Household Incomes, Production Shocks and Labour Allocation

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Outline

- Motivation
- Theory
- Methodology
- Results
- Conclusion

Growth in agriculture central to economic development

- 86% of rural people depend on agriculture
- Provides jobs for 1.3 billion smallholders and landless
- Fall in poverty (1993-2002) from 28% to 22% result of rural poverty from 37% to 29%
- While urban poverty remained constant at 13%
- 80% decline attributed to better conditions in rural areas rather than migration

Agricultural programs: raise farmers income

- Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) – income support for farmers
- Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) - Scheme to ensure access to protective irrigation to all agricultural farms in the country
- Pradhan Mantri Kisan Maan DhanYojana (PM-KMY) - social security to Small and Marginal Farmers in their old age

Non-agricultural rural programs: antipoverty cash, skills-enhancing programs

- Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) – guarantees 100 days of employment
- Sampoorna Grameen Rozgar Yojana (SGRY) - providing better employment opportunities to the poor
- Sansad Adarsh Gram Yojana (SAGY) - development of personal, human, social, environmental and economic development in the villages

Are both agricultural and non-farm programs complementary?

Will depend on how rural households respond in the labour market to agricultural productivity shocks

Classical theories of economic development

- Growth in agriculture is central to structural transformation and economic development (Nurkse 1953; Schultz 1953; Lewis 1954)
- Most pervasive feature is the shift out of labor from productivity growth in the agricultural sector (Gollin et al 2002)

Productivity growth increase wages which absorbs labour

- Manufacturing sector competes with the agricultural sector for labour
- Higher agricultural productivity increase labour demand
- Which impede reallocation of labour to the non-farm sector (Harris and Todaro 1970)

Two theories: which theory is supported by data in developing countries

(1) Shift out of labour from productivity growth in agriculture

(2) Productivity growth increase wages which absorbs labour

Recent evidence

- Kochar (ReSTAT 1999)-data from village during 1975-1984 – show both positive and negative shocks to agricultural income – supply more off-farm labour
- Adhvaryu, Chari and Sharma (ReSTAT 2013) – industrial employment grows during high-rainfall years in states with hire & fire laws
- Colmer (AEJ:AE 2021) – Manufacturing sector absorb workers during hot years when farm productivity suffers
- Emerick (JDE 2018) – high levels of precipitation increased agricultural productivity – increase labour share of the non-agri sector
- Gollin, Parente and Rogerson (AER 2002) – productivity gains release labour that was necessary to produce food for subsistence requirement
- Foster and Rosenzweig (EDCC 2004) – productivity gains generate additional demand for local produced non-tradables in non-agricultural sector

Recent evidence

Which theory is true?

- Existing studies are based on observational data
- How do these studies address causality?
- The identification strategy are based on instrumental variable (Kyle 2018 JDE) – variation in precipitation to isolate productivity shock
- Bustos, Caprettini and Ponticelli (2016, AER) use variation in the adoption of new technology
- Opens the scope for RCT

Research Questions

- How can we exogenously increase agricultural productivity among small holder farmers?
- What are the labour market consequence of increased farm productivity?
- What are the consequence of increased farm income on off-farm and non-farm activity?

Experimental intervention

RCT proceeds in two stages: Information dissemination experiment

- First stage: Intervention to increase agricultural productivity exogenously
  - Electronic solutions against agricultural pests (e-SAP intervention)
  - Technology-led extension program
  - Direct Seeded Rice (DSR) technology in paddy promoted

Farming practices below optimal

Climate Change!

- New pests and diseases
- Development of resistance by old pests
- New seed varieties with better traits
- Change in chemical composition of soil
- Huge potential exists for yield increase & reduction in cost of cultivation
- Better sprays and choice of appropriate variety of seeds
- Application of fertilizer at the right time and quantity

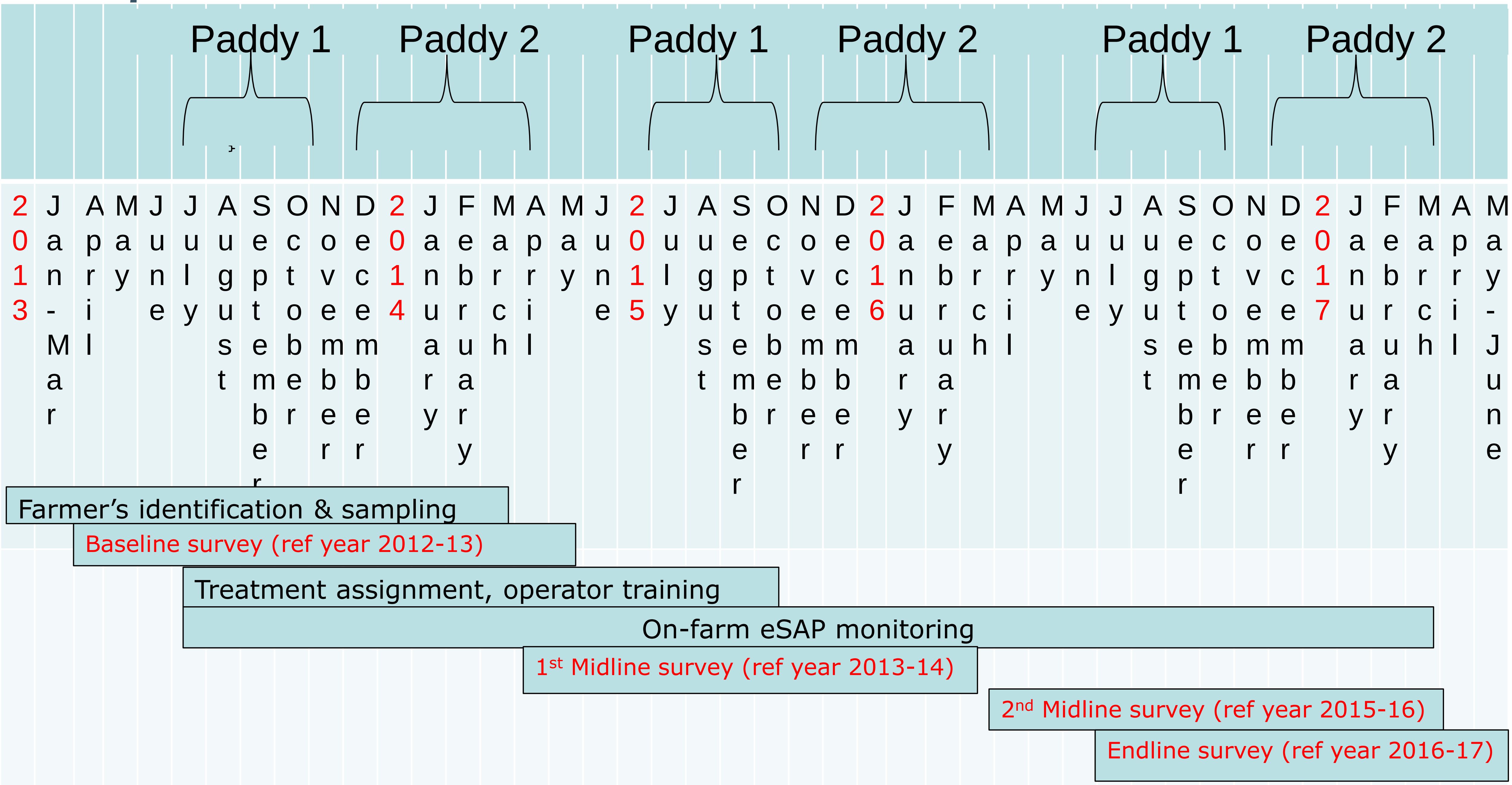
Experimental intervention

RCT proceeds in two stages: Information dissemination experiment

- Second stage: Post intervention sectoral reallocation of family labour

  - Household earnings come from four sectors – crop cultivation, livestock, off-farm labour, non-farm work
  - Examine both household income and sector of activity of family labour
  - Examine number of labour-days per acre (Extensive margin) and hours worked to total labour (Intensive margin)

Project timeline



eSAP Intervention–relax multiple constraints

- Providing real-time, comprehensive and contextual agricultural information to treated farmers

➢ Crop production – soil testing, fertilizer, pesticide
➢ Regular updates of input and output price
➢ Eligibility on agricultural credit
➢ Crop insurance
➢ Cattle insurance

Intervention–relax multiple constraints

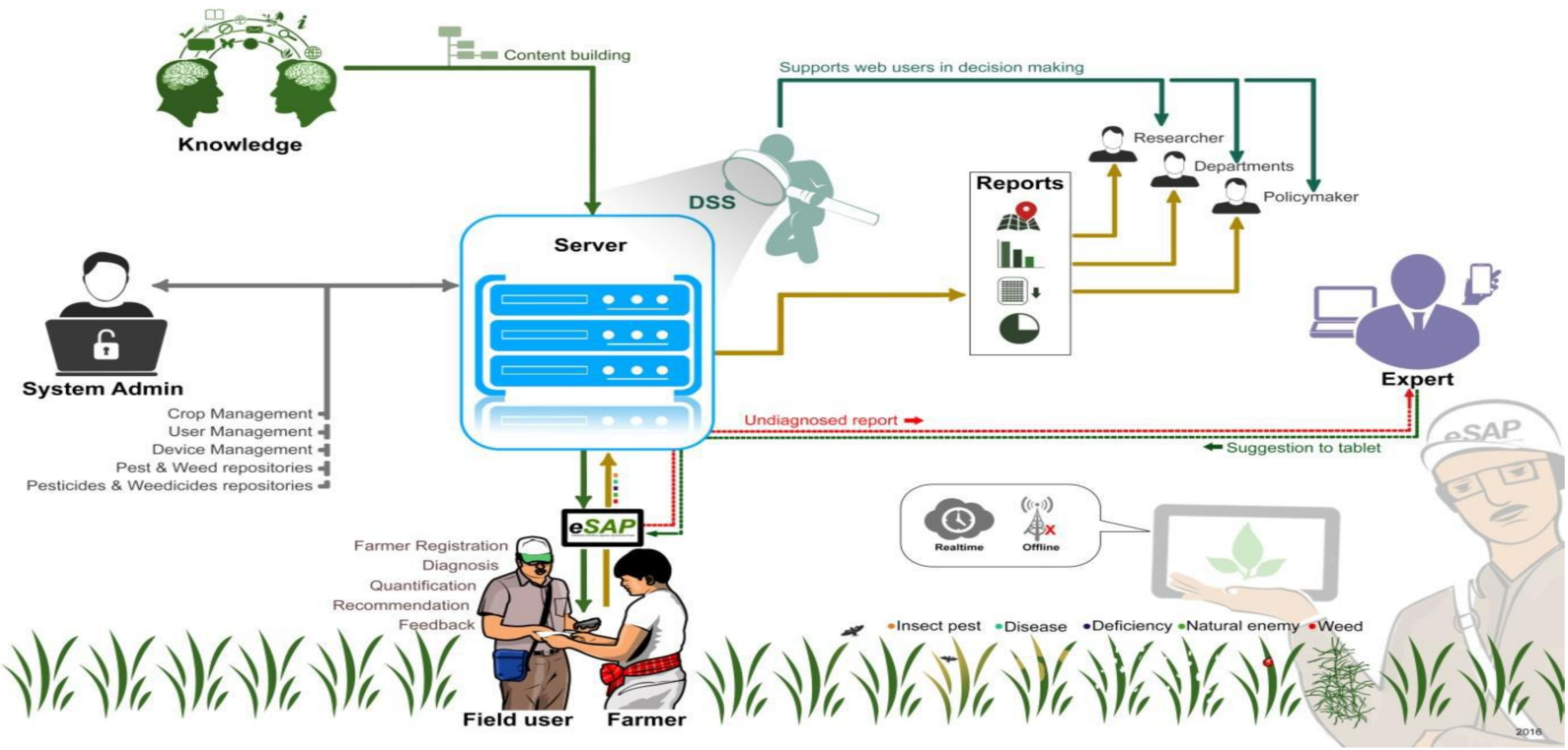
- We hired scientists from UAS Bangalore and Raichur
- Disciplines: agronomy; entomology; pathology; biotechnology; genetics; agri economics
- Tablet with information and real-time link with experts at Agri Universities
- Meet treated farmers every 12th day in their farm
- Provide information on every aspect throughout the crop-cycle for 3 seasons

Technology disseminated – Direct Seeded Rice (DSR)

- Rice seed is sown and sprouted directly into the field
- Less use of water and labour – reduction in cost of production
- High weed infestation, increase in soil borne pathogens and nutrient disorders,
- Management of pest and disease using eSAP and reduction in cost of production can increase profits

Computer-Assisted Extension

eSAP Workflow

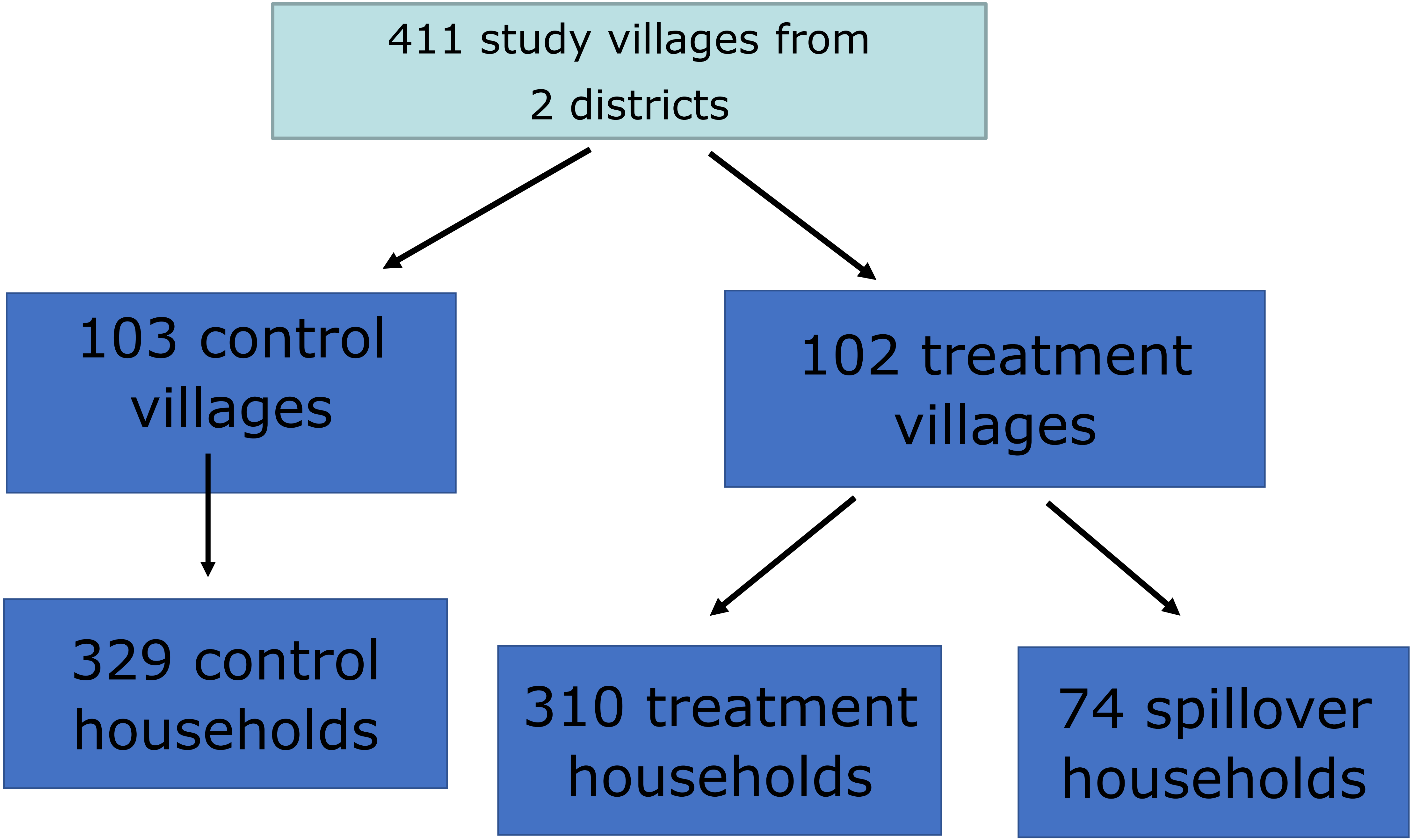



KARNATAKA
Bidar
Gulbarga
Bijapur
Raichur
Bagalkot
Belgaum
Koppal
Dharwad
Gadag
Haveri
Uttara Kannada
T - Tumkur
T
Shimoga
Udupi
Chikmagalur
Tumkur
Kolar
Bangalore
Hassan
Mandya
Bangalore Rural
Dakshina Kannada
Kodagu
Mysore
Chamarajanagar

Cluster Sampling design

> "Give a man a fish; you have fed him for today. Teach a man to fish; and you have fed him for a lifetime"
> Anne Isabella Thackeray Ritchie(1837–1919)
> in her novel, *Mrs. Dymond* (1885)

- Sample selection at household
- Strong spill over effects smaller the area
- Three stage randomization procedure – (1) Stratified GP (2) village (3) HH
- Random selection of spillover group within village
- Information intervention at household level
- But randomization at higher level i.e. GP


411 study villages from 2 districts
103 control villages
102 treatment villages
329 control households
310 treatment households
74 spillover households

Focus crops

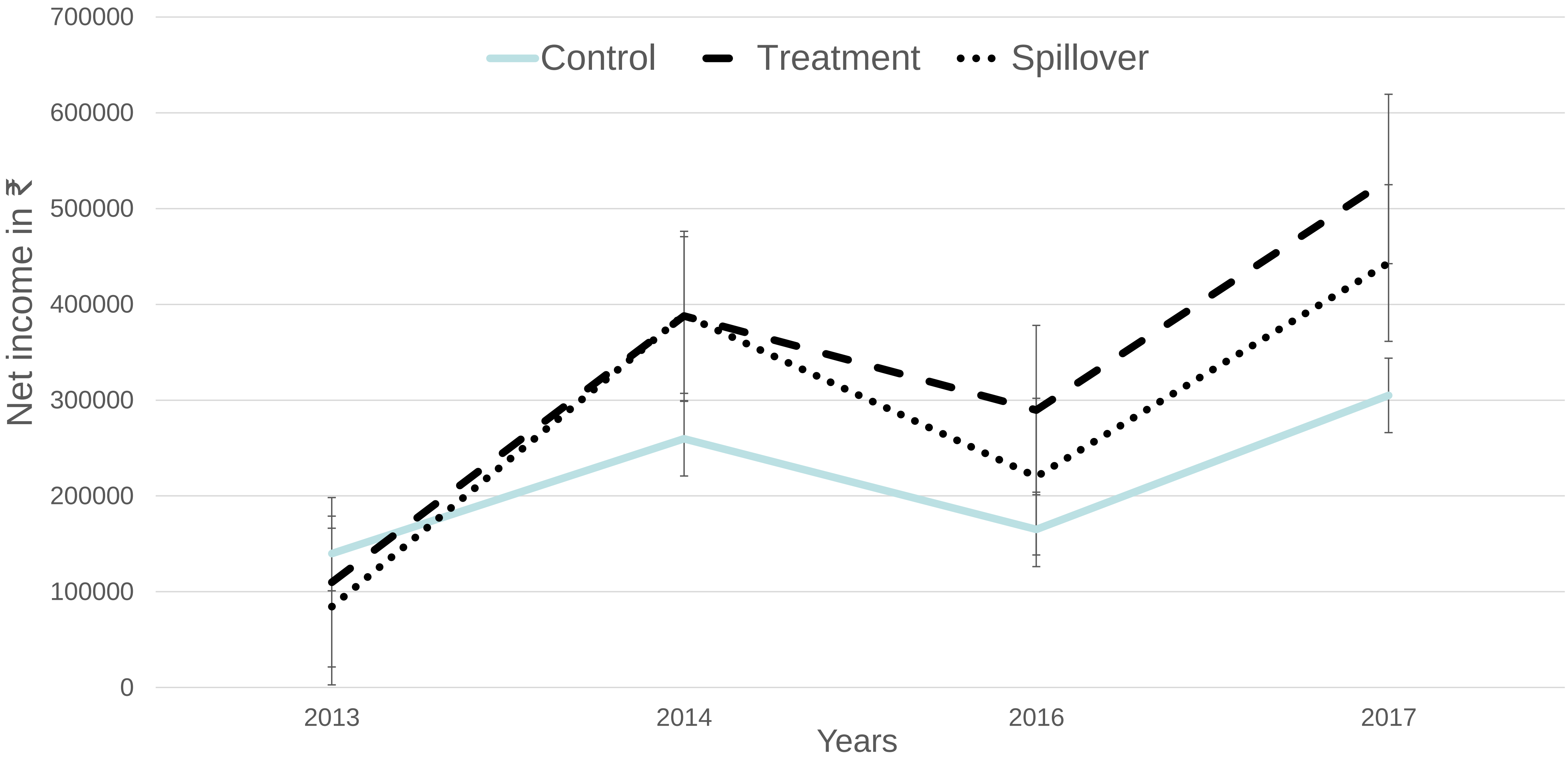
Gubbi	Siriguppa
Paddy	Paddy
Red Gram	Bengal Gram
Ragi	Sunflower
	Cotton

There are 30 other crops grown that includes horsegram; maize; sugarcane; cowpea; barley; groundnut; castor; and green gram

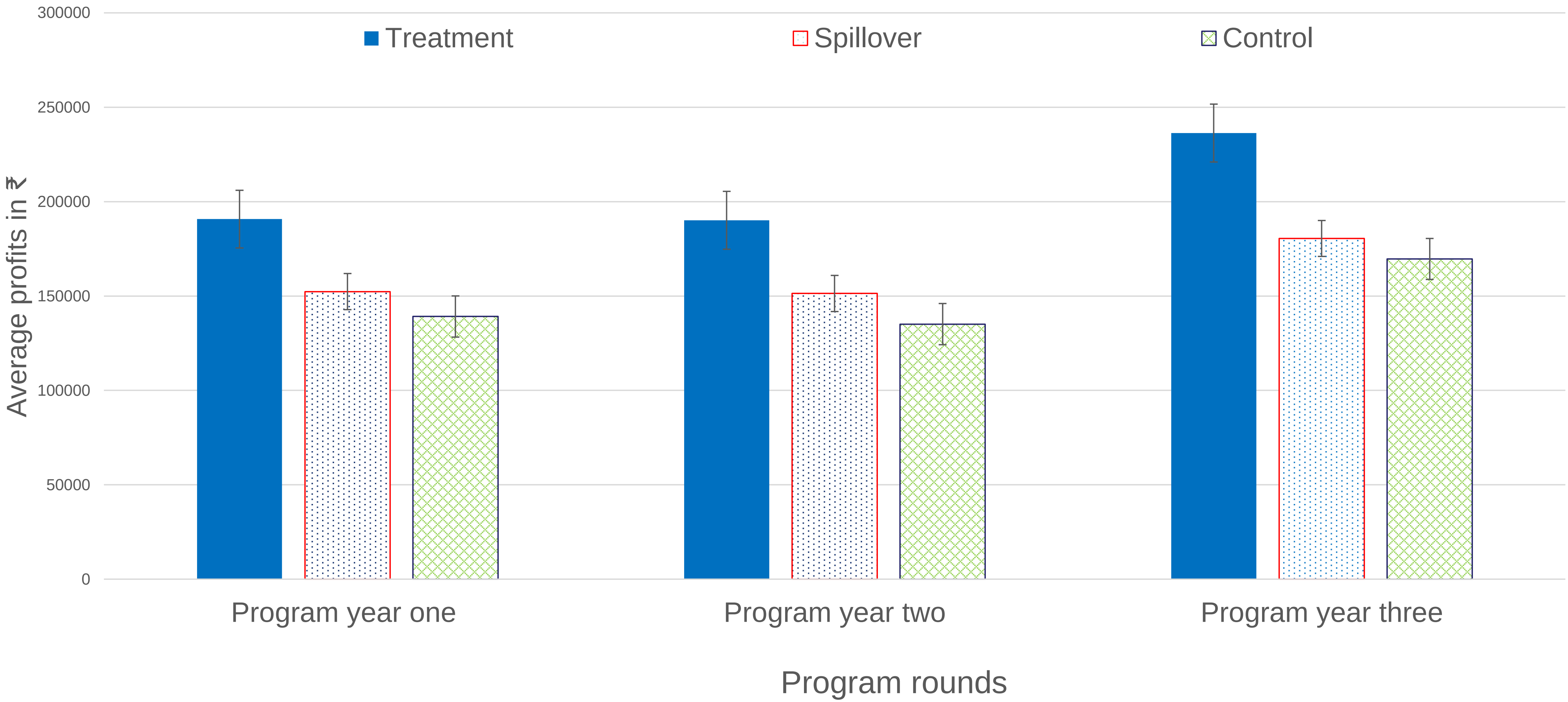
Survey timeline – panel data

Survey timeline	Reference year	Surveys conducted
Baseline round 0	June 2012- May 2013	Farm & household surveys
Follow-up round 1	July 2013 – May 2014	Farm survey
Follow-up round 2	June 2015 – May 2016	Farm & household surveys
Follow-up round 3	June 2016 – May 2017	Farm & household surveys

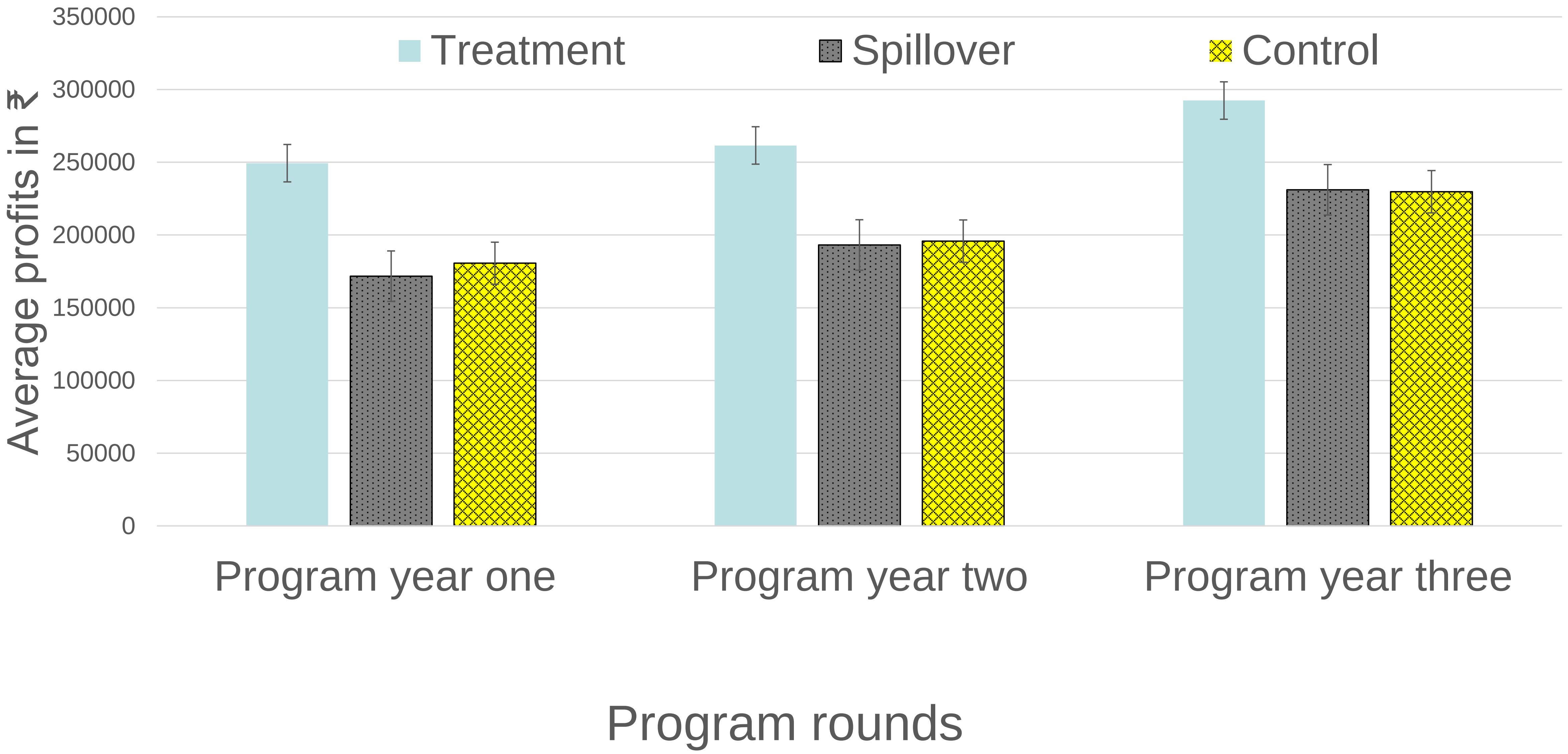
Trends in aggregate crop income by treatment groups



Mean crop profits over program years



Mean paddy profits over program years



Second stage: farm income, non-farm work and labour allocation

Estimation strategy

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

O_{it} - outcome of interest in crop plot *i* in period t

$Treat_i$ - dichotomous variable equal to 1 if household received treatment

$Spill$ – dichotomous equal to 1 if spillover farmers

O_{i0} - value of the dependent variable at the baseline

Y_t - year fixed effects

δ_v - group fixed effects

ε_{it} - error term

Incomes across sectors (per annum)

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Sector of activity			
	Crop cultivation	Livestock	Off-farm labour	nonfarm work
Program years	Three years	Three years	Last two years	
Unit of estimation	Crop-plot	Household	Individual	Individual
Dep. Var. :	Crop income per acre	Livestock income	Off-farm wage income	Non-farm income
Treated	3,182*** [20.55%] (1012)	15,763*** (4193)	348** [1.99%] (165)	-5,393*** [5.63%] (1822)
Spillover	[17.31%] 2,681** (1362)	2,104 (5948)	[4.92%] 859** (207)	[5.57%] -5,343** (2375)
Control mean (₹ in levels)	15,482	-25,554	17,439	95,789
Village FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES
R-squared	0.2097	0.2647	0.4530	0.2018
Observations	4,250	2,753	9041	9,041

Notes: Individual members included are over 18 years of age. Standard errors in parentheses clustered by village code (12 clusters) * p < 0.1, ** p < 0.05, *** p < 0.01

Household incomes (per annum)

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Household sector of activity			
	Crop cultivation	Off-farm labour	Nonfarm work	Activity across all sectors
Program years	Last two years (₹ per annum)			
Dep. Var. :	Crop income	Off-farm wage income	Non-farm income	Total income
Treated	82,757***	-1,785*	-31,999***	36.44% 74,594**
	(25143)	(1027)	(9596)	(33084)
Spillover	28,896	-47	-16,761	13,875
	(39343)	(1228)	(14141)	(48436)
Control mean (₹ in levels)	190,355	13,355	43,881	204,690
Village FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES
R-squared	0.3346	0.4971	0.1882	0.3031
Observations	2,041	2,041	2,041	2,041

Notes: Individual members included are over 18 years of age. Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Labour market – extensive margin

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Sector of activity			
	Crop cultivation	Livestock	Off-farm labour	nonfarm work
Program years	Three years	Three years	Last two years	
Unit of estimation	Crop-plot	Household	Individual	Individual
Dep. Var. :	Number of labour-days per acre	Number of labour-days	Number of labour-days	Number of labour-days
Treated	33.58 % 128.465*** (41.010)	-43.210** (14.832)	1.377 (0.864)	-14.963*** 4.16% (3.591)
Spillover	24.14% 92.345* (53.850)	-53.911** (20.791)	3.967*** 4.61% (0.990)	-10.983** 3.05% (4.562)
Control mean Dep. Var.	382.487	135.76	86	360
Village FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES
R-squared	0.0901	0.3124	0.4633	0.3652
Observations	4,250	2,753	9,041	9,041

Notes: Labour days: (no of timesXdaysXhours)/8. Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Labour use – intensive margin

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Sector of activity			
	Crop cultivation	Livestock	Off-farm labour	nonfarm work
Program years	Three years	Three years	Last two years	
Unit of estimation	Crop-plot	Household	Individual	Individual
Dep. Var. :	Hours worked to total labour per acre	Hours worked to total labour	Hours worked to total labour	Hours worked to total labour
Treated	[6.37%] -5.382**	-705.136***	11.022	-67.718*** [3.16%]
	(2.221)	(228.788)	(6.915)	(20.573)
Spillover	[9.21%] -7.772**	-593.027**	31.741*** [4.60%]	-70.243*** [3.27%]
	(2.384)	(236.821)	(7.920)	(24.260)
Control mean Dep. Var.	84.367	489	690	2,142
Village FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Clustered SE	YES	YES	YES	YES
R-squared	0.1410	0.4173	0.4633	0.4605
Observations	4,250	2,753	9,041	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

First stage: Impact of eSAP intervention

Crop yield – paddy crop

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	Crop yield by program round		
	One round	Two rounds	Three rounds
Treated	23.63% 6.251***	21.25% 5.605***	14.99% 4.030***
	(1.339)	(0.997)	(0.879)
Spillover	21.39% 5.659***	20.08% 5.296***	14.06% 3.778***
	(1.463)	(1.116)	(0.940)
Control mean Dep. Var.	26.447	26.374	26.869
GP FE	YES	YES	YES
Year FE	YES	YES	YES
Clustered FE	YES	YES	YES
R-squared	0.2393	0.2269	0.2197
Observations	1,595	2,117	2,572

Standard errors in parentheses clustered by village P code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Household crop income - post treatment

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Crop profit per acre by program round		
Dep. Var. :	One round	Two rounds	Three rounds
Treated	27.73% 5,424.177***	26.29% 5,388.38***	15.96% 3,619.755***
	(1580.878)	(1320.353)	(1056.43)
Spillover	21.21% 4,148.579**	22.75% 4,662.848 ***	14.05% 3,187.426***
	(1954.073)	(1690.599)	(1431.569)
Control mean Dep. Var.	19,557.78	20,488.530	22,676.78
GP FE	YES	YES	YES
Year FE	YES	YES	YES
Clustered FE	YES	YES	YES
R-squared	0.1530	0.1556	0.2086
Observations	1,595	2,117	2,572

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Crop hired labour – paddy cultivation

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Hired labour-days per acre by program round		
Dep. Var. :	One round	Two rounds	Three rounds
Treated	109.910***	107.694***	93.079**
	(25.732)	(24.014)	(40.406)
Spillover	21.462	6.922	15.926
	(29.204)	(40.412)	(48.339)
Control mean Dep. Var.	175.477	195.372	183.187
GP FE	YES	YES	YES
Year FE	YES	YES	YES
Clustered FE	YES	YES	YES
R-squared	0.0444	0.0550	0.0480
Observations	1,595	2,117	2,572

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

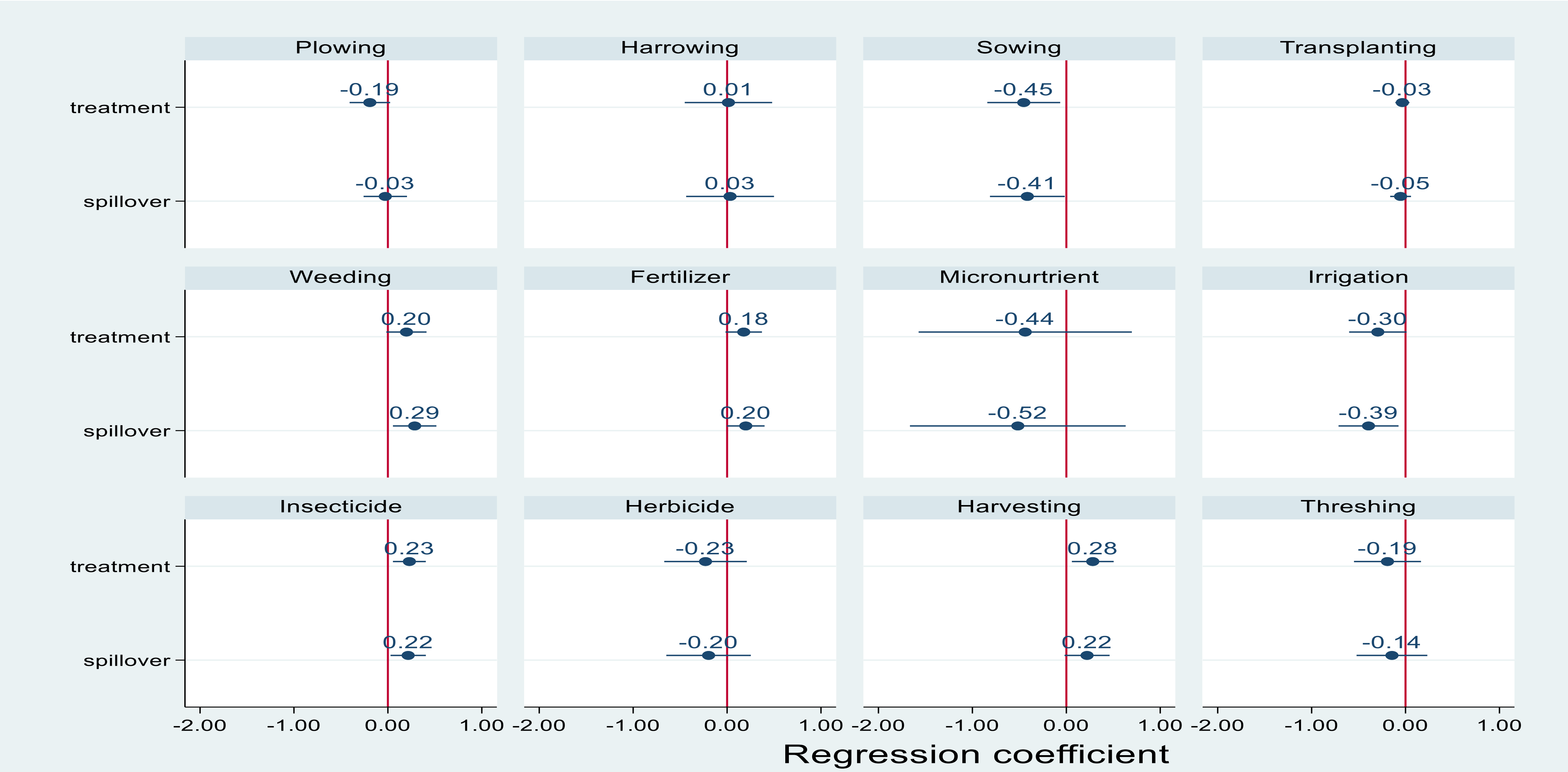
Crop family labour – paddy cultivation

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

	Family labour-days per acre by program round		
Dep. Var. :	One round	Two rounds	Three rounds
Treated	25.123**	26.781**	19.340**
	(10.448)	(10.985)	(10.113)
Spillover	37.217**	41.509 **	29.436**
	(16.626)	(16.108)	(14.519)
Control mean Dep. Var.	72.336	74.549	84.962
GP FE	YES	YES	YES
Year FE	YES	YES	YES
Clustered FE	YES	YES	YES
R-squared	0.0367	0.0408	0.0450
Observations	1,595	2,117	2,572

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Impact on components of input costs by agricultural operations in paddy cultivation



Notes: The plots show the ITT effect with 95% confidence intervals. Plots for each agricultural operation is based on separate regression that also include a constant term, time fixed effect, strata fixed effect, and value of the dependent variable at the baseline as controls.

Results summary

- Improvements in agricultural productivity cause increase in labour demand
- Family labour from non-farm sector reallocates to farm sector in response to increased demand for labour
- Our study examines the short term response of labour demand to growth in agricultural productivity
- Our experiment does not offer insights into how sustained productivity growth in agriculture affect labour allocation across sectors

Thank you very much

Back up slides

Preview of the results

- Rural households are significantly more likely to be withdrawn from nonfarm activities due to higher agricultural productivity
- Crop income of treatment households increased by 20.55 percent relative to the control group
- Nonfarm incomes for working family members of treatment households reduced by 5.63 percent relative to control

Preview of the results

- Nonfarm family labour withdrawn from the nonfarm sector by 4.15 percent relative to control group
- Reallocation of labour to the farm sector is across both extensive and intensive margins
- Spillover households in close proximity to treatment households experienced higher agricultural productivity via social network

Research design – randomized control trials

Information dissemination experiment

- Sample selection at household/village/gram panchayat?
- Strong spill over effects smaller the area
- Two stage randomization procedure – (1) GP (2) HH
- Random selection of spill over group within the village
- 50 treatment households + 10 spill over households
- 50 control households

Components of input costs

$$O_{it} = \beta_0 + \beta_1 Treatment_i + \beta_2 O_{i0} + Y_t + \delta_{gp} + \varepsilon_{it}$$

Dep. Var. : Input use	**Crop-wise plot level**		
	All crops	Cotton	Paddy
Plowing	0.100**	0.149**	0.091
	(0.047)	(0.065)	(0.065)
Sowing	-0.015	0.088***	-0.063
	(0.033)	(0.032)	(0.041)
Interculture	0.134*	0.181***	
	(0.073)	(0.077)	
Weeding	0.102***	0.279***	0.067
	(0.039)	(0.076)	(0.048)
Ferilizer application	0.062**	0.102**	0.082**
	(0.027)	(0.052)	(0.036)
Insecticide application	0.056*	0.103**	0.019
	(0.031)	(0.049)	(0.038)
Harvesting	0.126***	0.267***	0.044
	(0.045)	(0.079)	(0.036)

Standard errors in parentheses clustered by GP code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Price received from paddy sold

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

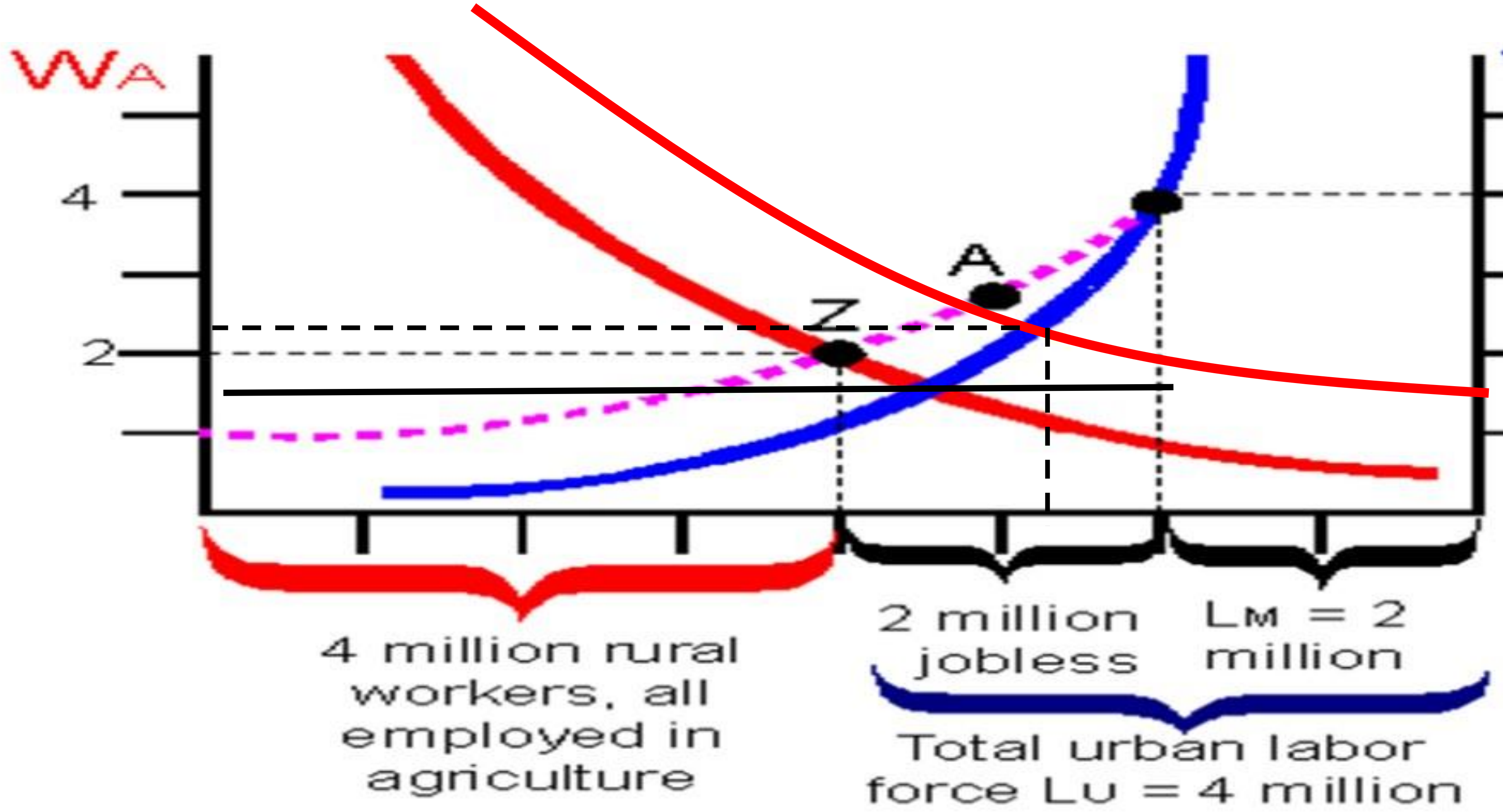
Dep. Var. :	**Output price per quintal**		
	2013-14	2015-2016	2016-2017
Treated	86.743	68.204	178.222***
	(87.202)	(50.837)	(7.020)
Spillover	48.202	71.023	159.966***
	(83.009)	(51.455)	(12.995)
Control mean Dep. Var.	2408	2685	3228
GP FE	YES	YES	YES
Year FE	YES	YES	YES
Clustered FE	YES	YES	YES
R-squared	0.1140	0.2835	0.1444
Observations	1,595	1,375	977

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

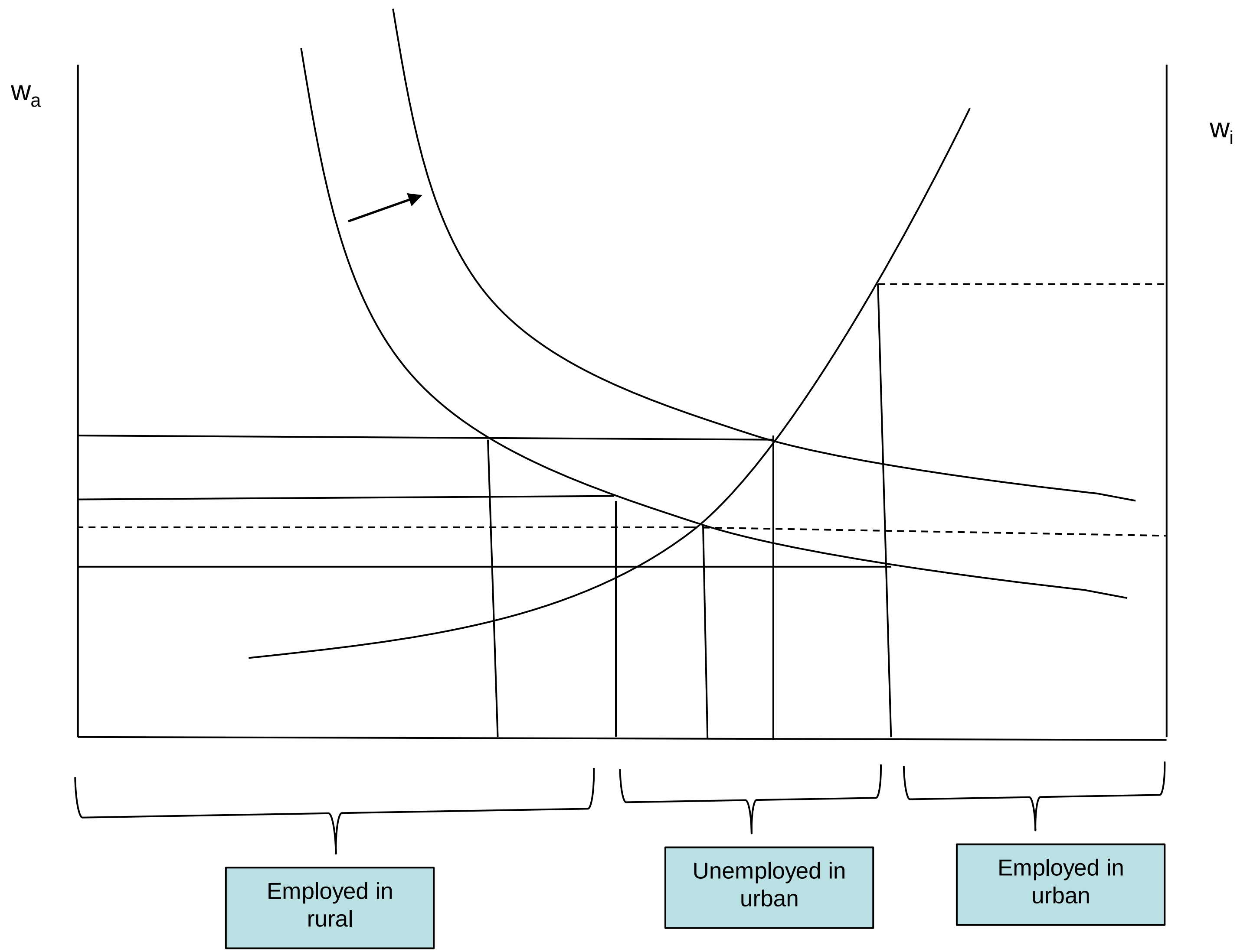
Novelty of the study

- General equilibrium effects – doubling farmers’ income
- Relaxing multiple constraints with extension information – credit; inputs; water; soil quality
- Quantifying spillover from information dissemination

Harris and Todaro (1970) two sector model



Harris and Todaro two sector model



Based on the project

"Information, Market Creation and Agricultural Growth"

funded by

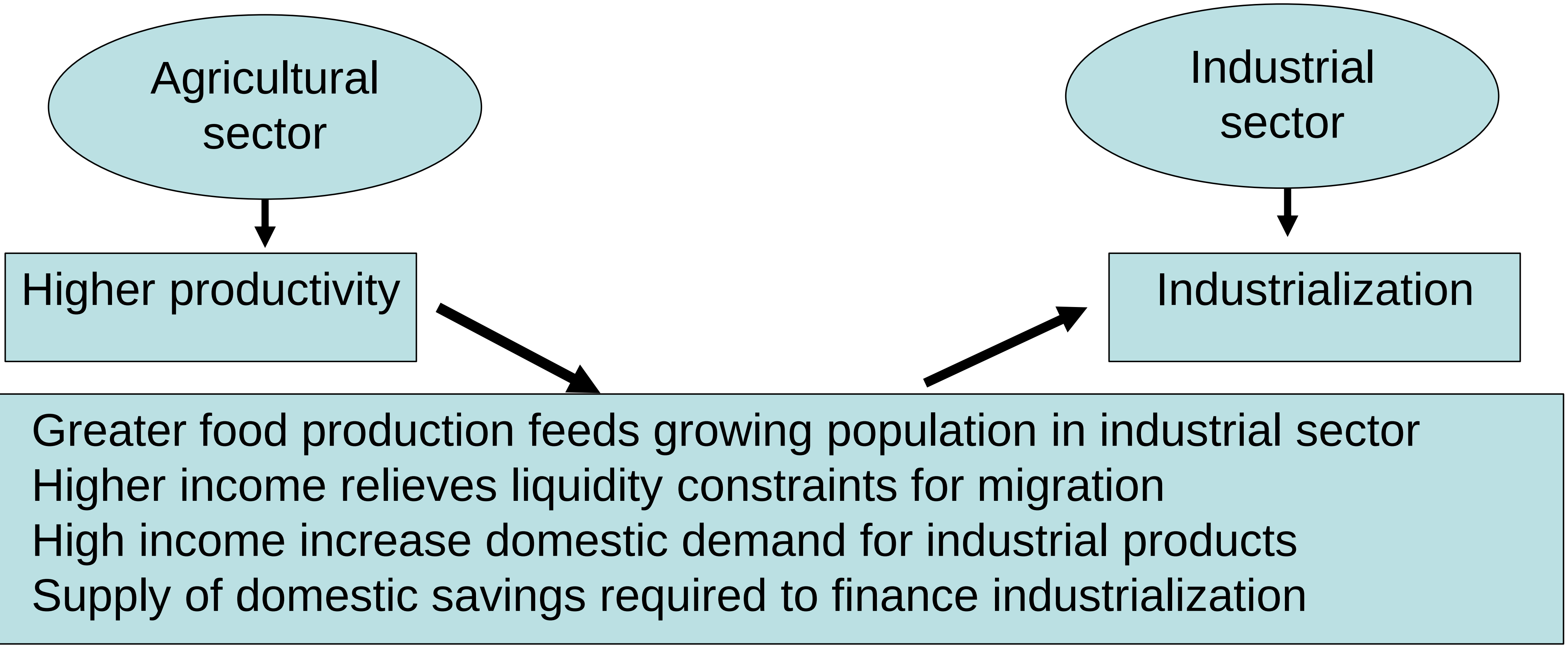
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

UKaid from the British people

Research jointly supported by the ESRC and DFID

Theory

- Conventional wisdom

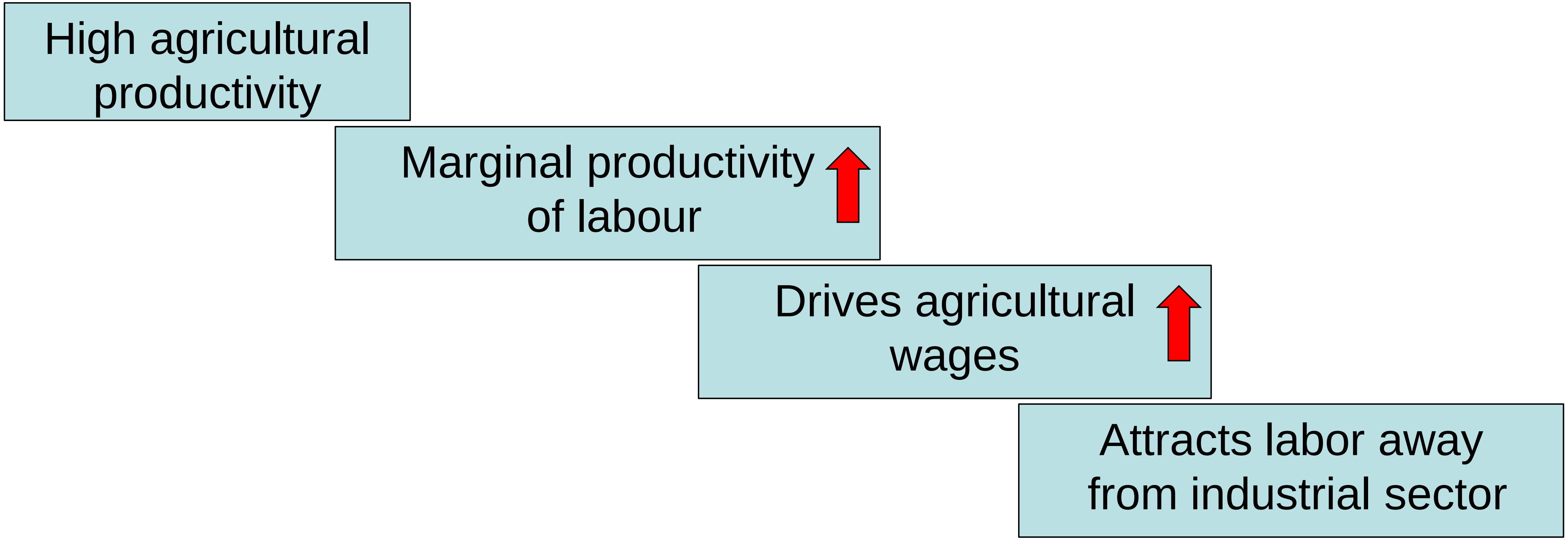


Shift out of labour from productivity growth in agriculture

- Partly based on Industrial Revolution in Britain
- Agricultural revolution precedes industrial revolution
- Release of labour from agricultural sector for manufacturing employment
- Increased farm incomes relieves liquidity constraints to migration where costs are barriers to households leaving rural areas

Theory

- Alternative theory – experience of Belgium – low agricultural productivity results in higher industrialization



How information is delivered?

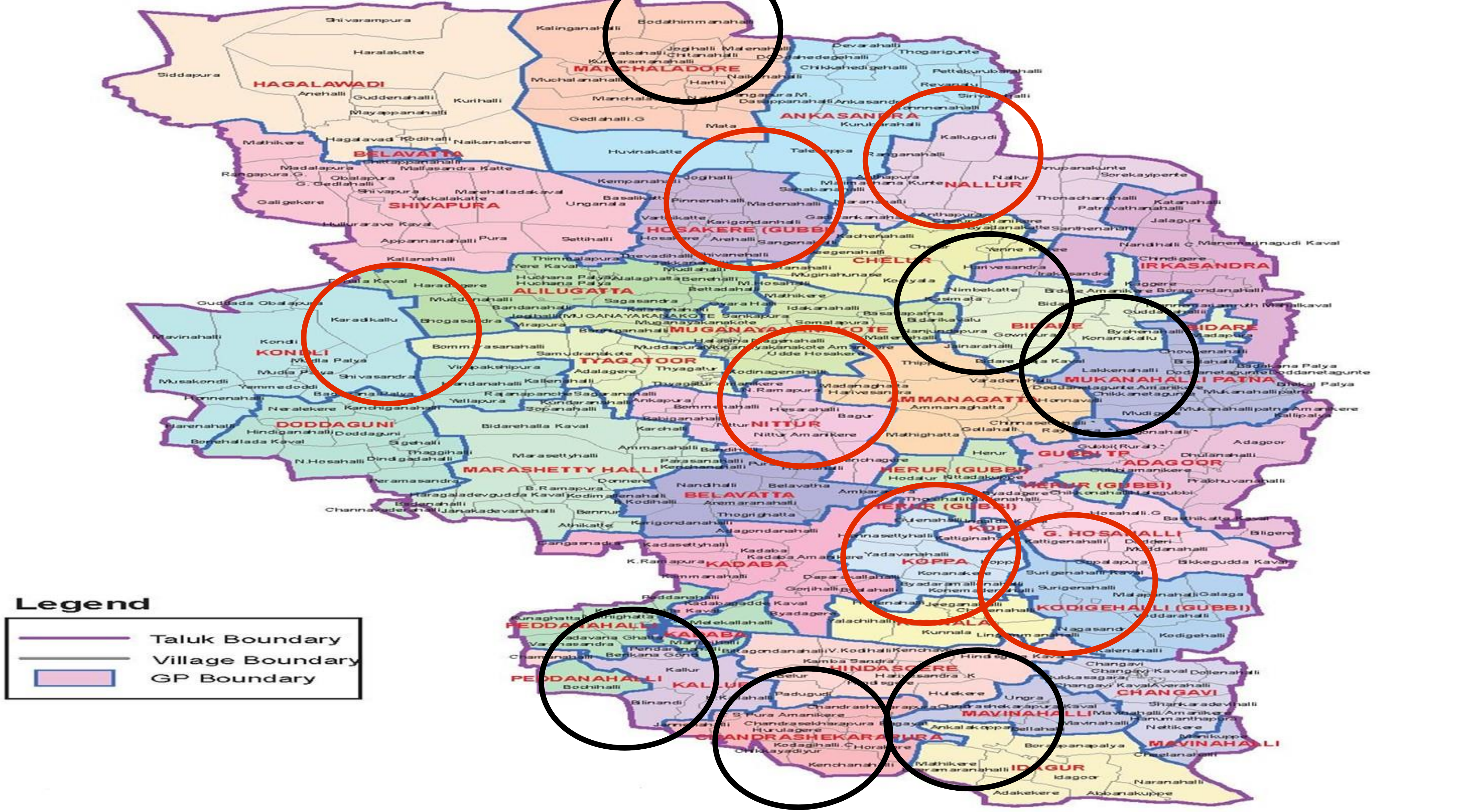
Traditional agriculture extension

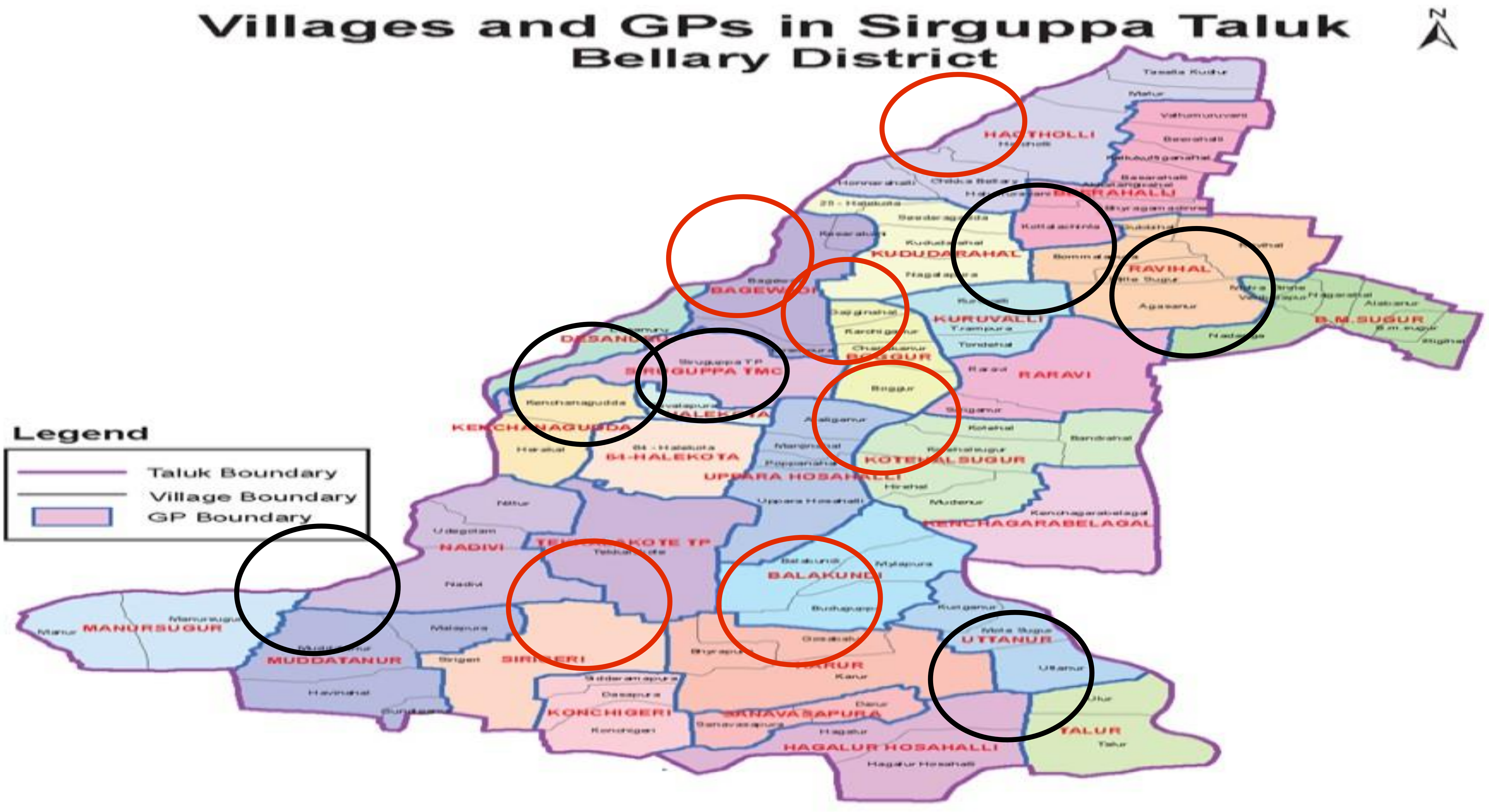
- Considerable resources spent by government
- Few farmers report contact/limited evidence of impact
- Serious governance issues
- Concerns about two-way information flow
- Agro-dealers mainly provide information – perverse incentives

Matrix of effects in RCT

Baseline - control		Baseline - treatment
$Y^{b}{}_{c}$	$=$	$Y^{b}{}_{T}$
↓	Intervention	↓ $\neq$
Post intervention - control	Effect size $\neq$	Post intervention - treatment
$Y^{p}{}_{c}$		$Y^{p}{}_{T}$

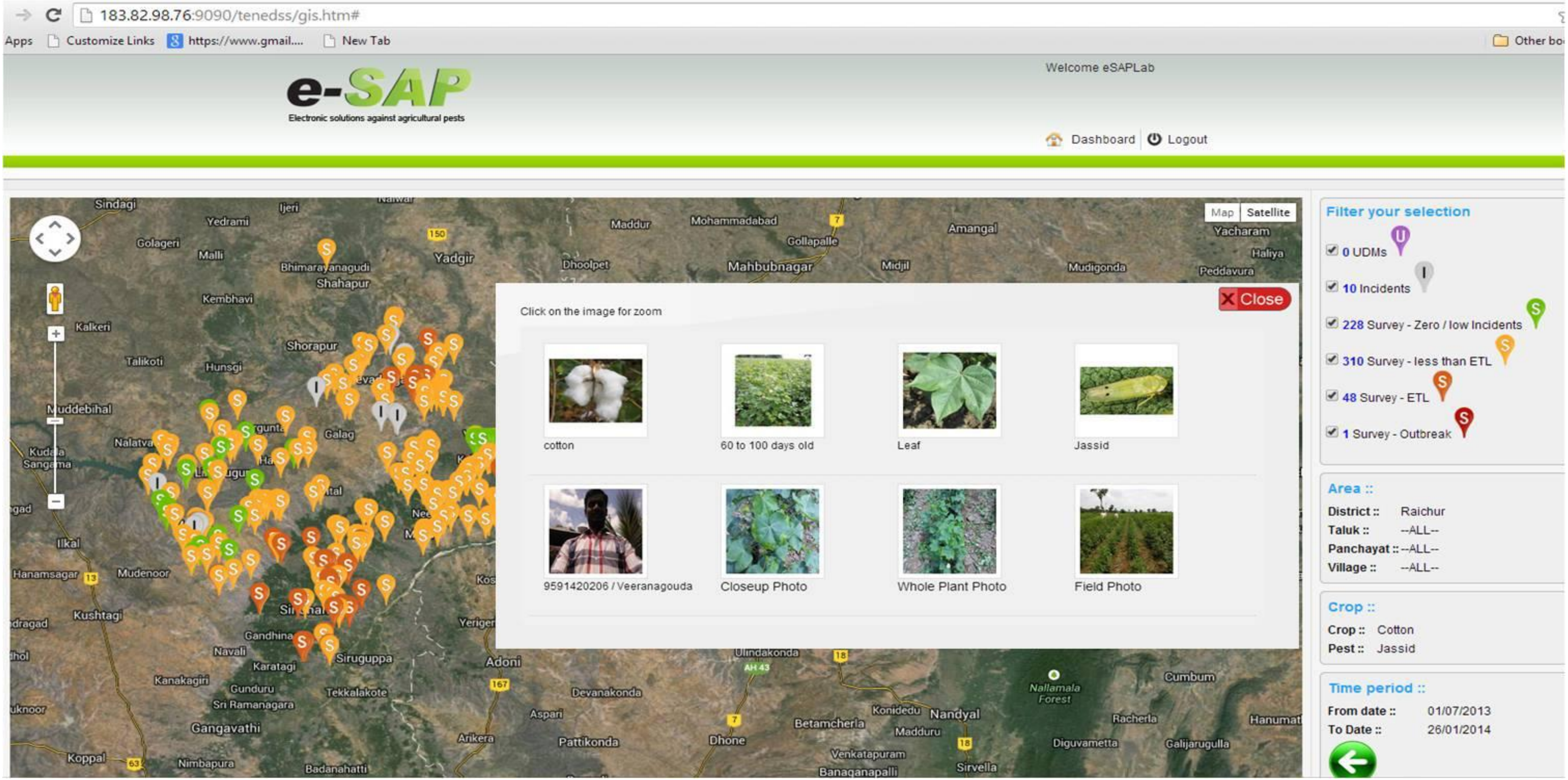
Villages and GPs in Gubbi Taluk
Tumkur District



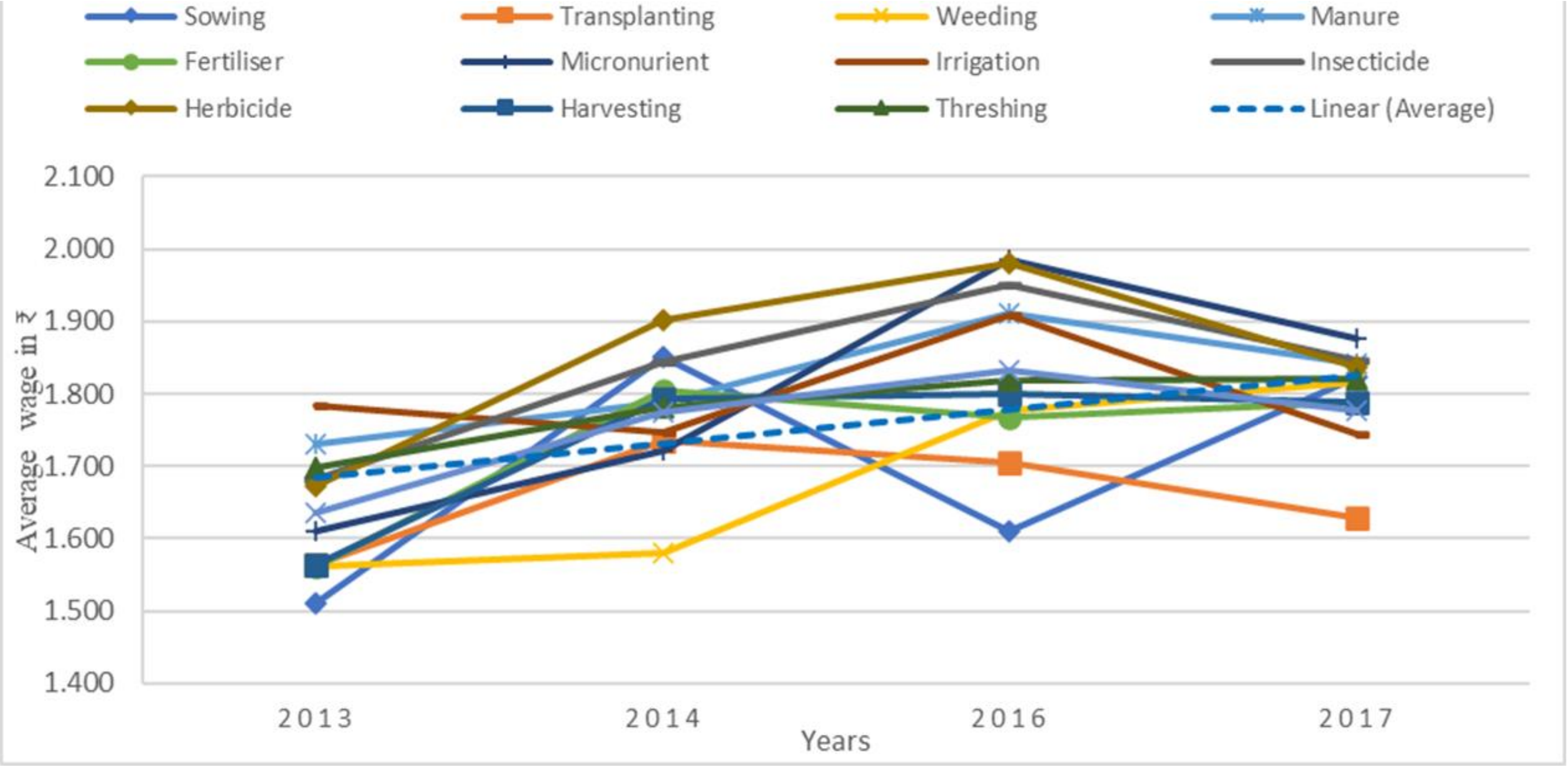

Villages and GPs in Sirguppa Taluk
Bellary District
N
Legend
Taluk Boundary
Village Boundary
GP Boundary
HACHOLLI
BAGEWADI
KUDUDARAHAL
RAVIHAL
KURUVALLI
B.M.SUGUR
SIRUGUPPA TMC
RARAVI
KENCHANAGUDDA
BI-HALEKOTA
UPPARA HOSAHALLI
KOTEHAL SUGUR
KENCHAGARABELAGAL
NADIVI
BALAKUNDI
MANURSUGUR
MUDDATANUR
UTTANUR
KONCHIGERI
HAGALUR HOSAHALLI
TALUR

Field captured images of paddy crop

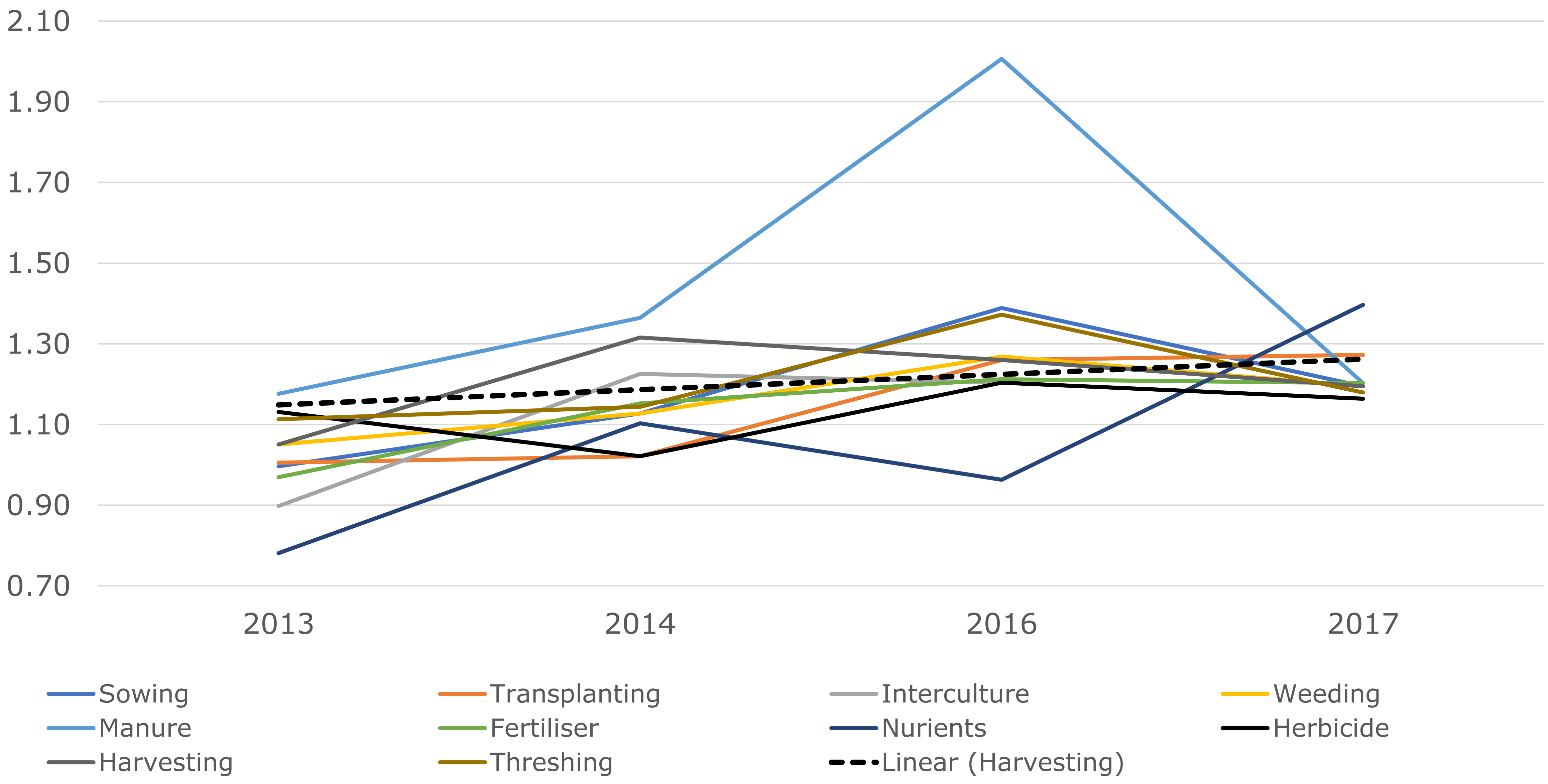
Expert laboratory providing diagnostics and solutions



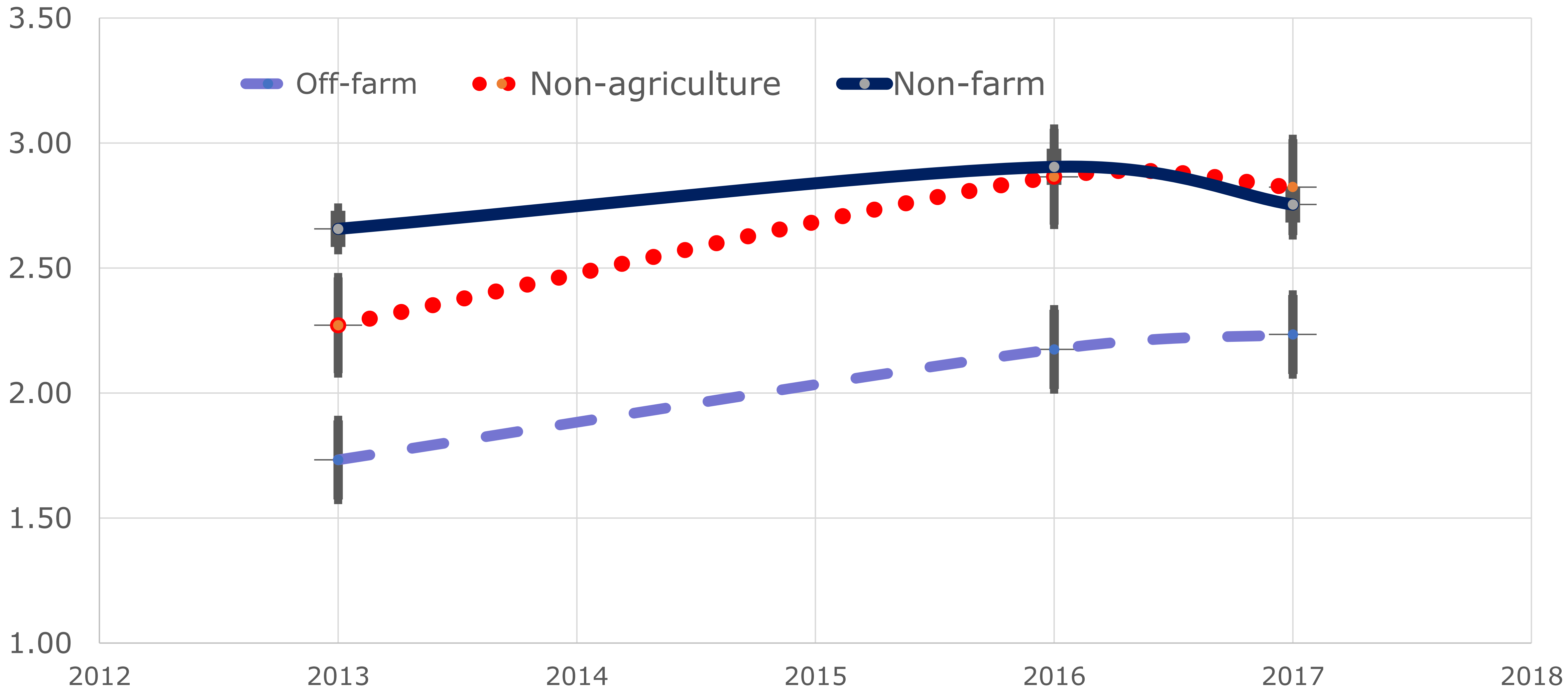
Male real wages by agricultural operations in treatment villages



Female real wage by agricultural operation in treatment villages



Average real wage across non-crop cultivation occupations in treatment villages



Household incomes (per annum) from non-agricultural activity

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	Non-agricultural activity	
	Two rounds	Three rounds
Treated	-2,948***	-3,164***
	(713)	(712)
Spillover	-2,458**	-2,415**
	(1099)	(1152)
Control mean Dep. Var.	60,815	64,249
GP FE	YES	YES
Year FE	YES	YES
Clustered FE	YES	YES
R-squared	0.3134	0.2360
Observations	5,987	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Family labour-days in non-agricultural activity

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	Family labour-days	
	Two rounds	Three rounds
Treated	-6.734***	6.438***
	(2.042)	(2.365)
Spillover	-7.363***	--6.826**
	(2.445)	(2.748)
Control mean Dep. Var.	178	176
GP FE	YES	YES
Year FE	YES	YES
Clustered FE	YES	YES
R-squared	0.5278	0.4223
Observations	5,987	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Household incomes (per annum) from self-employed nonfarm

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	**Self-employed nonfarm activity**	
	Two rounds	Three rounds
Treated	-1,274**	-1,346**
	(629)	(637)
Spillover	-2,094***	-2,151***
	(645)	(710)
Control mean Dep. Var.	28,591	31,303
GP FE	YES	YES
Year FE	YES	YES
Clustered FE	YES	YES
R-squared	0.4326	0.3268
Observations	5,987	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Hours worked to total labour in non-agricultural activity

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	Hours worked to total labour	
	Two rounds	Three rounds
Treated	-53.040***	-54.233***
	(18.116)	(17.848)
Spillover	-57.574***	-56.927**
	(20.874)	(22.087)
Control mean Dep. Var.	1427	1412
GP FE	YES	YES
Year FE	YES	YES
Clustered FE	YES	YES
R-squared	0.5270	0.4217
Observations	5,987	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Family labour-days in self-employed nonfarm

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	**Family labour-days**	
	Two rounds	Three rounds
Treated	-2.956**	-3.671**
	(1.281)	(1.586)
Spillover	-3.517**	-3.539*
	(1.395)	(1.979)
Control mean Dep. Var.	88	91
GP FE	YES	YES
Year FE	YES	YES
Clustered FE	YES	YES
R-squared	0.5486	0.4153
Observations	5,987	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Hours worked to total labour in self-employed nonfarm

$$O_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Spill + \beta_3 O_{i0} + Y_t + \delta_v + \varepsilon_{it}$$

Dep. Var. :	**Hours worked to total labour**	
	Two rounds	Three rounds
Treated	-13.734*	-18.616**
	(7.393)	(8.894)
Spillover	-18.231**	-17.561
	(8.9216)	(12.602)
Control mean Dep. Var.	705	730
GP FE	YES	YES
Year FE	YES	YES
Clustered FE	YES	YES
R-squared	0.5483	0.4149
Observations	5,987	9,041

Standard errors in parentheses clustered by village code (12 clusters) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$