Training Farmers through A Mobile App

Evidence from A Randomized Controlled Trial in China

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Take Away

Agriculture Extensions Services are Important for Developing Country Farmers

- Information and knowledge are critical constraints of adoption of farming technology (Foster and Rosenzweig, 1995, 2010; Magruder, 2018)
- Agricultural extension services are important to overcome these barriers
- Extension services can improve technology adoption and farmer productivity (Bellemare, 2010; Davis et al., 2012; Godtland et al., 2004; Grimm and Luck, 2020; Magnan et al., 2021; Pan, Smith, and Sulaiman, 2018).
- It can reduce poverty by providing information and transferring knowledge to farmers (Anderson and Feder, 2004; Nakasone, Torero, and Minten, 2014).
- If agriculture extension service is absent, information transfer can be scant or ineffective (Takahashi, Muraoka, and Otsuka, 2020).

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But, Extensions Have Challenges Too...

- Traditional extension services have high fixed and recurrent financial costs (Quizon, Feder, and Murgai, 2001)
- Farmers often have limited access to timely and quality information (Ferroni and Zhou, 2012).
- In-person training involves low-frequency visits outside season due to distance and time (Cole and Fernando, 2021).
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Rapid Expansion of ICTs Offers Great Potential

- ICT-based solutions may be an effective way of knowledge delivery rural setting (Aker, 2011; Fabregas, Kremer, and Schilbach, 2019).
  - Radio, television, computer, mobile phones, etc.
  - May help increase farmers' awareness of improved practices
- ICT can affect agriculture through information provision (Aker, Ghosh, and Burrell, 2016).
- Mobile phone can be a vital instrument in delivering information
  - Mobile phones are one of the fastest-growing and most widespread forms of ICT
  - 83% of adults in developing counties have a mobile phone (Klapper, 2019)

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Finding the Appropriate Mode of Delivery is Important

- Use of ICT needs to consider providing proper information, digital literacy, and proper monitoring of actual usage (Lele and Goswami, 2017).

- An appropriate mode of delivering information is important for its effectiveness.

- Voice messages and SMS messages are the popular methods that have been studied in the literature (Casaburi et al., 2019; Cole and Fernando, 2021; Fafchamps and Minten, 2012; Fu and Akter, 2016; Larochelle et al., 2019; Walter et al., 2021).

- However, certain kinds of information may be too complicated to convey by text or voice (Fabregas, Kremer, and Schilbach, 2019)

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Is Technical Training Through A Mobile App An Effective Method?

- We provide farmers technical training through an easy-to-use mobile application
  - Mobile app delivers complicated information through videos
  - The app records what, when, and how long a farmer watched each video in our app

- We also provided aspirational videos via the same app
  - Aspiration videos may enhance farmers' psychological well-being (Ridley et al., 2020)
  - Could also facilitate learning among farmers (Fabregas, Kremer, and Schilbach, 2019)

- We do an experiment to examine whether the training improves farmers' knowledge and grape quality

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Study Setting

- Our study takes place in the city of Beizhen in Liaoning, China
  - China has a 67 percent internet penetration and 99 percent of its netizens access the internet using a mobile phone (CNNIC, 2020)
  - More than 98 percent of rural villages in China have internet coverage, and the cost of accessing the internet is low (Speakman, 2020)

- We partner with the Beizhen government
  - Beizhen is a famous grape town and the largest grape fresh storage base in China
  - The Government is interested in improving the price small grape farmers receive
  - Commissioned Shenyang Agricultural University to find ways to improve the grape quality

- SAU developed training modules that would help farmers improve grape sweetness
  - But delivery is a challenge because of time and money cost

- We developed a mobile-app to deliver the training distantly

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Mobile App Interface

Preview of Results

- Technical training through our mobile app
  - Improves farmers' knowledge
    - Technical test score ↑ 0.45-0.52 SDs
    - A 9.4 to 10.8 percent increase in raw means
  - Farmers believe that their grapes are sweeter
    - Sweetness assessment ↑ 0.51 SDs
  - Helps them enhance the quality of their produce
    - Intent-to-treat (ITT): Grape sweetness ↑ 0.297 SDs
- Weak evidence of aspiration increasing
  - 2 percent increase in raw control mean (statistically significant at 10 percent level)
- While yield does not change, we find weak evidence of change in sale volume and revenue

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Intervention

- Placebo videos
  - Featuring the local history of the grape industry and natural landscapes of the region

- Technical videos
  - 60 videos on grape farming techniques to increase grape quality
  - One to three minutes in length
  - Curated to be relevant to the farmers' particular needs at each stage of the grape-growing period

- Aspiration videos
  - 15 aspirational videos promoting the practice of growing of high-quality grapes
  - Aspiration videos feature established farmers
  - Stories of their successful experience raising the quality of their grapes
  - They also get placebo videos

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  - Aspiration videos feature established farmers
  - Stories of their successful experience raising the quality of their grapes
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- Grape production has 5 stages:
  - Budding and leafing period (May)
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  - Fruit expansion period (July)
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Randomization

- Random treatment assignment happened before the grape planting season
- Unit of randomization is the zu (sub-village) of residence
- 1,026 farmers from 116 zus at the baseline
  - All have mobile phones with access to the internet
  - All have experience using mobile video app
- Randomly assigned into three groups
  - Control group (C): They only see placebo videos (C); 38 clusters, N = 370
  - Technical only arm (T1): They see technical videos and placebo videos; 39 clusters, N = 324
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Estimation Strategy

$$y_{iz} = \beta_0 + \beta_1 T1_z + \beta_2 T2_z + X_{iz}'\delta + \varepsilon_{iz}$$

- y_{iz} is the outcome of interest measured at endline for farmer i in zu z
- $T1_z$ is technical training only arm
- $T2_z$ is technical training and aspiration arm
- X_{iz} includes baseline characteristics
- Cluster SEs by zu (level of treatment).

Motivation

Research Question

Study Design

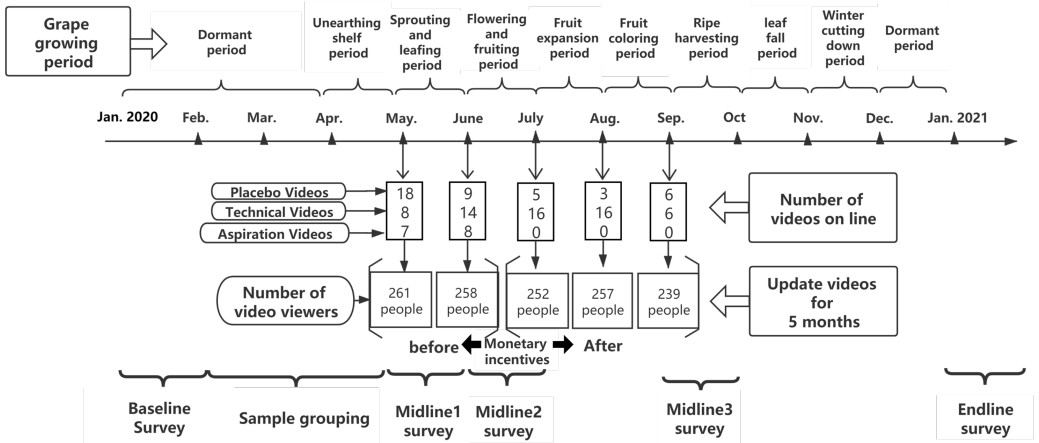
Empirical Framework

Data and Sample

Results

Take Away

Data Collection Timeline



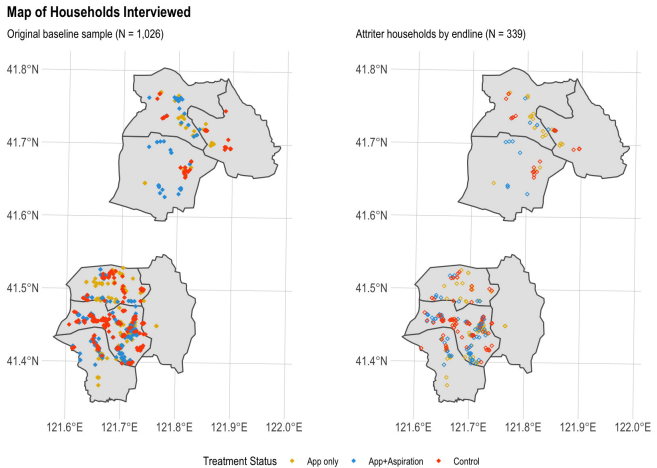
Baseline Sample Farmers Share Similar Characteristics...

	(1) C	(2) T1	(3) T2	(4) *p*-value from test of (1)=(2)=(3)
Panel A: Farmer Characteristics				
Male (=1)	0.67	0.72	0.70	0.532
Age (in years)	47.80	46.53	47.72	0.175
Completed middle school or above (=1)	0.62	0.67	0.58	0.069*
Has a good health (=1)	0.43	0.46	0.36	0.118
Household size	3.79	3.87	3.80	0.734
Has training experience (=1)	0.31	0.35	0.30	0.583
IHS(Total household income)	11.27	11.61	11.23	0.100*
Years of grape planting	21.50	21.45	21.48	0.999
Grape planting area (acre)	1.74	1.94	1.82	0.347
IHS(Grape yield)	10.92	11.00	11.09	0.617
IHS(Revenue from grape)	9.39	10.41	9.26	0.018**
IHS(Average grape sales price)	1.34	1.34	1.28	0.418
N	370	324	332	
Cluster	38	39	39	

...and Have Similar Outcomes

	(1) C	(2) T1	(3) T2	(4) *p*-value from test of (1)=(2)=(3)
Panel B: Outcomes Variables				
Test score (standardized)	0.00	-0.09	-0.11	0.523
Self assessed sweetness (standardized)	-0.00	0.07	0.11	0.595
Self assessed count (standardized)	-0.00	0.09	-0.01	0.552
Self assessed weight (standardized)	-0.00	0.23	-0.06	0.058*
IHS(Aspired income in 3 years)	11.37	11.78	11.91	0.119
Aspired sweetness in 3 years (standardized)	-0.00	-0.11	0.08	0.125
IHS(Aspired income in 5 years)	10.21	11.27	10.73	0.125
Aspired sweetness in 5 years (standardized)	-0.00	-0.06	0.08	0.322
N	370	324	332	
Cluster	38	39	39	
p-value from joint test of equality				
C=T1				0.007***
C=T2				0.148
T1=T2				0.016**

Study Households



Relatively Large Attrition, but Similar Across Arms

	(1) Missing at Midline	(2) Missing at Endline
T1	0.053	0.016
	(0.037)	(0.038)
T2	0.049	0.045
	(0.039)	(0.038)
Observations	1,026	1,026
Control-group mean	0.222	0.311
T1=T2 (*p*-value)	0.931	0.515

Measurement of Sweetness

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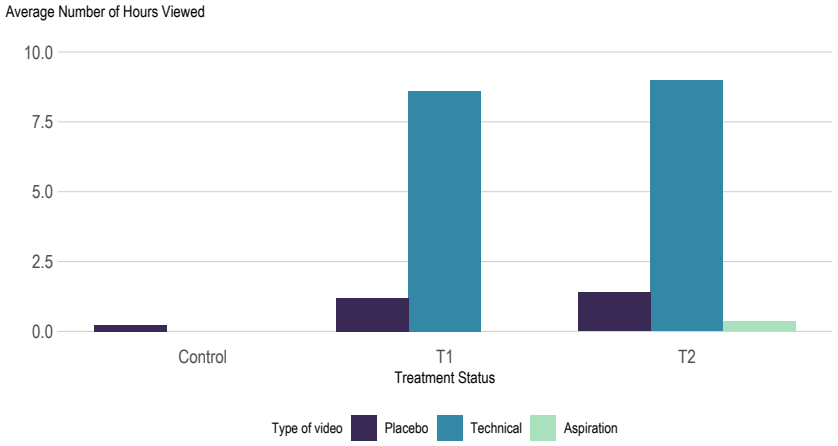
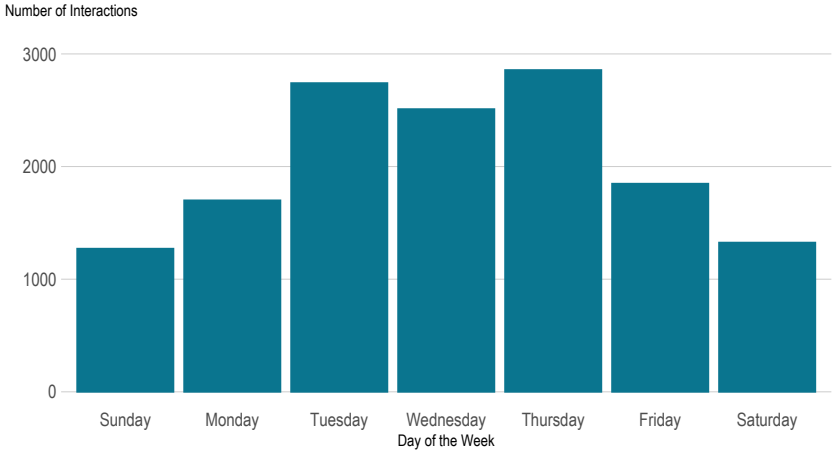
Treated Farmers Spent More Time on The App



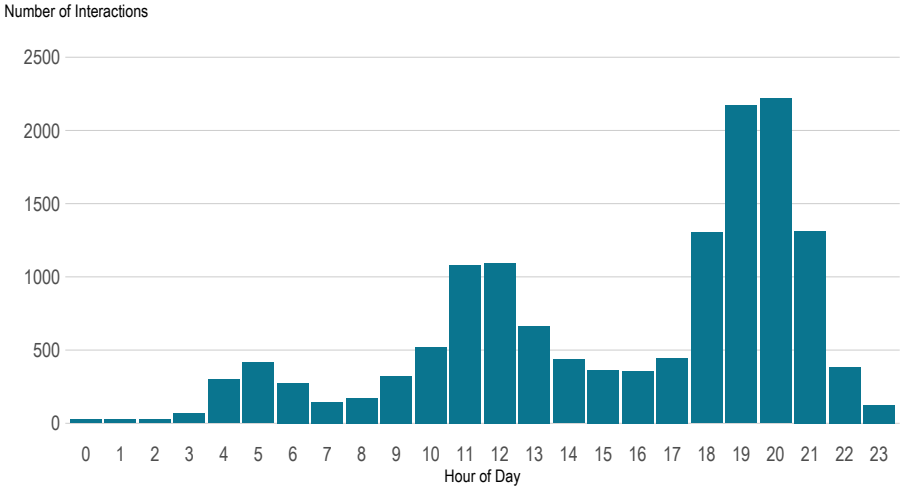
Note: Average hours viewed by all farmers. Each viewing instance is topcoded at twice the length of the video. Includes farmers surveyed at endline only.

Farmers Watched Videos During Weekdays



Note: Each interaction with the app is a video click by the user.

And After Work



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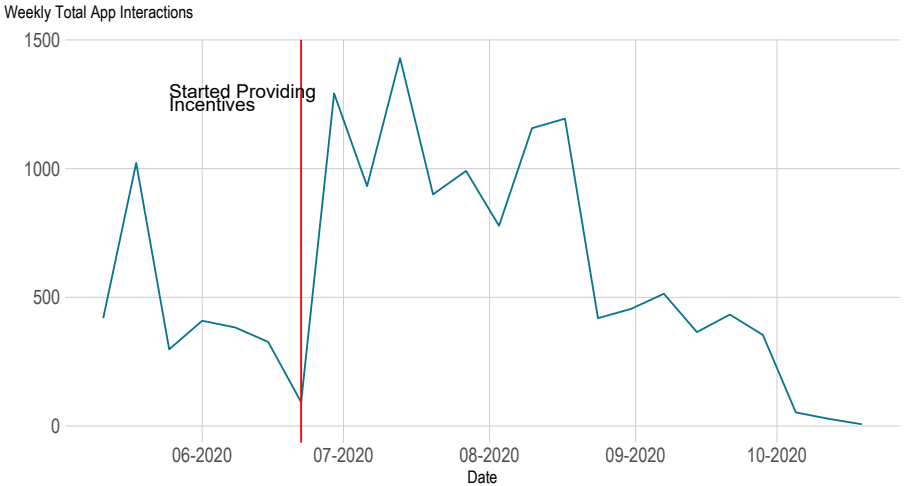
We Paid 2 RMB (0.3 USD) Per Videos to Increase Watching



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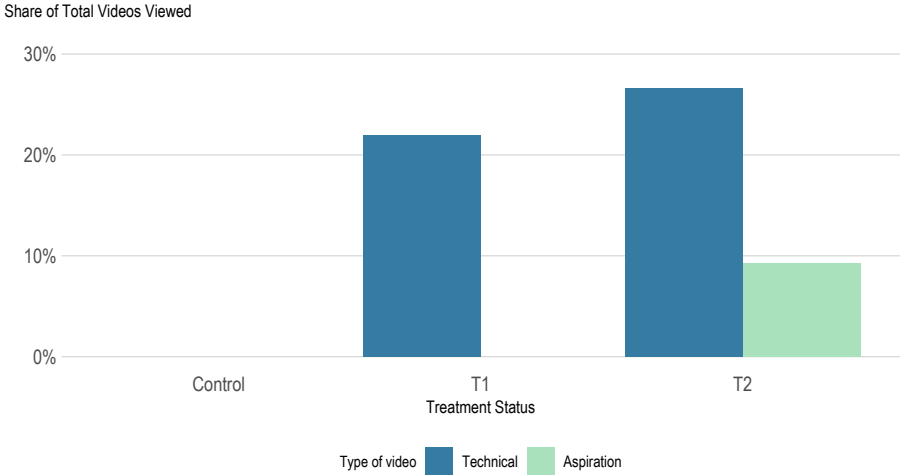
Still Relatively Low Share of Videos Watched



Note: Average share of videos viewed. Includes farmers surveyed at endline only.

Yet, Treatment Farmers Spent More Time on the App

	(1)	(2)	(3)
	Hours Spent Watching		
	Placebo Videos	Technical Videos	Aspirational Videos
T1	3.806***	22.380***	0.000
	(0.694)	(2.236)	-
T2	4.652***	23.837***	2.034***
	(0.795)	(1.826)	(0.335)
Observations	687	687	687
Control-group mean	2.478	0.102	0.008
T1=T2 (*p*-value)	0.365	0.614	0.000

Farmers Watched Videos Throughout the Study Period

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Technical Video				Aspirational Video		
	Overall	May	June	July	August	Overall	May	June
T1	0.222***	0.077***	0.172***	0.295***	0.253***	0.000	0.000	0.000
	(0.019)	(0.012)	(0.017)	(0.026)	(0.027)	-	-	-
T2	0.266***	0.090***	0.188***	0.356***	0.314***	0.093***	0.095***	0.091***
	(0.019)	(0.012)	(0.020)	(0.026)	(0.022)	(0.012)	(0.013)	(0.015)
Observations	687	687	687	687	687	687	687	687
Control-group mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
T1=T2 (p-value)	0.104	0.463	0.554	0.098	0.083	0.000	0.000	0.000

Both Interventions Increase Knowledge Test Scores

	(1) Standardized Test Score (All 10 questions)	(2) Standardized Test Score (Repeated 5 questions)
T1	0.520***	0.371***
	(0.097)	(0.095)
T2	0.451***	0.413***
	(0.102)	(0.083)
Observations	687	687
Control-group mean	0.000	0.000
Raw Control-group mean	7.380	4.388
Raw Control-group SD	1.532	0.805
T1=T2 (*p*-value)	0.492	0.572

App ↑es sweetness, but not when bundled with aspiration

	(1) Sweetness	(2) Count	(3) Weight
T1	0.297**	0.138	-0.114
	(0.132)	(0.117)	(0.103)
T2	0.099	0.010	-0.154
	(0.109)	(0.121)	(0.116)
Observations	679	679	679
Control-group mean	0.000	0.000	0.000
Raw Control-group mean	15.920	68.173	1.659
Raw Control-group SD	1.327	20.272	0.510
T1=T2 (*p*-value)	0.150	0.364	0.720

Treated Farmers' Believe Their Grapes Are Sweeter

	(1) Sweetness	(2) Count	(3) Weight
T1	0.474***	0.173*	0.213**
	(0.092)	(0.103)	(0.105)
T2	0.510***	0.039	0.149
	(0.086)	(0.093)	(0.106)
Observations	687	687	687
Control-group mean	0.000	0.000	0.000
Raw Control-group mean	17.377	81.784	1.865
Raw Control-group SD	1.897	20.617	0.439
T1=T2 (*p*-value)	0.666	0.202	0.576

Headline Findings Remain The Same When We Pick Controls Using ML

	(1) Standardized Test Score (All 10 questions)	(2) Standardized Test Score (Repeated 5 questions)	(3) Sweetness	(4) Count	(5) Weight
T1	0.463***	0.361***	0.0.301**	0.143	-0.060
	(0.093)	(0.095)	(0.131)	(0.119)	(0.119)
T2	0.486***	0.406***	0.098	0.008	-0.165
	(0.099)	(0.084)	(0.111)	(0.124)	(0.134)
Observations	687	687	679	679	679
Control-group mean	0.000	0.000	0.000	0.000	0.000
Raw Control-group mean	7.380	4.388	15.920	68.173	1.659
Raw Control-group SD	1.532	0.805	1.327	20.272	0.510
T1=T2 (p-value)	0.810	0.540	0.142	0.350	0.440

T2 Farmers Have A Slight Increase in 3-year Aspiration for Sweetness

	(1)	(2)	(3)	(4)
	3-year aspiration		5-year aspiration	
	IHS(Income)	Sweetness	IHS(Income)	Sweetness
T1	0.103	0.125	0.101	0.101
	(0.080)	(0.107)	(0.089)	(0.095)
T2	0.028	0.186*	0.034	0.095
	(0.094)	(0.107)	(0.094)	(0.096)
Observations	686	684	685	684
Control-group mean	12.215	0.000	12.392	0.000
Raw Control-group mean		18.375		19.197
Raw Control-group SD		1.884		2.230
T1=T2 (*p*-value)	0.404	0.562	0.475	0.946

Intervention Does Not Have Significant Impact on Additional Outcomes

	(1) Jufeng Variety (=1)	(2) Planting Area (Acre)	(3) IHS(Yield)	(4) IHS(Sale Volume)	(5) IHS(Revenue)	(6) IHS(Price)
T1	-0.004	-0.031	0.038	0.227	0.265	0.039
	(0.012)	(0.069)	(0.075)	(0.163)	(0.178)	(0.028)
T2	-0.000	0.064	0.032	-0.168	-0.135	0.035
	(0.007)	(0.068)	(0.081)	(0.214)	(0.227)	(0.027)
Observations	687	687	687	687	687	672
Control-group mean	0.988	1.790	11.10	10.74	11.63	1.646
T1=T2 (*p*-value)	0.742	0.252	0.944	0.015	0.019	0.857

However, Labor Expenditure Increases for T1

	(1) Fertilizer Expenditure (IHS)	(2) Biofertilizer Expenditure (IHS)	(3) Labor Expenditure (IHS)	(4) Pesticide Expenditure (IHS)
T1	0.132	-0.135	1.134**	-0.046
	(0.134)	(0.399)	(0.529)	(0.100)
T2	0.026	-0.326	0.842	-0.039
	(0.138)	(0.382)	(0.515)	(0.125)
Observations	687	687	687	687
Control-group mean	9.225	4.923	6.098	8.736
T1=T2 (*p*-value)	0.368	0.624	0.581	0.944

Motivation

Research Question

Study Design

Empirical Framework

Data and Sample

Results

Take Away

Providing Training Through Apps Is An Effective Delivery Mechanism

- Technical training through mobile app improves farmers' knowledge
- Also helps them enhance the quality of their produce
  - Can be an effective alternative to traditional extension service
- Farmers find the app helpful
  - 88 percent of farmers who used the app think it is helpful.
- Cost of our whole experiment, including developing the app and watch bonuses
  - T1: $ 27.5 and T2: $ 31.7 per farmer
  - Average cost diminishes as the longer the farmers use the app

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But, There is a Scale vs Intensity Tension

- Bundling multiple objectives together on an ICT platform dilutes the impact
- It suggests that ICT-based delivery of training need to be targeted
- While ICT-based delivery can be easily scaled, learning intensity may have to be balanced

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Thank You!

Appendix

Sample Coverage