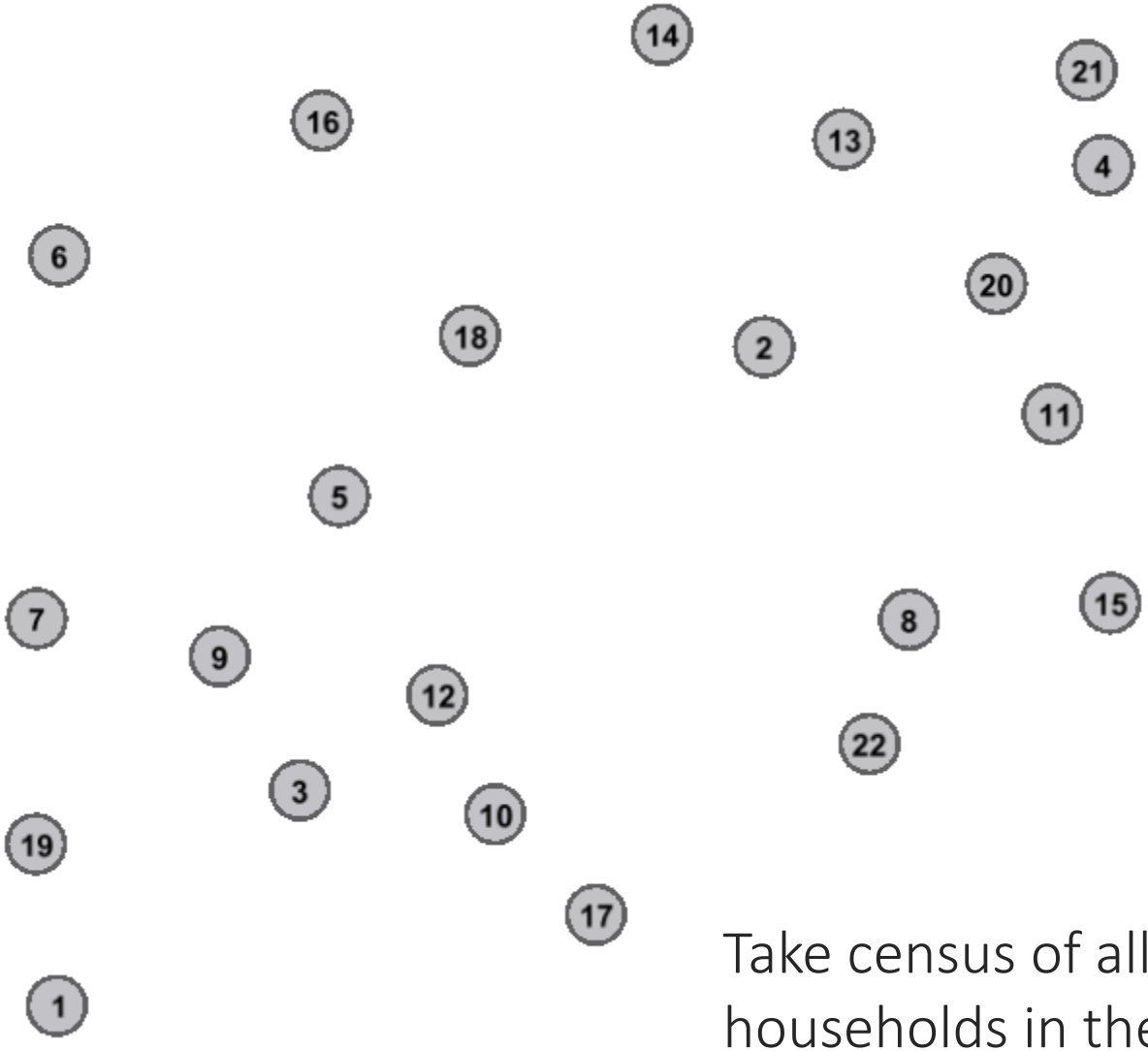
Experimental Design

Demand Side		Supply Side	
Treatment	Seed+Fertilizer Packet + Marketing/Training	Treatment	Marketing/Training
A	Free pack distribution randomly	D	Early commitment offer at fixed 'market' price
B	Free pack distribution based on degree	E	Late commitment offer at fixed 'market' price
C	Free pack distribution based on eigenvector centrality	F	Late commitment offer at discounted price
Control	No interventions		

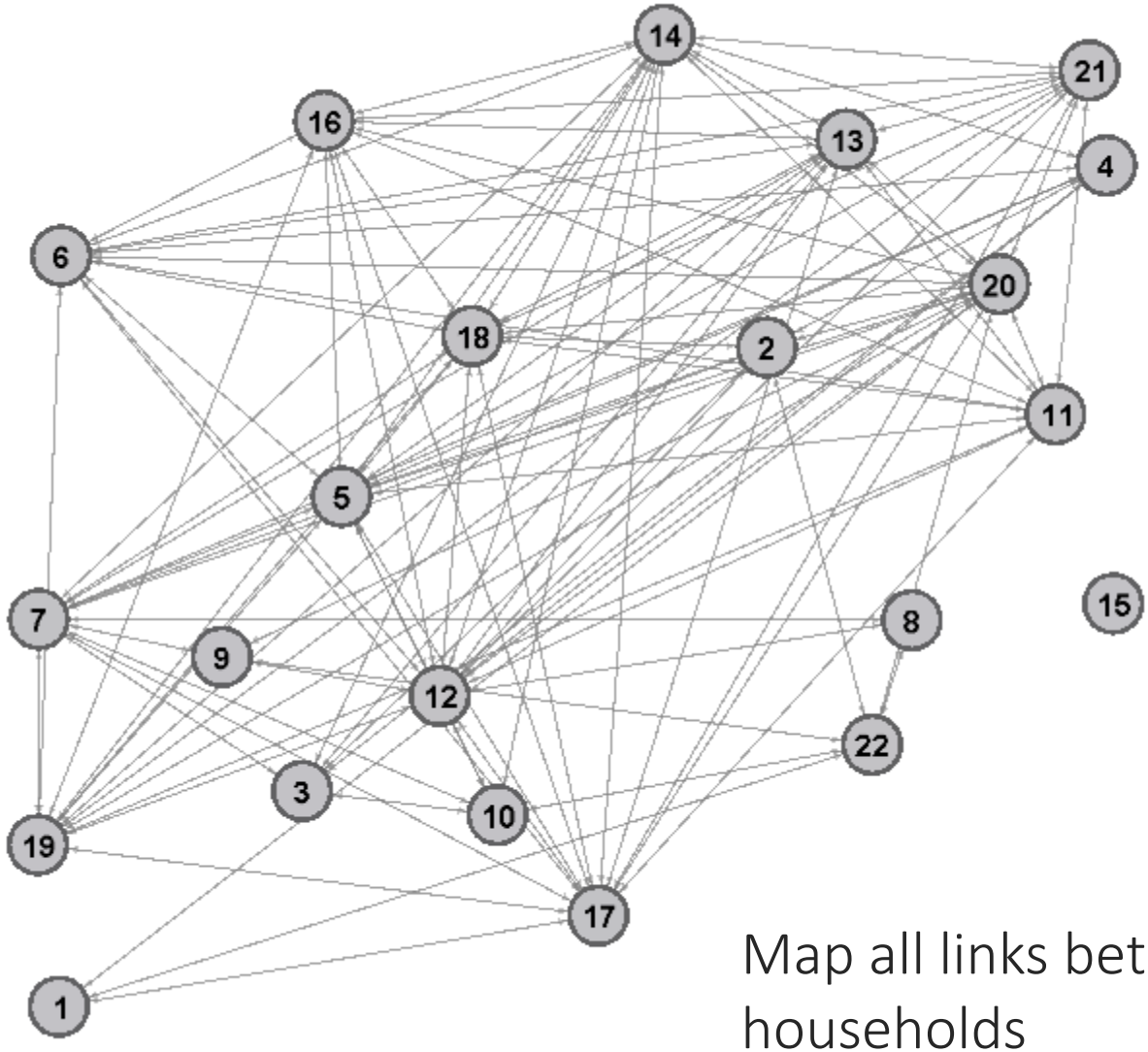
Note: Degree is a social network measure of connectedness (number of connections). Eigenvector centrality is a social network measure of influence within network (lots of friends of friends).

Sample Distribution

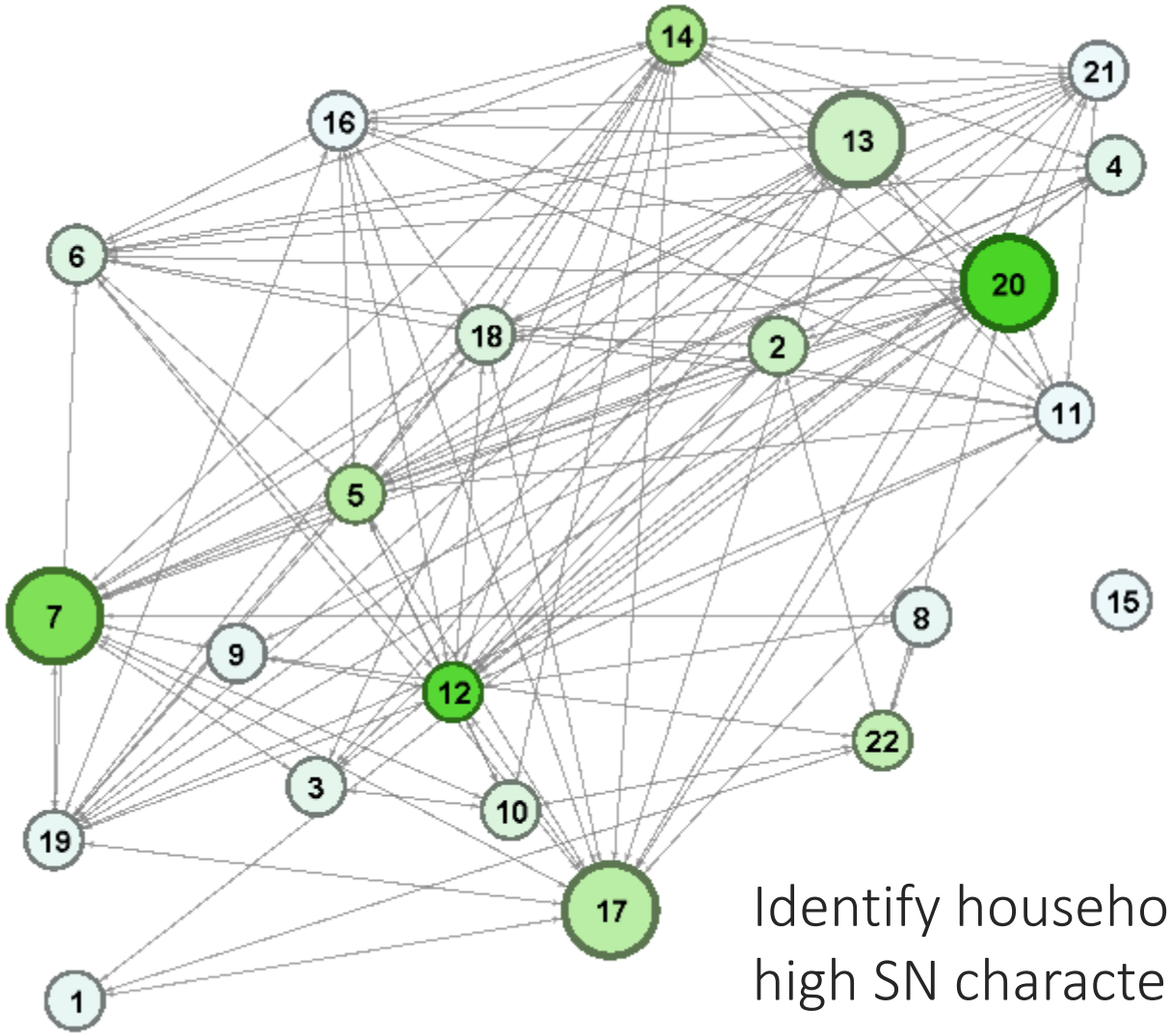
Groups	Number of Villages	Number of households
A	38	2113
B	16	957
C	15	927
D	12	731
E	12	660
F	11	666
Control	20	1062
Total	**124**	**7116**



Take census of all households in the village



Map all links between households



Identify households with high SN characteristic for treatment

Design: Supply of fertilizers (partner: AGRODIA)

Early commitment
Market price fairs

12 villages

Late commitment
Market price fairs

12 villages

Late commitment
Subsidized price fairs

12 villages

Early commitment

- ❑ **Purchase order in February**
- ❑ **5% payment up front**
- ❑ **Envelope for savings**
- ❑ **Delivery in June**
- ❑ **Payment of the top-up**

Late commitment – market price

- **Agricultural input fair in June/July**
- **Market price**
- **Payment up front**

Late commitment – subsidy

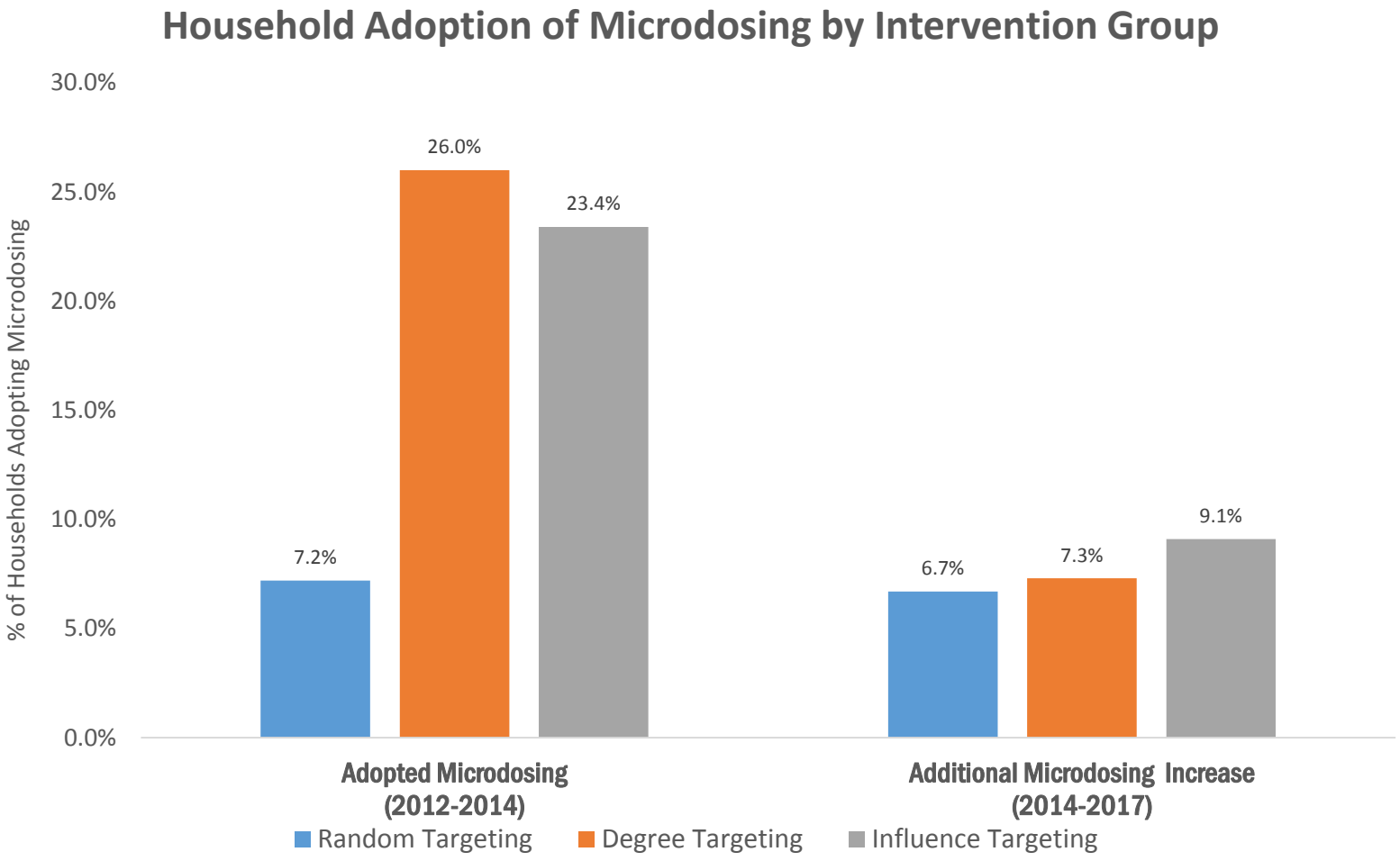
- **Agricultural input fair in June/July**
- **20% subsidy**
- **Payment up front**

Partnership for Treatment Implementation

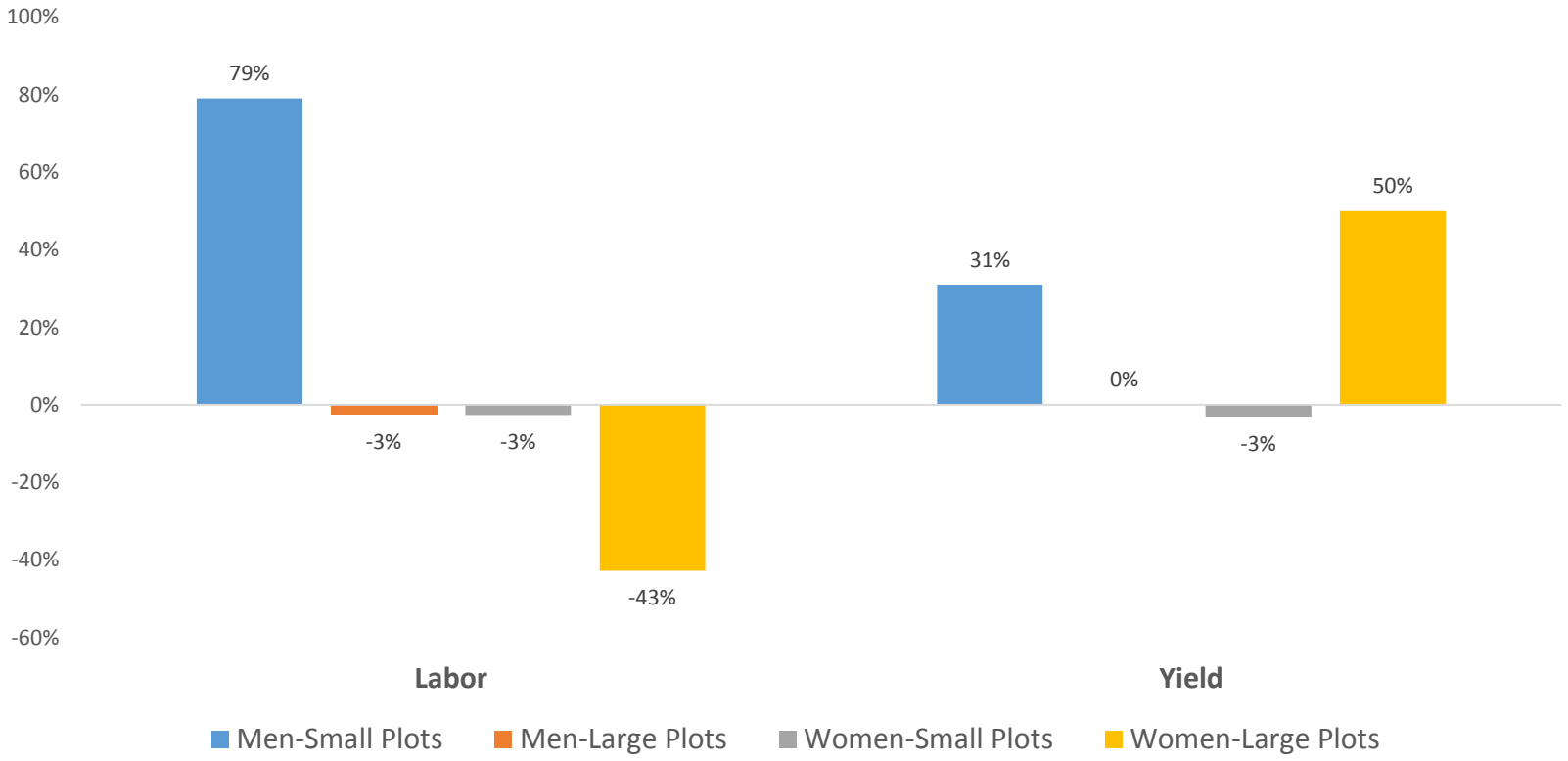
- AGRODIA led organization of input fairs with agro-input dealers and all fertilizer delivery
  - Fertilizer for supply side intervention
    - Total fertilizer purchased by farmers from agro-input dealers= 7,680 KG
    - Total fertilizer supplied for free to farmers = 51,712 KG
  - Input kits were sold/distributed with sufficient seed and fertilizer for 0.5 hectare.

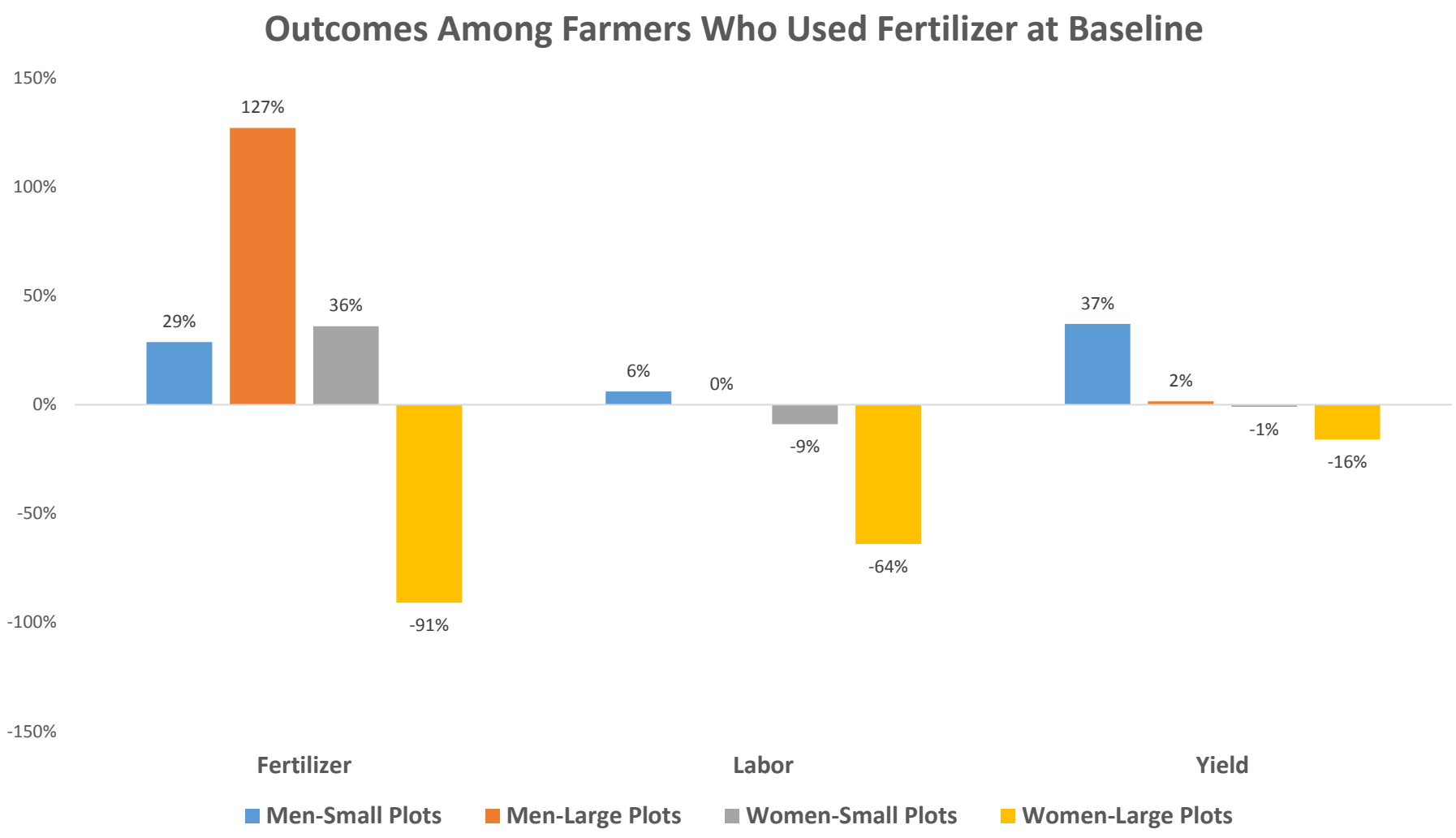
- INERA conducted training of farmers in SN treatment villages.
  - Number of village level trainings = 148
  - Number of farmers trained = 2,470
  - Distributed 20 kits per village in SN treatment groups
  - Approximately 16% of the village population.

Kit Receipt

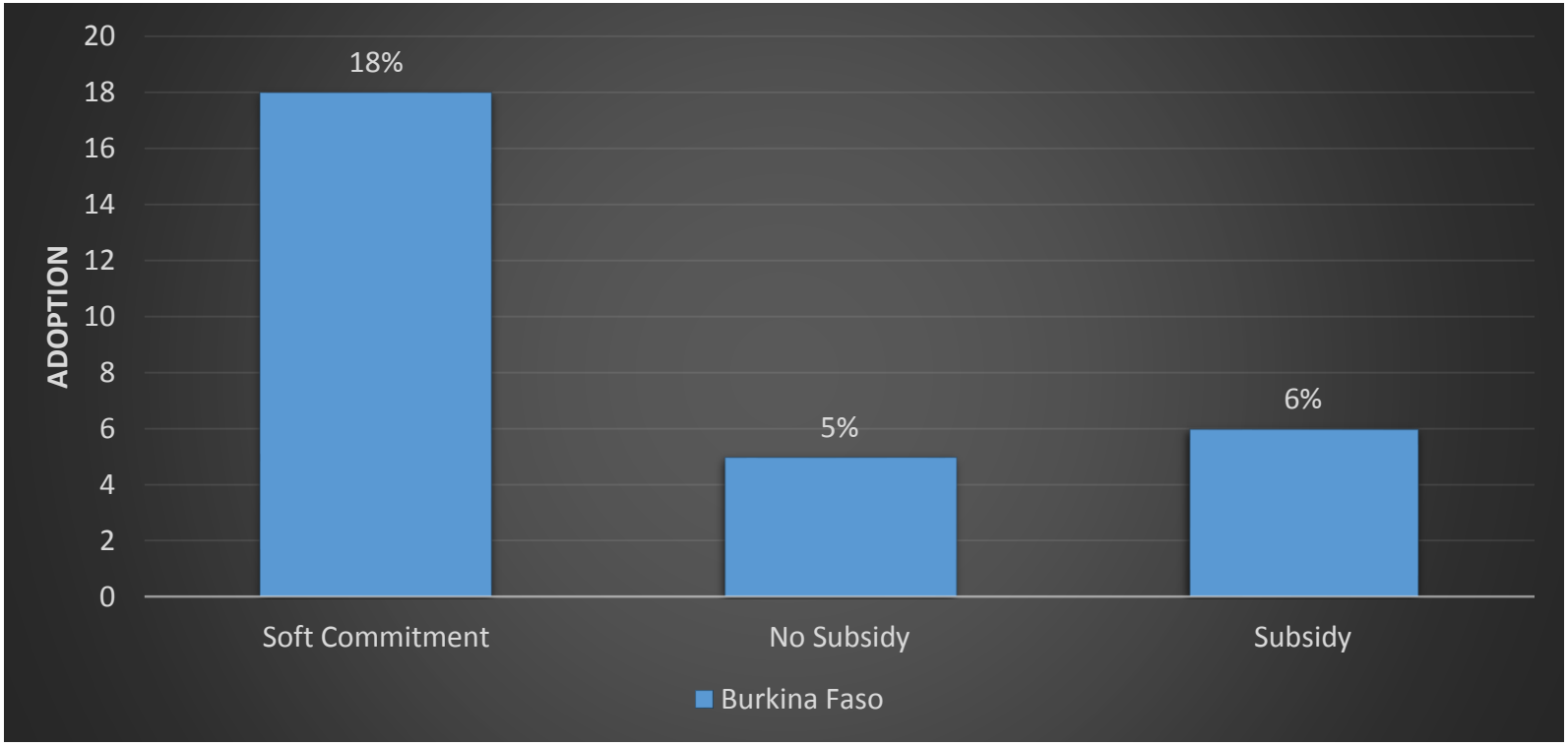

Household Adoption of Microdosing by Intervention Group
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
% of Households Adopting Microdosing
26.0%
23.4%
7.2%
6.7%
7.3%
9.1%
Adopted Microdosing (2012-2014)
Additional Microdosing Increase (2014-2017)
Random Targeting
Degree Targeting
Influence Targeting

Outcomes Among Farmers Who Did Not Use Fertilizer at Baseline




Outcomes Among Farmers Who Used Fertilizer at Baseline
150%
100%
50%
0%
-50%
-100%
-150%
29%
127%
36%
-91%
6%
0%
-9%
-64%
37%
2%
-1%
-16%
Fertilizer
Labor
Yield
Men-Small Plots
Men-Large Plots
Women-Small Plots
Women-Large Plots

Market Organization Experiments



Policy Implications

- Targeting extension advice leads to improved adoption rates, but adoption is not the only indicator by which we should assess 'success'.

- Among those who adopt, significant variation in input substitution in response to microdosing promotion and yield effects.
  - Plot size and experience with fertilizer were important determinants of yield effects.

- Private market innovations such as advanced purchase orders led to substantial increases in adoption and have much lower costs than subsidies.
  - Agrodealers can use extension results to better understand market demand. Successful farmers are future customers.

Extra Slides

Recent Work

- **On constraints in ag technology adoption**
  - Karlan et al. (2014), Jack (2011)

- **On social networks,**
  - SN structure (Jackson 2007)
  - Earlier literature (Foster and Rosenzweig (1995), Conley and Udry (2004), Munshi (2004), and Bandiera and Rasul (2006))
  - Information diffusion (Beaman and Dillon 2016, Banerjee et al. 2016)
  - Adoption (Beaman et al. 2016)

- **On commitment mechanisms**
  - Early commitment (Bryan et al. 2014, Karlan and Linden 2015)
  - Hard commitment (Duflo et al. 2012)

Measuring Social Networks to Target

- Most social network analyses in economics have used a network sample. Some evidence that this leads to measurement error (Chandrasekhar, 2011) by omitting influential links.

- We field a social network census already used in several studies in Mali (2008) and Burkina Faso (2011):
  - Type of network: Farmers within villages, households, men and women's networks
  - Type of SN links: Relatives, organizations, plot neighbors, financial ties, people with whom they discuss agricultural issues, friends.
  - Type of information: Frequency of communication, subject of communication
  - Information on link: household composition, assets, education

Study Design: Sample

Groups	Total # villages in the sample	# villages Census survey only	# households census only	# villages with Census and SN census	# of households with Census and SN Census	# of households for baseline & Followup survey
A	78	78	4,154	38	2,113	2,015
B	16	16	957	16	957	0
C	15	15	927	15	927	0
D	12	12	731	12	731	0
E	12	12	660	12	660	0
F	11	11	666	11	666	0
Control	20	20	1062	20	1062	522
Totals	**164**	**164**	**9,157**	**124**	**7,116**	**2,537**

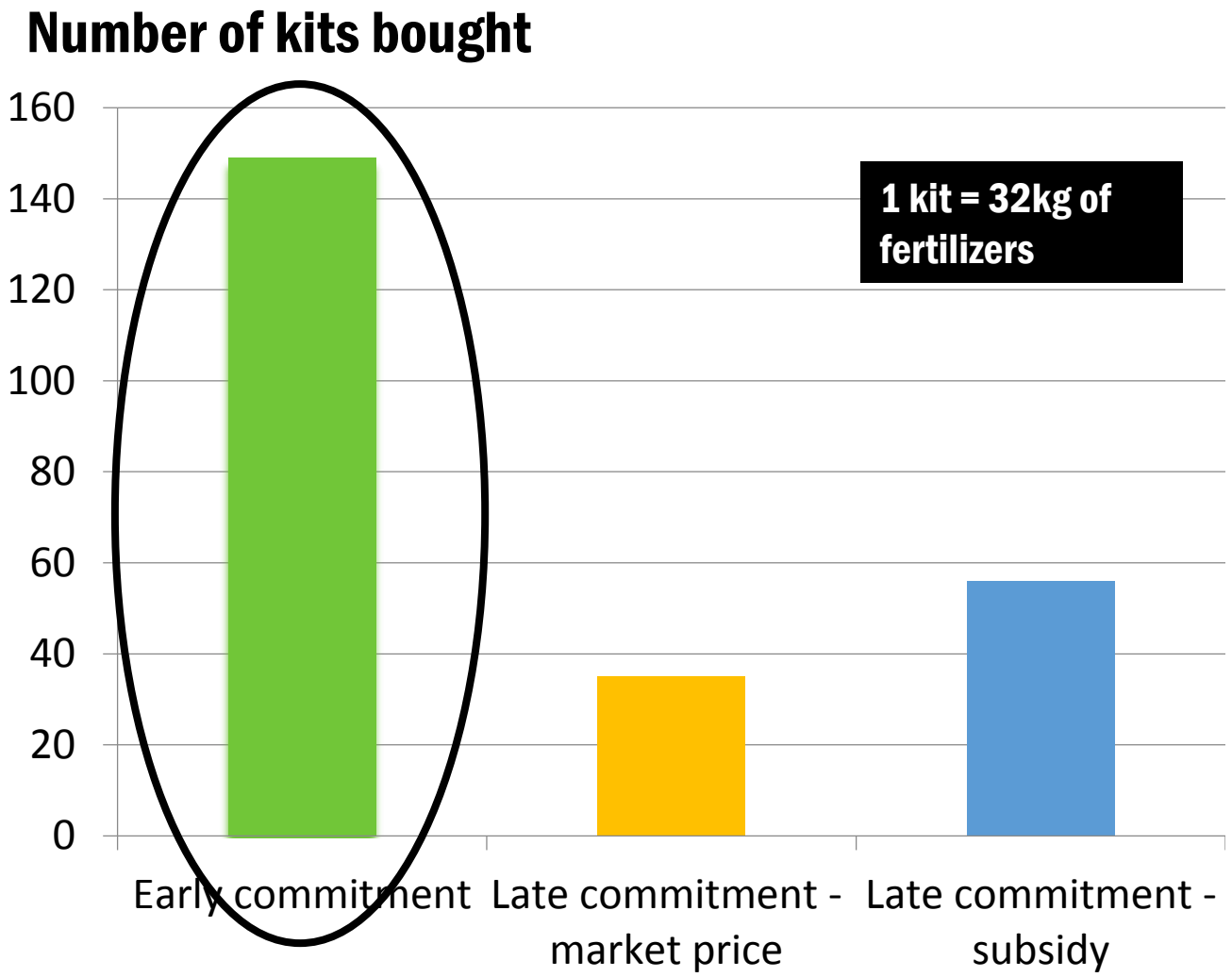
Descriptives and Balancing Tests at the HH Level

VARIABLES	Control (N=1,013) Mean (SD)	A (N=3,935) Mean (SD)	B (869) Mean (SD)	C (N=884) Mean (SD)	D (N=709) Mean (SD)	E (N=644) Mean (SD)	F (N=638) Mean (SD)	pvalue_all
Household demographics								
Number of adults (>14 year old)	4.923	4.943	4.9	5.277	4.381	5.27	4.495	0.069
	(3.56)	(3.59)	(3.45)	(3.96)	(2.87)	(4.24)	(3.03)	
Head age	48.32	48.72	48.03	47.88	49.41	48.85	48.99	0.804
	(15.59)	(15.28)	(15.20)	(15.07)	(15.55)	(16.29)	(15.08)	
Head gender (1=female)	0.107	0.134	0.0947	0.0817	0.166	0.124	0.133	0.067
	(0.31)	(0.34)	(0.29)	(0.27)	(0.37)	(0.33)	(0.34)	
Number of adult males	2	2.071	2.153	2.207	1.927	2.011	2.017	0.174
	(1.45)	(1.61)	(1.59)	(1.55)	(1.48)	(1.62)	(1.62)	
Number of adult females	2.411	2.526	2.464	2.645	2.451	2.624	2.475	0.701
	(1.62)	(1.81)	(1.77)	(1.79)	(1.76)	(1.92)	(1.70)	
Crop choice								
Has a plot where main crop is millet	0.372	0.346	0.474	0.462	0.269	0.286	0.353	0.054
	(0.48)	(0.48)	(0.50)	(0.50)	(0.44)	(0.45)	(0.48)	
Has a plot where main crop is maize	0.127	0.13	0.156	0.129	0.155	0.155	0.108	0.785
	(0.33)	(0.34)	(0.36)	(0.34)	(0.36)	(0.36)	(0.31)	
Has a plot where main crop is rice	0.018	0.023	0.033	0.007	0.045	0.017	0.031	0.105
	(0.13)	(0.15)	(0.18)	(0.08)	(0.21)	(0.13)	(0.17)	
Has a plot where main crop is peanut	0.159	0.214	0.266	0.265	0.183	0.199	0.165	0.114
	(0.37)	(0.41)	(0.44)	(0.44)	(0.39)	(0.40)	(0.37)	
Has a plot where main crop is niebe	0.087	0.090	0.087	0.068	0.085	0.056	0.066	0.200
	(0.28)	(0.29)	(0.28)	(0.25)	(0.28)	(0.23)	(0.25)	

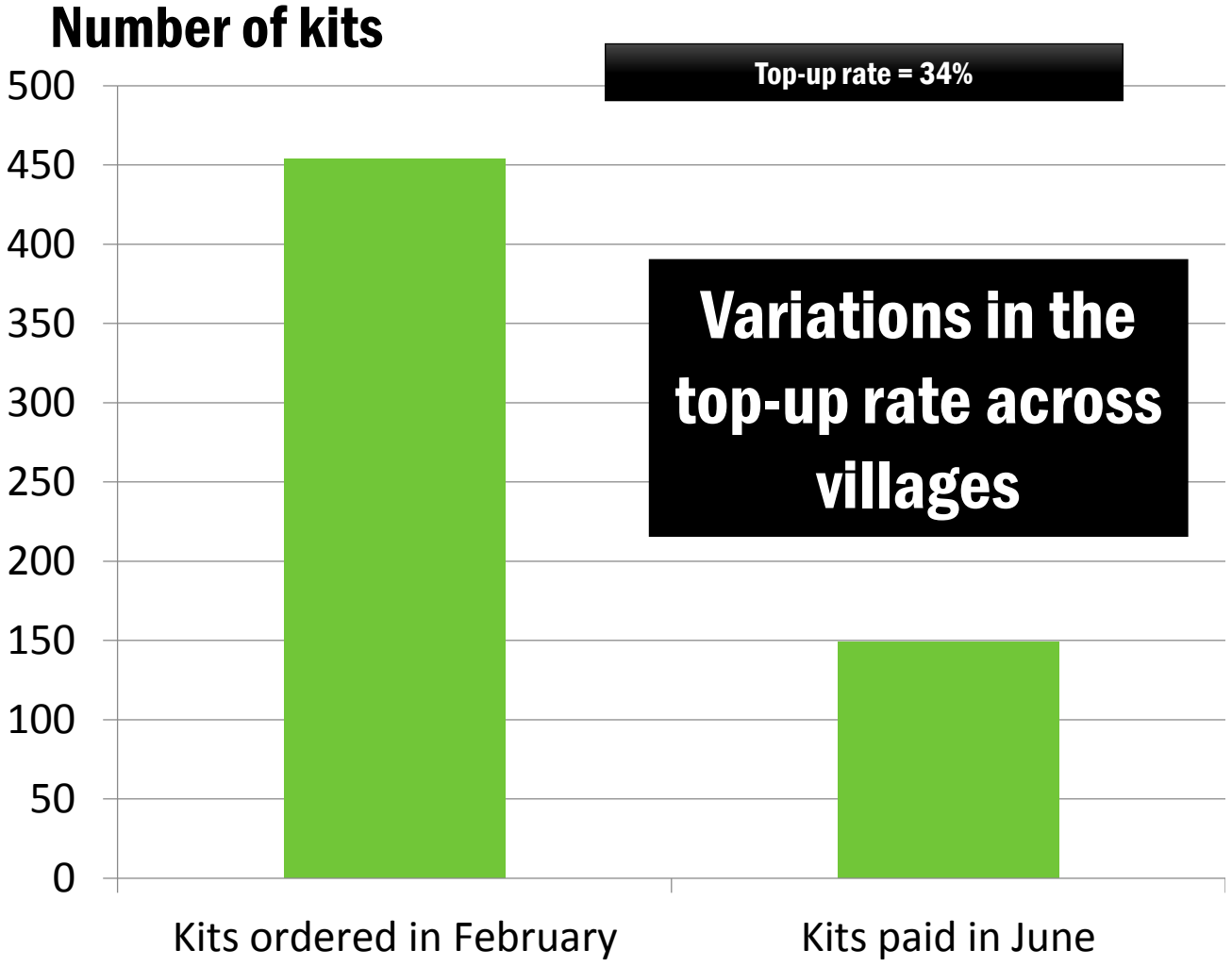
Descriptives and Balancing Tests (Cont.)

VARIABLES	Control (N=1,013) Mean (SD)	A (N=3,935) Mean (SD)	B (869) Mean (SD)	C (N=884) Mean (SD)	D (N=709) Mean (SD)	E (N=644) Mean (SD)	F (N=638) Mean (SD)	pvalue_all
Plot size and land holding								
Number of plots in households	3.446	3.507	3.599	3.393	3.627	3.427	3.342	0.935
	(2.24)	(2.39)	(1.87)	(2.03)	(2.32)	(2.20)	(1.94)	
Number of sorghum plots	2.233	2.289	2.134	1.94	2.554	2.283	2.222	0.221
	(1.51)	(1.69)	(1.44)	(1.20)	(1.78)	(1.45)	(1.45)	
Total land holding	4.042	4.211	3.996	4.468	4.022	4.422	4.191	0.876
	(3.11)	(3.43)	(2.95)	(3.66)	(3.10)	(3.52)	(3.08)	
Total sorghum land holding	2.93	3.109	2.716	2.951	3.151	3.375	3.191	0.263
	(2.42)	(2.69)	(2.27)	(2.36)	(2.63)	(2.72)	(2.57)	
Average land holding	1.234	1.293	1.163	1.388	1.175	1.388	1.299	0.149
	(0.79)	(0.85)	(0.71)	(0.84)	(0.76)	(0.87)	(0.76)	
Avera sorghum land holding	1.377	1.447	1.366	1.568	1.284	1.542	1.487	0.218
	(0.91)	(0.96)	(0.92)	(0.96)	(0.84)	(0.94)	(0.89)	
Seed, fertilizer and microdosing								
Local sorghum seeds	0.938	0.925	0.909	0.946	0.927	0.915	0.923	0.640
	(0.24)	(0.26)	(0.29)	(0.23)	(0.26)	(0.28)	(0.27)	
Improved sorghum seeds	0.046	0.070	0.062	0.041	0.078	0.059	0.042	0.176
	(0.21)	(0.26)	(0.24)	(0.20)	(0.27)	(0.24)	(0.20)	
Mixed sorghum seeds	0.047	0.040	0.062	0.045	0.039	0.073	0.067	0.701
	(0.21)	(0.20)	(0.24)	(0.21)	(0.20)	(0.26)	(0.25)	
Fertilizer application (1=yes)	0.581	0.644	0.711	0.689	0.607	0.705	0.641	0.579
	(0.49)	(0.48)	(0.45)	(0.46)	(0.49)	(0.46)	(0.48)	

Results: fertilizer take-up



Results: early commitment



Comparisons to Other Input Fair Experiments