Using Social Networks to Increase the Uptake of New Agricultural Technology

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Overview

1. Background
2. Research questions
3. Agricultural technology
4. Study design
5. Study implementation and challenges
6. Preliminary results

1.1 Background

- Nearly 66% of Nepal's population is employed in agriculture (IRIN, 2013)
- Agriculture has been expanding into marginal areas of the country, increasing pressures on the environment (FAO)
- Agriculture extension services are responsible for farmer training and technology dissemination (IRIN, 2013)

Our project aims to improve the dissemination of profitable, sustainable farming practices by improving the agricultural extension services.

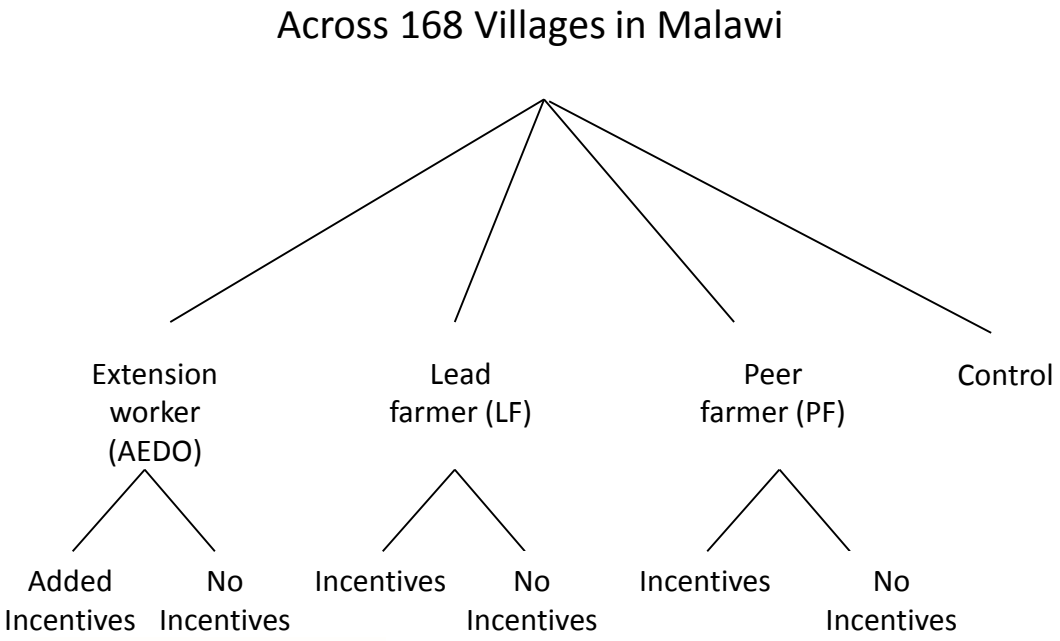
1.2 Extension Services are critical, but face challenges

Agriculture Extension Services in Nepal face challenges in promoting adoption of technologies:

- One Agriculture Service Centre (ASC) covers ~ 10 VDCs ~ 90 wards ~ 360 villages ~ 3,600 HHs
- One ASC is staffed by 2-3 extension workers.
- Extension workers are often on deputation or leave. So, in most cases, one ASC is staffed by one extension worker.

1.3.1 We conducted a similar study in Malawi, with promising results

Study Design – Promote two technologies, pit planting and composting. Randomize the identity of the person promoting those technologies among villages between: (1) extension workers, (2) lead farmers (recognized locally as a leader), or (3) peer farmer (recognized locally as an "average joe"). Vary whether the communicators receive incentives.



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1.3.2 With small incentives, adoption among villages with both lead and peer communicators increased

- Without Incentives,
  - Adoption in peer and lead farmer villages is indistinguishable from 'pure control' villages where technology was never introduced

- With Incentives
  - 11.5 pp increase in pit planting, and 26.1 pp increase in composting
  - 10.7% increase in maize yield in incentive villages over baseline (ITT effect)
  - 299.3% increase in maize yields over baseline for farmers who adopted the technology (TOT effect)

There are cheap ways to leverage the "freely available" social learning to improve agricultural extension services.

2. Research Questions

1. How can we make the Agriculture Extension Services in Nepal more effective – in a cost effective way?

2. In practice, does maize intercropping with French beans, tomatoes, and ginger increase yields and profits?
   - By how much? Under what circumstances?

3.1 We promote maize intercropping with French beans, tomato, and ginger

Why maize intercropping?

- Maize intercropping has been tested and proven to be effective in the hilly regions of Nepal by the International Maize and Wheat Improvement Center (CIMMYT).
- Recommended in extensive interviews with Nepal's Department of Agriculture and other agricultural experts

Evidence suggests that maize intercropping can be profitable in Nepal.

Table 1: Profitability of various intercropping combinations between maize and vegetables and oilseed crops in the hills of Nepal

Intercropping Combination	Maximum gross benefit ha^{-1} (US$)
Maize + Ginger	5,339
Maize + Tomato	2,145
Maize + Soybean	1,295
Maize + Cauliflower	3,193
Maize + Brinjal	2,214
Maize + Radish	2,078
Maize + Cowpea	1,120
Maize + Groundnut	886

Source: (Ortiz-Ferrera *et al.*, 2008)

3.2 The effectiveness of maize intercropping is well-documented in the literature

- Hamal et al. (2008), Katuwal et al. (2008), Govind et al. (2008): suggest that maize intercropping has benefited farmers in the hilly region of Nepal

- Maize intercropping has also been proven effective outside of Nepal:
  - Sileshi, et al. (2012): 12-year study shows maize intercropping increases yields by 50%
  - Hugar and Palled (2008): Maize intercropping with French bean increased value of yield compared to monocropping
  - Sharma and Tiwari (1996): Maize intercropping with tomato increases the number and weight of fruit per plant
  - Adeniyan et al, (2007), Muoneka and Asiegbu (1997), West and Griffith (1992): Maize intercropping with other types of crops increase yield

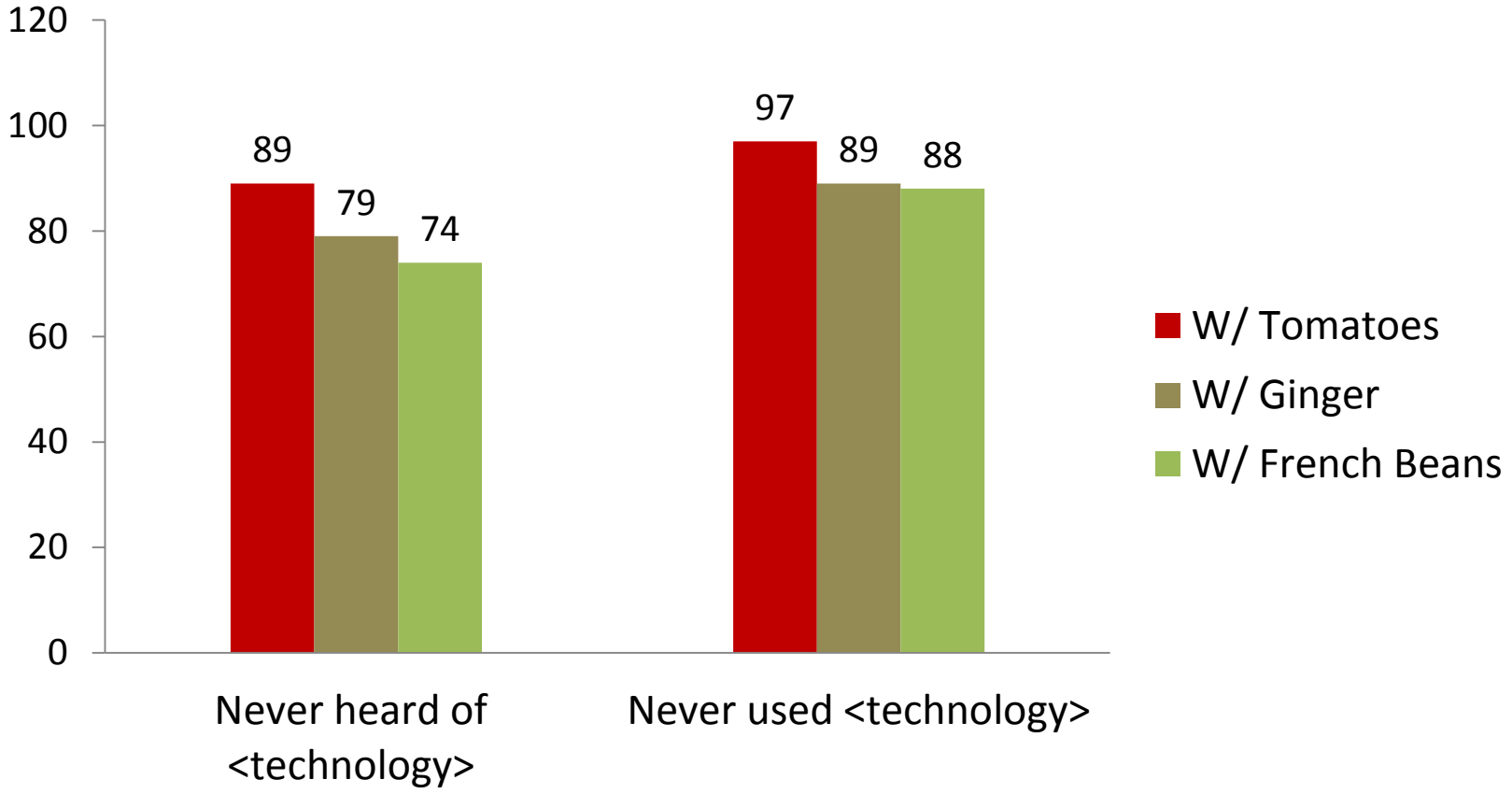
3.3 Maize intercropping offers significant benefits, but is not widely adopted

Benefits of Maize Intercropping

- Maize is widely grown in mid hills, and an important staple cereal crop
- “Climate-smart” technology (provides food security)
- Generates higher yields
- Reduces risk of crop failure, diversifies diet, reduces weed competition, controls disease and pest (Seran and Brintha, 2010).
- Potential for large-scale adoption: can be implemented easily at a low cost requiring few additional inputs.

Intercropping techniques are tested, but adoption rate is below 10%, which suggests that promoting the techniques could benefit farmers.

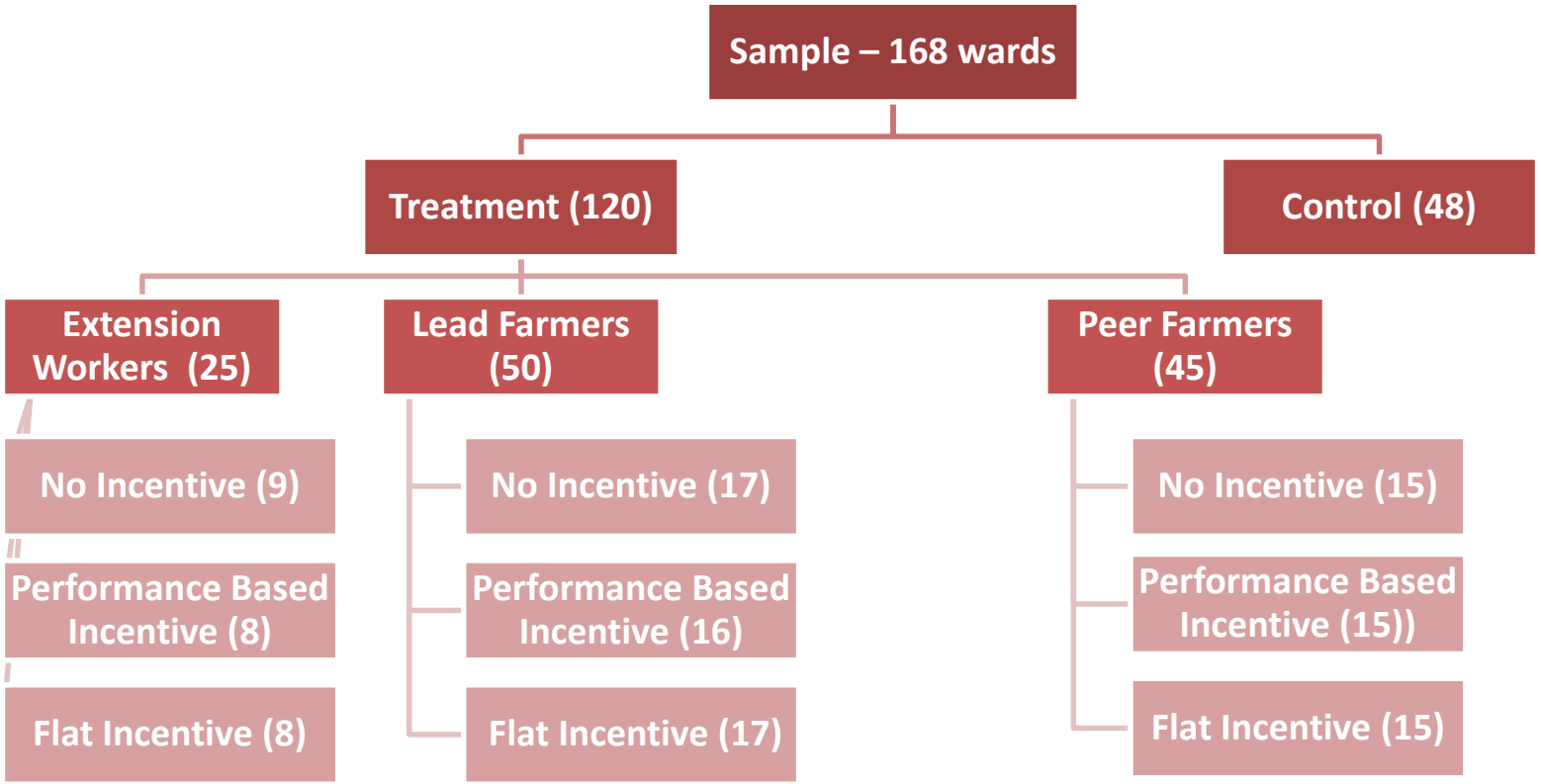
3.3 Our data suggest that many people do not adopt maize intercropping because they do not know about it



The lack of knowledge of intercropping suggests that an information intervention will be successful in increasing the practice.

4.1 Our study examines the effectiveness of the type of communicator and the type of incentives they receive

Study Design



4.2 We employ three stage randomization in our sample

10 Districts

- Chose 10 districts from the mid-hills region based on maize production data

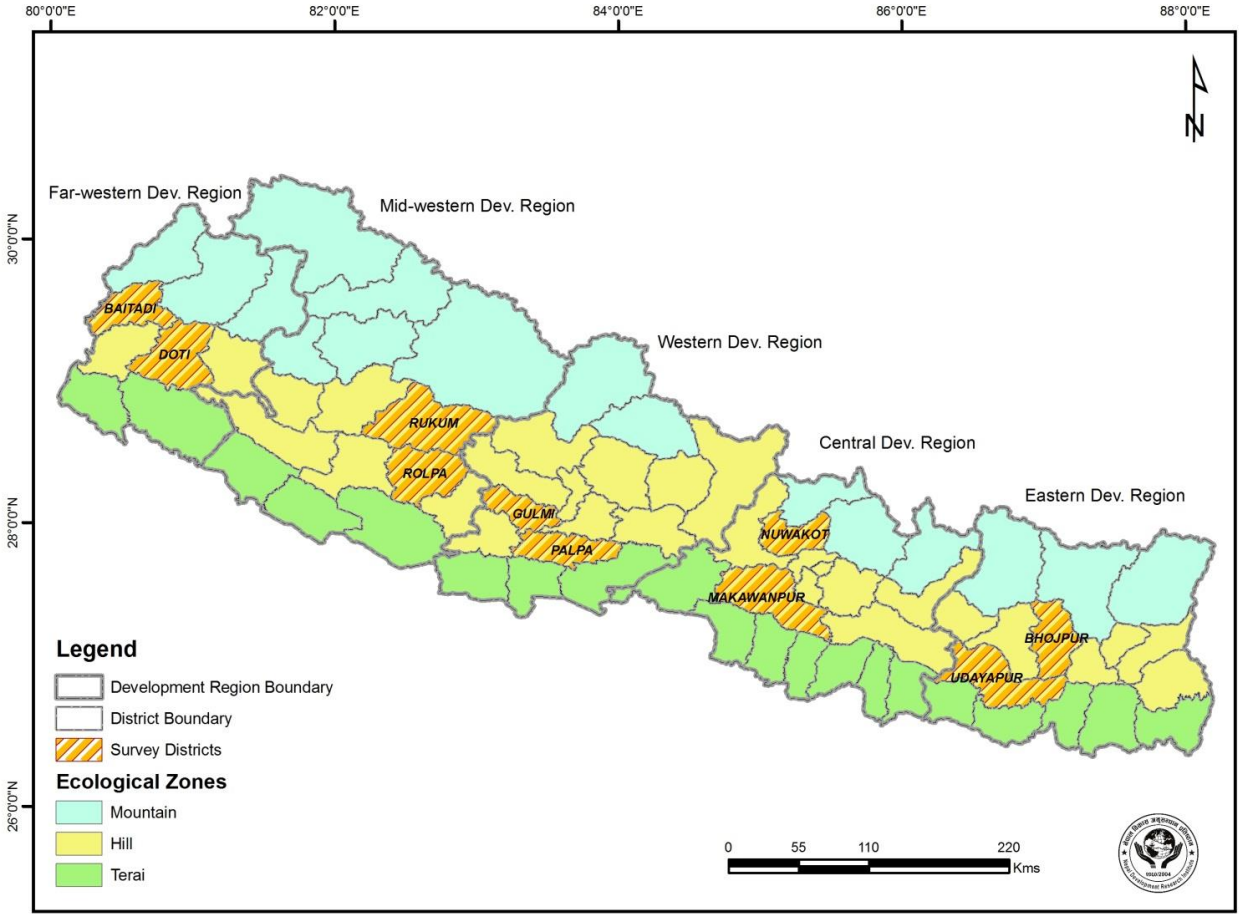
40 Agriculture Service Center (ASC) Areas

- Selected randomly from the pool of all Agricultural Service Centers areas within the 10 districts

168 Sample Wards

- Chose 120 treatment wards and 48 control wards randomly from all wards in the 40 ASC areas

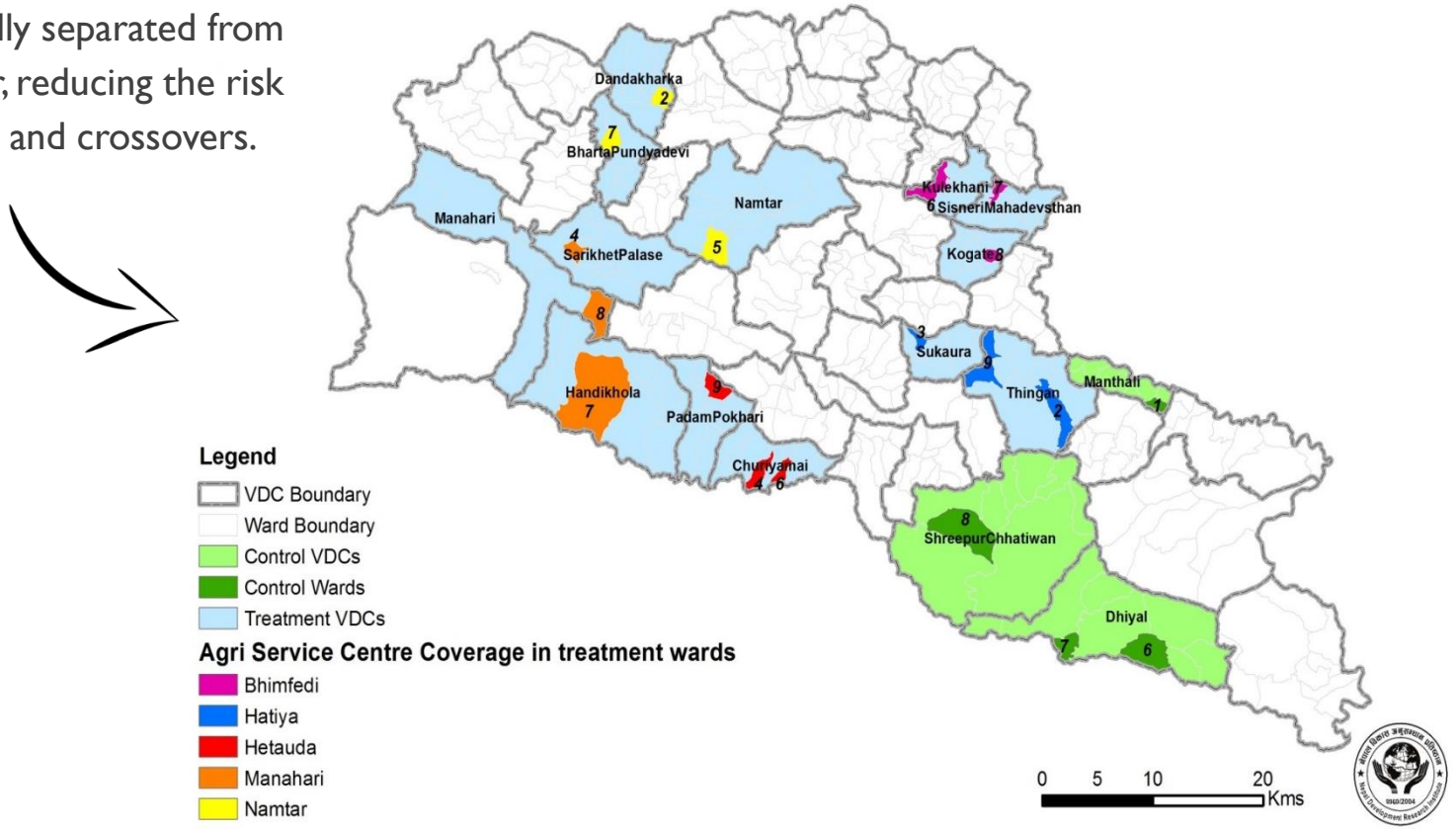
4.3 We choose sample districts in the mid-hills region



We choose the mid-hills region for the similar climatic zone and crops across the region, plus high fraction of the population that are farmers.

4.4 Within districts, we choose treatment and control wards

The sample wards (both treatment and control) are geographically separated from one another, reducing the risk of spillovers and crossovers.



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5.1 Study implementation consists of recruiting and training farmers on maize intercropping techniques

Step 1
- Train extension workers on agricultural technologies and their responsibilities to recruit lead and peer farmers

Step 2
- Extension workers identify lead and peer farmers and train them on agricultural technologies and their respective responsibilities

Step 3
- Extension workers, lead and peer farmers disseminate agricultural technologies to general population

Step 4
- "Communicators" offered flat incentives and those offered performance incentives who meet the requirements are rewarded

5.3 Two major challenges hindered progress in the field

Earthquake

- A 7.8 magnitude earthquake struck Nepal on April 25th, 2015
- Affected 2 of the 10 districts in our sample
- Destroyed the Dept. of Agriculture's (DoA) building, where our government partners were located
- Many DoA staff were reassigned to earthquake relief, so attention was diverted from the project

Fuel Crisis

- Nepal also experienced a fuel crisis, caused by government rationing of fuel in response to strikes from Sept. 2015 ~ Feb. 2016.
- Delayed incentive distribution to farmers, since there was no transportation available
- Delayed 3rd round of household surveys, since staff could not travel

To mitigate the effect of these circumstances on our study, we plan to extend the project by a year.

5.4 In response to the implementation challenges, we extend our study timeline by a year (1/3)

Agricultural calendar		Implementation activities		Status
	Nov-13			
	Dec-13			
	Jan-14	Wards sampling and assignment		Complete
	Feb-14	Training of Agriculture Extension Workers(AEWs); Identification of Lead (LFs) and Peer farmers (PFs) and their training on agriculture technology		Complete
Land preparation and planting	Mar-14	Round 1 (Baseline) household survey	AEWs, LFs, and PFs spread intercropping techniques	Complete
	Apr-14			
	May-14			
Maize harvest	Jun-14	1st On-farm monitoring survey		Complete
	Jul-14			
	Aug-Dec-14			

All implementation activities occurred on schedule

5.4 In response to the implementation challenges, we extend our study timeline by a year (2/3)

Agricultural calendar		Implementation activities		Status
	Jan-15	Refresher training of AEWs		Complete
	Feb-15			
Land preparation and planting	Mar-15	Round 2 household survey	AEWs, LFs, and PFs spread intercropping techniques	Complete
	Apr-15			
	May-15			
Maize harvest	Jun-15	Rapid Assessment of earthquake affected sample areas		Complete
	Jul-15	2nd On-farm monitoring survey		Complete
	Aug-Dec-15			
	Jan-16	Round 3 household survey	Refresher training of AEWs; Distribution of 1st round of Incentives to LFs, PFs, and AEWs.	Complete
	Feb-16			

← Earthquake, 4/25/2015

The earthquake delayed the study by a year, since farmers may not have seen results from intercropping due to the earthquake.

← 5-month delay in 1st round incentive distribution due to fuel crisis

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5.4 In response to the implementation challenges, we extend our study timeline by a year (3/3)

Agricultural calendar		Implementation activities		Status
Land preparation and planting	Mar-16	AEWs, LFs, and PFs spread intercropping techniques		
	Apr-16			
	May-16			
Maize harvest	Jun-16	3rd On-farm monitoring survey		
	Jul-16			
	Aug-16			
	Sep-16			
	Oct-16	Round 4 household survey	Distribution of 2nd round of Incentives to LFs, PFs, and AEWs.	
	Nov-16			
	Dec-16			

Due to the earthquake, we extend our study by a year, so farmers can experiment with intercropping under normal conditions.

← Additional on-farm survey

← Additional household survey; additional incentives distribution

6.1 Preliminary results

- To analyze the effect of maize intercropping on productivity and profit, we must have random variation in the use of maize intercropping, induced by our experiment.
  1. With the data currently available (Baseline and Round 2), we investigate the effect of the experiment on knowledge of intercropping.
  2. We will be able to look at uptake directly in later rounds.

- The following section contains information on:
  1. Demographic differences between lead farmers, peer farmers, and the general population
  2. Knowledge of intercropping among farmers (excluding peer and lead farmers) in treatment and control wards

6.2 At baseline, lead farmers, followed by peer farmers, are wealthier than others in our sample (1/3)

Baseline Demographic Outcomes by Communicator Type (Lead Farmer, Peer Farmer, or Neither)						
	Summary Statistics by Communicator Type			Difference p-value		
	Neither lead nor peer farmer	Peer Farmer	Lead Farmer	(1) vs. (2), p-value	(1) vs. (3), p-value	(2) vs. (3), p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Income Amount (000s)	118.583	130.658	141.487	0.274	0.005	0.399
	(6.417)	(9.112)	(9.043)			
Asset Index	-0.276	0.205	0.755	0.000	0.000	0.001
	(0.066)	(0.058)	(0.098)			
Livestock Index	-0.044	0.077	0.079	0.053	0.093	0.983
	(0.041)	(0.060)	(0.063)			
Improved Walls	0.913	0.920	0.918	0.581	0.626	0.921
	(0.010)	(0.014)	(0.014)			
Improved Roof	0.670	0.693	0.692	0.321	0.182	0.967
	(0.016)	(0.015)	(0.017)			
Piped Water	0.753	0.773	0.758	0.410	0.817	0.531
	(0.019)	(0.026)	(0.012)			
HH Head Caste - Brahmin, Chhetri, Newari, Tagadhari	0.399	0.408	0.437	0.633	0.035	0.252
	(0.039)	(0.043)	(0.040)			
HH Head Caste - Matwali	0.439	0.456	0.458	0.347	0.198	0.944
	(0.044)	(0.052)	(0.046)			
HH Head Caste - Dalit	0.162	0.135	0.103	0.254	0.004	0.187
	(0.018)	(0.023)	(0.015)			
Comparison p-values are computed using standard errors clustered at the ward level (i.e. the unit of randomization).						

6.2 Lead and peer farmers also have more land and are visited more frequently by extension workers (2/3)

Baseline Farming Outcomes by Communicator Type (Lead Farmer, Peer Farmer, or Neither)						
	Summary Statistics by Communicator Type			Difference p-value		
	Neither lead nor peer farmer	Peer Farmer	Lead Farmer	(1) vs. (2), p-value	(1) vs. (3), p-value	(2) vs. (3), p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Plots Cultivated Last Year	2.887	3.177	3.633	0.057	0.001	0.005
	(0.084)	(0.186)	(0.212)			
Cultivation Area (Acres)	1.222	1.328	1.766	0.115	0.003	0.006
	(0.021)	(0.067)	(0.127)			
Maize Plots Cultivated Last Year	1.937	2.146	2.155	0.077	0.001	0.917
	(0.074)	(0.146)	(0.076)			
Cultivation Area for Maize (Acres)	0.815	0.877	1.130	0.265	0.012	0.024
	(0.025)	(0.045)	(0.095)			
Extension Visit in Last Year	0.185	0.339	0.386	0.000	0.000	0.016
	(0.016)	(0.022)	(0.026)			
No. of Extension Visits in Last Year	0.321	0.582	0.784	0.000	0.005	0.101
	(0.055)	(0.083)	(0.163)			
Comparison p-values are computed using standard errors clustered at the ward level (i.e. the unit of randomization).						

6.2 Lead and peer farmers also know more about the techniques we promote at baseline (3/3)

Baseline Intercropping Knowledge by Communicator Type (Lead Farmer, Peer Farmer, or Neither)						
	Summary Statistics by Communicator Type			Difference p-value		
	Neither lead nor peer farmer	Peer Farmer	Lead Farmer	(1) vs. (2), p-value	(1) vs. (3), p-value	(2) vs. (3), p-value
Know of Maize Intercropping with Tomato	0.080	0.164	0.161	0.008	0.001	0.887
	(0.007)	(0.024)	(0.018)			
Use Maize Intercropping with Tomato	0.015	0.029	0.052	0.098	0.001	0.010
	(0.003)	(0.009)	(0.007)			
Know of Maize Intercropping with Ginger	0.188	0.223	0.247	0.092	0.004	0.149
	(0.030)	(0.039)	(0.034)			
Use Maize Intercropping with Ginger	0.104	0.116	0.115	0.573	0.232	0.980
	(0.022)	(0.035)	(0.020)			
Know of Maize Intercropping with French Beans	0.221	0.297	0.310	0.007	0.000	0.444
	(0.035)	(0.030)	(0.035)			
Use Maize Intercropping with French Beans	0.103	0.149	0.174	0.010	0.001	0.170
	(0.024)	(0.025)	(0.032)			
Comparison p-values are computed using standard errors clustered at the ward level (i.e. the unit of randomization).						

6.3 These baseline demographics are consistent with experimental design

- Experiment is designed to select:
  - Lead farmers who are community leaders and early adopters of new farming practices
  - Peer farmers who are more similar to the average farmer, but are also well-connected and seen as leaders
- These results above indicate that the correct people were chosen as lead and peer farmers by our selection process
  - Are also consistent with the Malawi paper

6.4 Our intervention increases knowledge of maize intercropping, in general and for individual crops

Treatment Effect on Knowledge of Intercropping, One Year After Intervention								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Know of maize intercropping (generally)	Know of maize intercropping (generally)	Know of maize intercropping with tomato	Know of maize intercropping with tomato	Know of maize intercropping with ginger	Know of maize intercropping with ginger	Know of maize intercropping with French beans	Know of maize intercropping with French beans
Extension	0.106	0.155**	0.402***	0.406***	0.529***	0.609***	0.426***	0.377***
	(1.40)	(2.27)	(3.32)	(4.92)	(4.96)	(7.18)	(3.68)	(4.10)
Lead Farmer	0.134**	0.162***	0.303***	0.322***	0.386***	0.414***	0.336***	0.304***
	(2.20)	(3.35)	(3.55)	(4.03)	(3.16)	(5.91)	(4.80)	(5.26)
Peer Farmer	0.134**	0.149***	0.247**	0.214**	0.426***	0.399***	0.347***	0.349***
	(2.04)	(3.07)	(2.01)	(2.03)	(4.12)	(6.86)	(4.48)	(4.90)
District FE	N	Y	N	Y	N	Y	N	Y
Extension = Lead	0.662	0.914	0.501	0.436	0.365	0.060	0.488	0.455
Extension = Peer	0.680	0.925	0.369	0.144	0.477	0.024	0.554	0.797
Peer = Lead	0.992	0.766	0.705	0.401	0.793	0.840	0.911	0.597
Control Mean	0.714	0.714	0.186	0.186	0.272	0.272	0.299	0.299
R-Sq.	0.018	0.186	0.152	0.261	0.231	0.453	0.159	0.276
Observations	1760	1760	907	907	940	940	1105	1105

Note: Each dependent variable is 0 if the respondent has not heard of intercropping and 1 if they have. District fixed effects for each of the nine districts in this study are included where specified. Sample contains people who are neither lead nor peer farmers, only. T-stats in parenthesis. * p<.1, ** p<.05, *** p<.01

6.5 The increase in knowledge looks promising

- The variation in knowledge will hopefully lead to variation in uptake of maize intercropping, which will allow us to study the productivity of the technique.
  - Take-up/adoption data currently being processed in the field.
  - Will analyze the take-up/adoption data over then next few months, when it is available from the field.
- We may see more variation in all treatments versus the pure control arm, versus using the variation between different types of treatment