Interlinking weather index insurance with credit to alleviate market failures in smallholder agriculture. The EPIICA project in rural Ethiopia

by

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Presentation at the I4 mid-term review meeting held in Rome, Jun 13-14, 2012

on behalf of the I4 EPIICA research team

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Plan of presentation

- Background and context
- Ethiopia background
- The EPIICA project design
- Project developments
- Results from baseline survey
- Productivity and efficiency of fertilizer use
- Willingness to pay for weather index insurance

The interlocking puzzle of input use in agriculture:

- Rain-fed agriculture exposes farmers to huge risks in the purchase of inputs:
  - I pay for fertilizer today, will it rain tomorrow?
  - Risk is a commonly given reason for low input use in Ethiopian agriculture (Dercon and Christiaensen, 2009).

- Most farmers need credit in order to be able to make the purchase of fertilizer + seeds in the leanest season.
  - Research from Kenya indicating that many farmers indicate at harvest time they would like to use fertilizer in the next season, but then don't.

- The large correlated risks from weather make agricultural lending extremely risky.
  - Most developing countries have very thin rural credit markets, rely on government subsidies and guarantees.

The interlocking puzzle of input use in agriculture:

Implication:

The presence of large correlated risks prevent:

- banks from lending to agriculture.
- farmers from using inputs.

- Since the core source of correlated risk is weather, index insurance seems to provide a natural way to resolve this problem:
  - Provision of insurance to lenders means that they can take on the risk of lending to agriculture.
  - Provision of insurance to farmers means that they can afford to take on the risk of using and borrowing for inputs.
  - Simultaneous provision of credit and insurance allows us to create 'state-contingent loans':
    - Receive inputs on credit, if the weather is bad you pay nothing back, if the weather is good you pay loan + premium + interest on both.

Obstacles to Credit Provision on the Supply Side:

- Banks in most developing countries very reluctant to lend to agriculture:
  - Correlated shocks mean that even if average default probability is low, portfolio risk from agriculture to lenders is huge.
  - Predominant source of correlated risks is weather, rainfall.
  - Pressure to forgive loans to farmers when default is caused by weather may be irresistible.
    - Consequence: private capital to ag very scarce even in countries where agriculture provides the best avenue for export-driven growth.

Obstacles to Insurance uptake on Demand Side:

- Recent research:
  - Demand for index insurance products is typically quite low, even though they seem to solve a problem in a very natural way. Why?
    - Trust? Is a new institution credible when asking for money now in return for future promises of payouts?
    - Time inconsistency? Difficult to ask poor people to pay up front for a service whose benefits will not be realized immediately?
    - Credit constraints? The poor simply can't afford the premia?
  - In addition, Duflo, Kremer, & Robinson (2010) show that:
    - Time inconsistency is a major problem in the demand for fertilizer:
      - farmers understand that yields are higher with fertilizer, but the time gap between costs and benefits makes purchase hard.
- So, on the demand side as well, linking credit and insurance may overcome the behavioral problems that are barriers to the uptake of index insurance products.

Why is fertilizer use low in Ethiopia

- A host of demand and supply side factors have been invoked to explain the limited adoption of fertilizer in Ethiopia. Reasons include:

Limited knowledge and education (Asfaw and Admassie, 2004, Yu et. al. 2011);

Risk preferences;

Credit constraints (Croppenstedt, Demeke and Meschi, 2003);

Irregular rainfall (Alem et. al. 2008);

Limited profitability of fertilizer use (Dadi, Burton, and Ozanne, 2004; World Bank, 2006);

Lack of market access (Abrar, Morrissey, and Rayner, 2004;

Incomplete markets (Zerfu and Larson, 2010);

Inefficiency of input use (Yu et. al. 2011);

Limited or untimely availability of the inputs themselves

The Interlinking solution:

- Provide loans to farmers that are explicitly weather-contingent:
  - Farmers take loans to purchase inputs, insurance premium is added on to the loan amount and paid immediately to the insurer.
  - The beneficiary of the insurance policy is the bank itself, so if the weather index triggers the bank is paid with certainty (no intermediaries between bank and insurer).
  - The Cooperative Unions sit between the financial institutions and the borrowers and serve several critical roles:
    - First, they aggregate transactions and decrease the fixed costs of making loans.
    - Second, they are entities with the legal authority to contract with banks, much easier for formal financial institutions to deal with than smallholder farmers.
    - Third, they can use their extensive relationships with primary cooperative and farmers to serve as enforcers of the loan contracts, minimizing default risks.
  - Credit contracts written with Unions.

Our research partners:

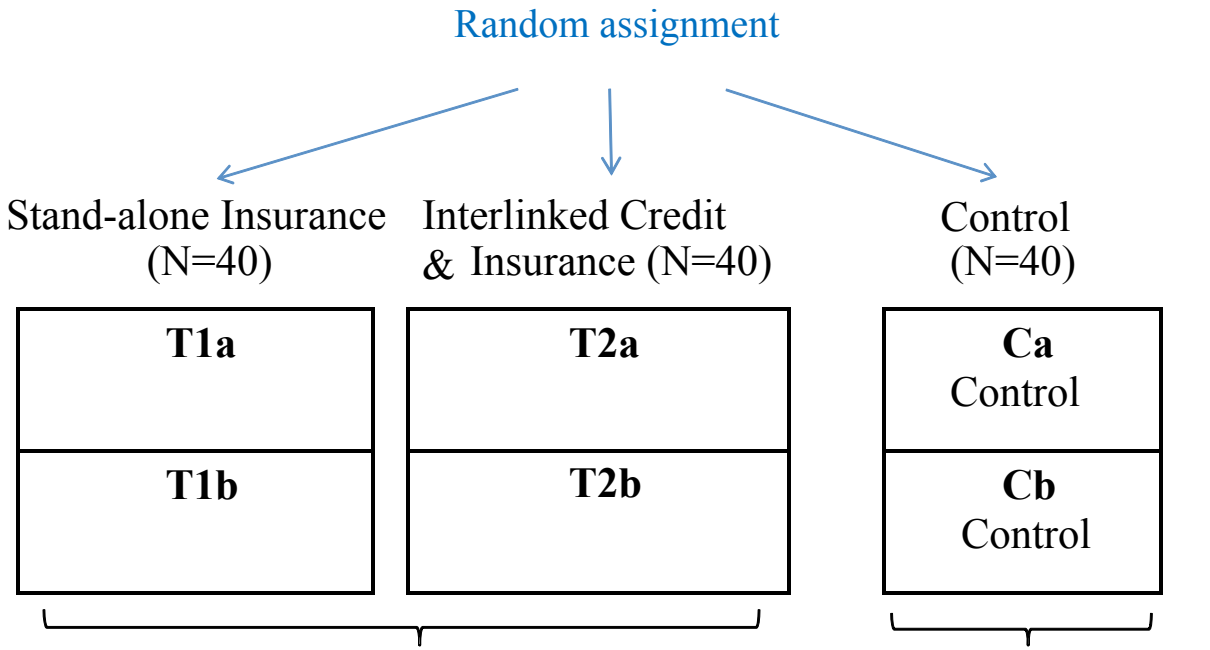
- Nyala Insurance:
  - Provide rainfall based index insurance to farmers in East Gojam, North Shewa North & South Wollo.
  - Insurance is intended to cover the *inputs* to production, not the output of the farm.
- Dashen Bank:
  - Will provide credit to farmers that will be backed up by the Nyala product; serves as a form of collateral substitute in ag lending.
  - Contracting is done through Cooperative Unions, who recruit farmers through Kebele-level cooperatives. No loan contracts with farmers.
  - This means that Dashen can contract with only a few, financially sound and legally well-founded intermediaries, who in turn use their relationships with farmers to enforce contracts.

The EPIICA research design

- Randomized controlled trial to provide simple, statistically robust measures of impact.
- Two arm trial:
  - A control group receives no insurance and no credit.
  - A 'standalone' arm receives only the index insurance product; we don't prevent the use of credit but we also don't provide any explicit form of interlinking.
  - The 'interlinked' arm receives state-contingent loans.
- The study will then be conducted by comparing each of the two treatment arms to the control, and to each other.
  - Provides a simple, transparent measure of the impact of insurance, the impact of interlinked insurance, and the impact of the interlinking itself.
- Three years of household surveys to track farmer behavior.

The original research design:

120 Kebeles selected by Nyala



Credit users at baseline

Non-credit users at baseline

Subsidy to price of insurance randomized at Kebele level

Survey experiment randomized at household level. For each Kebele:

6 coop households survey only

6 coop households survey + insurance promotion

6 coop households survey + promotion + price voucher

2 non-coop households

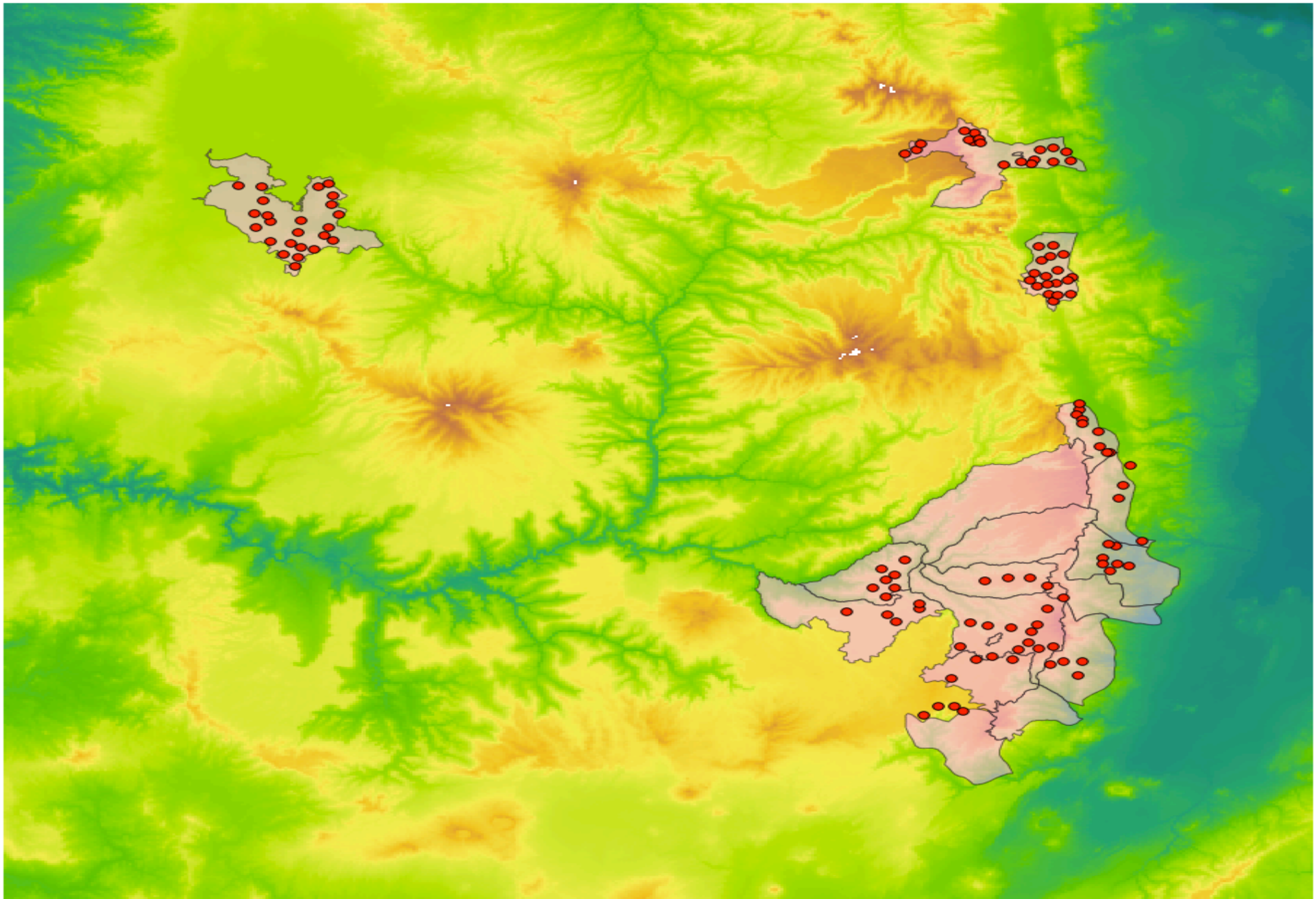
18 coop household surveys

2 non-coop households

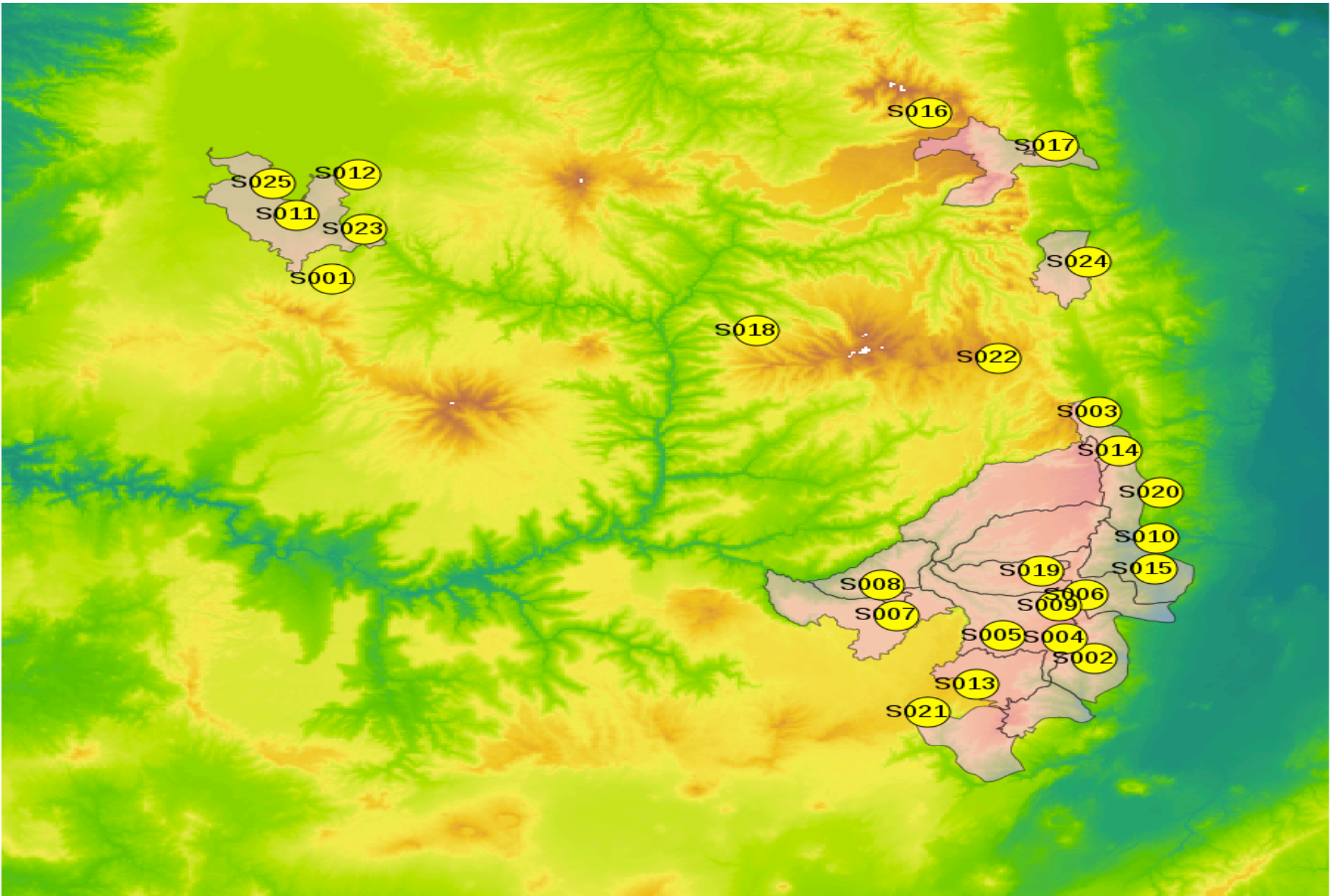
Longer-term question on supply side:

- Can the provision of index insurance crowd in private sector credit to agricultural markets?
  - Long history of government 'amnesties' on agricultural loans when drought occurs.
  - Historically, virtually all credit to ag has been provided or backed by the government.
  - Government is now interested in trying to have the private sector take over more of this role, but a viable commercial model has yet to emerge.
- The empirical strategy: Track over the course of time as index insurance is switched on in new parts of the country:
  - Use institutional data from Dashen to track the spatial coverage of agricultural lending to see the extent to which they expand credit in the *places* that the insurance will cover them.

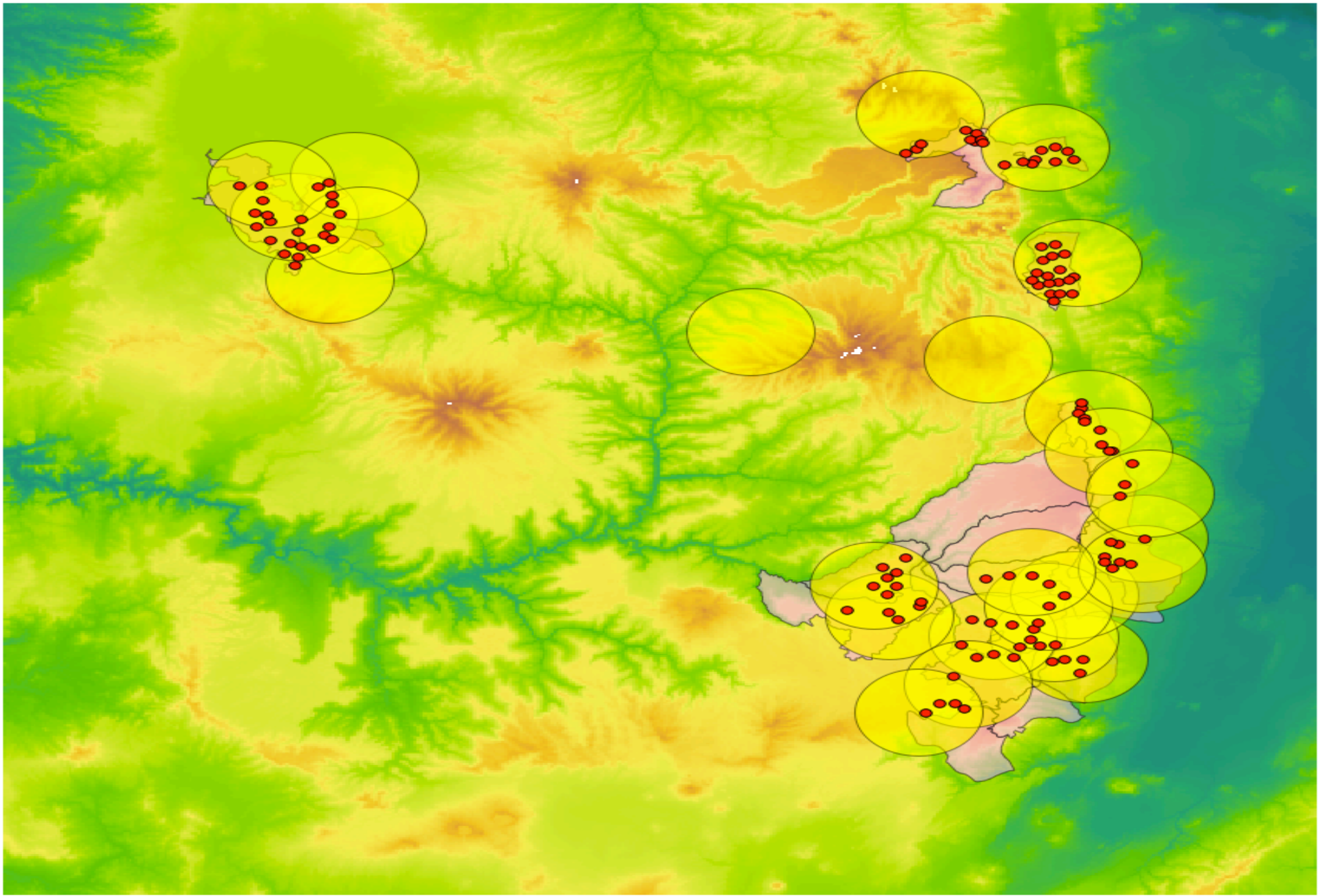
EPIICA project area and Kebele locations



EPIICA Rainfall station locations



EPIICA: Circles around rainfall stations and location of Kebeles



Project developments (1)

- Year 1, 2010-11
- Novel index designed that directly predicted yields from observed rainfall. However, judged too complicated and non-transparent by NISCO, hence was abandoned in early 2011.
- Baseline survey conducted by the EEA in all 120 Kebeles (2400 households) in January-March 2011. Clean data became available in July 2011
- Reverted to design of a simple standard weather insurance contract based on three periods (phases), and trigger and exit rainfall levels for each phase based on water requirements for different crops. However, albeit new index and products were ready soon after abandonment of early index, timing was too late for market operations, hence no marketing of products or sales in 2011.

Project developments (2)

- In summer of 2011 following issues came up
- Not all originally designated villages were affected by erratic or low rainfall. Frost and flood major risks in several villages.
- Both analysis of the baseline data and subsequent visits to all selected villages (120) by NISCO in late 2011 revealed that in about one third of them primary risk was not periodic rainfall shortages but rather frost and flooding. Villages for which such risks were severe were dropped from experiment and sample was reweighted so as to give three groups of control, standalone insurance and interlinked villages for a total of 84 kebeles (28 in each group).
- Crop phenologies were rechecked by Nyala for all relevant crops in all areas of intervention. This led to redefinition of contract phases.

Project developments (3)

- Work 2012
- Rainfall indices developed for all 26 weather stations covering the 84 villages.
- Programs developed for estimating actuarially fair value of any contract based on the dekadal tainfall data and any trigger and exit level in each phase. These programs were transferred to NISCO.
- In March 2012 NISCO contacted Swiss Re for offers on reinsurance for planned contacts.
- Swiss Re returned a month later with offers and prices for reinsurance for only 9 out of the 26 weather stations, due to lack of adequate historical rainfall data for the others (albeit dekadal rainfall data had been interpolated for a long period for all stations)
- NISCO started marketing jointly with Dashen Bank in May 2012. Sales to start in June 2012.

Underlying project assumptions

There is considerable unrealized production potential, that can be realized with larger and better use of intermediate inputs and especially inorganic fertilizer.

Absence of smallholder credit and significant credit constraints, that make input use suboptimal.

Weather risk major constraint on the demand side for fertilizer and other inout use

General demographic information of the rural households surveyed in Amhara in 2011 (1)

	All			North Shewa			West Gojam		
	All	Poor	Non Poor	All	Poor	Non Poor	All	Poor	Non Poor
Number of households	2399	959	1440	1199	564	635	480	189	291
Share of households in the zone (%)	100	40	60	100	47.0	53.0	100.0	39.4	60.6
Average household size	5.3	6.0	4.8	5.5	6.1	4.9	5.7	6.3	5.4
Number of adult equivalents	4.5	5.1	4.0	4.7	5.3	4.1	4.8	5.3	4.4
Average age of the head (years)	49.7	49.7	49.7	51.4	51.5	52.3	46.3	46.0	46.5
Sex of household head (%)									
Male	89.4	89.7	89.2	89.2	89.4	89.0	92.7	92.6	92.8
Female	10.6	10.3	10.8	10.8	10.6	11.0	7.3	7.4	7.2
Type of hhld head 's education									
No Education	46.7	44.1	48.4	37.3	34.2	40.0	62.1	65.6	59.8
Formal Education	22.9	20.9	24.2	23.6	21.8	25.2	16.0	13.2	17.9
Informal Education	30.5	35.0	27.5	39.1	44.0	34.8	21.9	21.2	22.3
Duration of hhld head's formal education (years)	4.7	4.4	4.9	5	4.6	5.3	4.6	4.9	4.4
Hhld head can read and write in local language									
Read only	7.4	7.5	7.3	9.0	10.8	7.4	3.8	1.1	5.5
Read and Write	39.5	40.3	38.9	42.2	41.8	42.5	32.5	32.3	32.7
Cannot read or write	53.1	52.2	53.8	48.8	47.3	50.1	63.8	66.7	61.9

General demographic information of the rural households surveyed in Amhara in 2011 (2)

	All			South Wollo			North Wollo		
	All	Poor	Non Poor	All	Poor	Non Poor	All	Poor	Non Poor
Number of households	2399	959	1440	360	85	275	360	121	239
Share of households in the zone (%)	100	40	60	100.0	23.6	76.4	100.0	33.6	66.4
Average household size	5.3	6.0	4.8	4.6	5.1	4.4	4.8	5.6	4.3
Number of adult equivalents	4.5	5.1	4.0	3.9	4.3	3.8	4.0	4.9	3.6
Average age of the head (years)	49.7	49.7	49.7	49.6	47.9	50.2	48.7	48.3	48.9
Sex of household head (%)									
Male	89.4	89.7	89.2	87.2	87.1	87.2	88.1	88.4	87.9
Female	10.6	10.3	10.8	12.8	12.9	12.8	11.9	11.6	12.1
Type of hhld head 's education									
No Education	46.7	44.1	48.4	48.6	49.4	48.4	56.0	53.5	57.2
Formal Education	22.9	20.9	24.2	26.0	22.4	27.1	26.5	28.1	25.8
Informal Education	30.5	35.0	27.5	25.4	28.2	24.5	17.5	18.4	17.0
Duration of hhld head's formal education (years)	4.7	4.4	4.9	5	3.7	5.3	3.9	3.9	3.8
Hhld head can read and write in local language									
Read only	7.4	7.5	7.3	11.2	7.1	12.5	3.1	2.5	3.4
Read and Write	39.5	40.3	38.9	36.9	38.8	36.3	42.2	46.3	40.2
Cannot read or write	53.1	52.2	53.8	52.0	54.1	51.3	54.7	51.2	56.5

Subjective evaluations of income adequacy among various groups (1) (percent of respondents)

	All			North Shewa			West Gojam		
	All	Poor	Non Poor	All	Poor	Non Poor	All	Poor	Non Poor
Is current household income adequate to meet needs									
Not enough even for food	25.4	29.1	22.9	17.1	24.6	10.5	23.2	19.9	25.4
Just enough for food	44.0	46.9	42.0	43.8	48.7	39.4	46.0	46.8	45.5
Just enough for food and necessities	22.4	19.5	24.4	25.6	20.3	30.4	27.4	31.2	25.0
Enough to meet most of needs	8.2	4.5	10.7	13.5	6.5	19.7	3.4	2.2	4.2
Average number of days of the week the hhld eats meat	0.17	0.13	0.20	0.26	0.18	0.33	0.04	0.02	0.05

Subjective evaluations of income adequacy among various groups (2) (percent of respondents)

	All			South Wollo			North wollo		
	All	Poor	Non Poor	All	Poor	Non Poor	All	Poor	Non Poor
Is current household income adequate to meet needs									
Not enough even for food	25.4	29.1	22.9	29.1	34.1	27.5	52.4	60.3	48.3
Just enough for food	44.0	46.9	42.0	49.6	55.3	47.7	36.6	33.1	38.5
Just enough for food and necessities	22.4	19.5	24.4	18.4	8.2	21.8	8.7	5.8	10.3
Enough to meet most of needs	8.2	4.5	10.7	2.9	2.4	3.1	2.3	0.9	3.0
Average number of days of the week the hhld eats meat	0.17	0.13	0.20	0.03	0.00	0.04	0.2	0.17	0.22

Ownership and use of agricultural land, and use of fertilizers and other inputs

	All			North Shewa	West Gojam	South Wello	North Wello
	All	Poor	Non Poor	All	All	All	All
Average land owned per hhld (Ha)	1.28	1.23	1.32	1.42	1.47	1.00	0.83
Average land cultivated in the past 12 months (Ha)	1.38	1.35	1.40	1.54	1.63	0.89	1.01
Average number of parcels per hhld	4.03	3.78	4.20	4.18	4.53	3.49	3.42
Percent of area irrigated	11.1	12.8	10.0	11.9	5.3	6.7	20.6
Percentage of HHDS that use:							
Chemical Fertilizer	59.4	62.3	57.4	65.7	97.1	14.4	32.8
Organic Fertilizer	55.9	51.8	58.5	52.9	52.3	70.0	56.4
Chemicals (pesti/herbicide)	27.7	26.0	28.9	36.0	40.4	4.4	6.7
Improved seeds	28.2	28.0	28.4	19.9	80.6	6.1	8.1

Incomes of households

	All			North Shewa	West Gojam	South Wollo	North Wollo
	All	Poor	Non Poor	All	All	All	All
Total income per capita	1770	947	2319	1836	1873	1925	1255
Total cash income per capita	1060	733	1277	1095	1093	1194	751
Total noncash income per capita	711	214	1042	742	781	722	505
	Percentage of total income per capita						
Total income per capita	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total cash income per capita	59.9	77.4	55.1	59.6	58.4	62.0	59.8
Total noncash income per capita	40.2	22.6	44.9	40.4	41.7	37.5	40.2
NON FARM INCOME							
Non farm cash income per capita	12.3	13.9	11.9	11.9	6.8	14.8	21.8
Non farm in kind income per capita	1.4	1.6	1.3	0.4	0.1	1.7	8.0
Total non farm income per capita	13.7	15.5	13.2	12.3	6.9	16.5	29.8
CROP INCOME							
Cash crop income per capita	29.1	42.7	25.4	28.3	35.4	32.4	15.4
Crop in kind income per capita	25.2	17.2	27.4	21.7	33.8	25.5	24.7
Total crop income per capita	54.3	59.9	52.7	50.0	69.2	57.8	40.0
LIVESTOCK INCOME							
Livestock cash income per capita	18.5	20.8	17.9	19.5	16.2	14.9	22.7
Livestock in kind income per capita	13.6	3.8	16.2	18.2	7.7	10.3	7.5
Total livestock income per capita	32.0	24.6	34.1	37.7	23.9	25.7	30.2

Average consumption and poverty

	All	North Shewa	West Gojam	South Wollo	North Wollo
Mean Consumption per equivalent person (in birr)	**1896**	**1799**	**1947**	**2272**	**1784**
Cash	**1084**	**932**	**1013**	**1464**	**1310**
Food	783	664	732	988	1045
Non Food	301	268	281	476	265
Non Cash	**812**	**867**	**934**	**808**	**474**
Crops in kind	525	468	757	571	363
Animal products in kind	287	399	177	237	111
Percentage Contribution to total consumption (percentages of means above)	**100**	**100**	**100**	**100**	**100**
Cash	**57.2**	**51.8**	**52.0**	**64.4**	**73.4**
Food	41.3	36.9	37.6	43.5	58.6
Non Food	15.9	14.9	14.4	21.0	14.9
Non Cash	**42.8**	**48.2**	**48.0**	**35.6**	**26.6**
Crops in kind	27.7	26.0	38.9	25.1	20.3
Animal products in kind	15.1	22.2	9.1	10.4	6.2
Percentage Contribution to total consumption (mean of hhld percentages)	100	100	100	100	100
Cash	**66.0**	**61.2**	**66.0**	**71.7**	**76.2**
Food	47.9	43.9	48.1	47.4	61.2
Non Food	18.1	17.3	17.9	24.3	15.0
Non Cash	**34.0**	**38.8**	**34.0**	**28.3**	**23.8**
Crops in kind	24.6	27.1	25.4	21.8	18.1
Animal products in kind	9.4	11.7	8.6	6.5	5.7
Poverty rate (percentage – Total poverty line – 3581 birr)	**92.0**	**91.8**	**95.0**	**85.8**	**94.4**
Poverty rate (percentage – Food poverty line – 1893 birr)	**67.6**	**69.8**	**74.6**	**51.1**	**67.5**
Poverty rate (percentage – bottom 40% of distribution – 1242.44 birr)[1]	**40.0**	**47.0**	**39.4**	**23.6**	**33.6**

Quantity and prices of inorganic fertilizer used

	All			North Shewa	West Gojam	South Wollo	North Wollo
	All	Poor	Non Poor	All	All	All	All
Urea Inorganic Fertilizer used (kg per Ha)	165.1	55.6	238.3	293.2	80.2	6.0	12.8
DAP Inorganic Fertilizer used (kg per Ha)	339.3	53.3	530.7	639.8	91.4	6.0	8.4
Total Inorganic Fertilizer used (kg per Ha)	504.4	108.9	769.0	933.0	171.6	12.0	21.2
Urea Inorganic Fertilizer purchased (kg per Ha)	203.7	52.5	305.1	284.9	289.5	6.6	13.5
DAP Inorganic Fertilizer purchased (kg per Ha)	377.0	48.7	596.9	630.3	298.9	6.6	8.7
Total Inorganic Fertilizer purchased (kg per Ha)	580.7	101.2	902.0	915.2	588.4	13.2	22.2
Urea Inorganic Fertilizer Price (Birr per Kg)	11.2	11.7	10.9	13.1	7.7	12.3	8.8
DAP Inorganic Fertilizer Price (Birr per Kg)	14.1	12.4	15.2	17.4	8.8	13.0	11.5

Average Crop Yields

	All			North Shewa	West Gojam	South Wollo	North Wollo
(Kgr per Hectare)	All	Poor	Non Poor	All	All	All	All
Sorghum	1145.2	1070.7	1211.3	1184.8	1116.0	1053.0	1150.8
Teff	933.4	795.9	1026.9	860.5	872.2	1251.6	825.1
Barley	1022.3	899.1	1090.9	1004.3	1153.2	1311.3	694.4
Wheat	1123.1	1033.7	1165.8	1141.2	1166.7	1019.8	1123.2
Maize	1627.1	1640.8	1618.9	1536.5	1707.8	1394.8	1528.6

Finance and credit

	All			North Shewa	West Gojam	South Wello	North Wello
	All	Poor	Non Poor	All	All	All	All
Percent of hhlds with at least a member belonging to a MFI formed group	20.9	20.0	21.6	32.1	9.7	23.9	21.9
Percent of hhlds with at least a member having a bank account	17.4	12.6	21.6	13.8	12.3	20.0	16.3
Percent of hhlds with at least a member having taken a loan over the past year (for non agricultural purposes)	14.6	14.7	14.5	19.4	6.4	20.6	15.2
Percent of hhlds that applied over the past 5 years for a bank or a MFI loan (for non agricultural purposes)	22.0	22.2	21.9	24.6	17.4	44.2	25.2
Percent of hhlds that over the past year needed money quickly for an emergency that they could not cover from own resources	16.8	20.2	13.7	21.5	10.3	47.5	21.3

Cross tabulation of households classified into different credit constraint classes

	CRSTG				
CRSTINP	No credit constraint	Quantity credit constraint	Price credit constraint	Risk credit constraint	Total
No credit constraint	**1,284**	**344**	**130**	**339**	**2,097**
	54.3	14.5	5.5	14.3	88.6
	61.2	16.4	6.2	16.2	100.0
	88.7	89.4	82.8	89.9	88.6
Quantity credit constraint	**84**	**16**	**10**	**24**	**134**
	3.6	0.7	0.4	1.0	5.7
	62.7	11.9	7.5	17.9	100.0
	5.8	4.2	6.4	6.4	5.7
Price credit constraint	**49**	**10**	**12**	**4**	**75**
	2.1	0.4	0.5	0.2	3.2
	65.3	13.3	16.0	5.3	100.0
	3.4	2.6	7.6	1.1	3.2
Risk credit constraint	**30**	**15**	**5**	**10**	**60**
	1.3	0.6	0.2	0.4	2.5
	50.0	25.0	8.3	16.7	100.0
	2.1	3.9	3.2	2.7	2.5
Total	**1,447**	**385**	**157**	**377**	**2,366**
	61.2	16.3	6.6	15.9	100.0
	61.2	16.3	6.6	15.9	100.0
	100.0	100.0	100.0	100.0	100.0

Note: 1st line in each section denotes frequencies, 2nd line percentages of all households,
3nd line is row percentages, 4rd line is column percentages

Estimation of the crop production function

Dependent Variable: Log of gross value of crop production	OLS Estimation with kebele fixed effects		IV estimation with kebele fixed effects	
	coefficients	t-stat[1]	coefficients	z-stat[1]
Log of hectares cultivated[2]	0.305***	6.76	0.535***	3.06
Log of value of crop inputs used[2]	0.195***	10.03	0.458***	4.27
Log of total labour (in months) used[2]	0.145***	4.54	0.205	1.45
Log of value of agricultural capital	0.147***	7.65	0.084***	3.56
Dummy for hired labour	0.095***	2.86	0.017	0.42
Log age of household head	0.011	0.20	-0.077	-1.10
Hhd's head education in years	0.003	0.37	0.004	0.54
Nr of parcels cultivated	0.101***	11.14	0.042***	2.89
Share of land irrigated	0.409***	4.34	0.297***	2.40
Average rainfall index	-0.041**	-1.91	-0.032	-1.34
Average slope index	0.051	1.40	0.073*	1.81
Average altitude index	0.022	0.85	0.054*	1.80
Constant	4.426***	12.08	2.220*	1.87
Observations	2316		2232	
R-squared	0.6484		0.5673	

	OLS Estimation with kebele fixed effects	IV estimation with kebele fixed effects
Test for returns to scale		
Test H0=land+ inputs+ total labour+ agricultural capital=1		
F-value	19.44	5.24
p-value	0.0000	0.0221
Test for exogeneity of regressors		
H0=regressors are exogenous		
Wu-Hausman		
F-value		11.7754
p-value		0.0000
Durbin-Wu-Hausman		
Chi-sq test Chi-sq (3)		32.2542
p-value		0.0000

Marginal products of production factors compared to market prices of the factors (means across surveyed households)

	Unit	All hhlds
Marginal Product of Land	'000 Birr/Ha	11.1
Value Added Crop Prod./Ha	*'000 Birr/Ha*	*11.9*
Marginal Product of Purchased inputs (compared to 1)		4.7
Marginal Product of Labour	Birr/month/man	120
Market Price of Labour	*Birr/month/man*	*1176*
Marginal Product of Capital (Compared to 0.2)		1.9

Determinants of inorganic fertilizer used

Dependent Variable: Log value of inorganic fertilizer used	Heckman's two step consistent estimator		1st stage estimations	
	coefficients	z-stat	coefficients	z-stat
Log acres of land cultivated	0.133*	1.55	0.295***	6.32
Log value of agricultural capital	0.119**	2.06	0.002	0.05
Log Hhd size in equivalent adults	-0.005	-0.04	0.258***	3.24
Dummy=1 if anyone in the hhd had operated an income generated enterprise over the past 12 months	0.054	0.34	0.244**	2.50
Share of wages to Total hhd income	0.417	1.25	-0.163	-0.76
Share of non wages – non farm income to total hhd income	0.498	1.41	-1.233***	-7.00
Nr of big animals [oxen & cows] over the previous year	-0.026	-1.31	0.076***	5.17
Average area irrigated	-1.687***	-8.80	0.633***	5.27
Average rain in past twelve months (meaning 1 better, 3 worse than normal)	-0.097	-1.55	-0.156***	-3.93
lamda	-1.822***	-8.32		
Log age of hhd head			-0.389***	-3.60
Education of head of household in years (formal)			0.027*	1.93
Dependency Ratio			0.105	0.72
Risk averse hhd head			-0.393***	-2.80
Quantity credit constrained			-0.265***	-3.21
Price credit constrained			-0.004	-0.03
Risk credit constrained			-0.260***	-3.16
Average slope of land (1 meaning all steeply sloped, and 3 all flat land)			0.509***	7.64
Average way farm is cultivated (meaning 1 by hand, 3 by tractor			0.369*	1.76
Average Altitude of land cultivated (meaning 1 much above compared to village center and 5 much below compared to village center)			-0.042	-1.04
Experienced Shock: Drought			-0.412***	-5.81
Constant	7.693***	18.29	-0.313	-0.45
Observations	2243			
Censored Observations	871			
Uncensored Observations	1372			
Wald Chi2	120.01			
Prob > Chi2	0.0000			

* significant at 10%; **significant at 5%; ***significant at 1%

Ex-ante demand for rainfall index insurance. Ethiopia

			Percent of those not interesated because of			
	Zone	Percent of household expressing interest in index insurance contracts	Liquidity constraints	Other means of covering losses, or losses not important	Lack of trust towards inurance company	Other reasons
Poor	North Shewa	88.8%	66.1%	7.1%	26.8%	0.0%
	West Gojam	89.4%	57.9%	15.8%	26.3%	0.0%
	South Wello	83.5%	92.9%	0.0%	7.1%	0.0%
	North Wello	92.6%	55.6%	0.0%	44.4%	0.0%
	Total	88.9%	67.3%	7.1%	25.5%	0.0%
Non poor	North Shewa	89.3%	41.3%	9.5%	49.2%	0.0%
	West Gojam	88.7%	31.3%	37.5%	31.3%	0.0%
	South Wello	92.7%	76.9%	7.7%	15.4%	0.0%
	North Wello	88.7%	68.0%	4.0%	28.0%	0.0%
	Total	89.7%	47.4%	15.0%	37.6%	0.0%

Probit estimates of ex-ante Willingness to Pay for Weather

Dependent Variable: Willing to pay for rainfall based insurance	Probit Estimation coefficients	z-stat[1]
Bid for insurance contract **[bids]**	-0.00414***	-10.16
Age of hhd head **[head_age]**	-0.00207	-0.98
Hhd head can read and write **[head_rw]**	0.29263***	4.74
Hhd size in equivalent adults **[eq_scale]**	-0.00390	-0.19
Total income per equivalent adult **[eq_inc]**	0.00000	0.48
Nr of big animals (oxen & cows) 12 months ago **[bgan_lstyr]**	-0.00038	-0.03
Total area of parcels cultivated in hectares **[parcel_s]**	0.10257**	2.05
Total Number of parcels cultivated **[parcels_culti]**	0.01996	1.20
Proportion of area irrigated **[parcel_i_s]**	-0.01250	-0.10
Chemical fertilizer used – dummy **[chem_fert]**	-0.06752	-1.03
Credit Constrained – dummy **[CRSTG_d]**	-0.25902***	-4.40
Risk averse hhd head **[risk_averse]**	-0.57323***	-4.17
Experienced Shock: Drought **[sh_drought]**	-0.13975*	-1.77
Used cash savings or sold etc animals or other assets to cope against most serious shock **[sh_cash]**	-0.13237**	-1.96
Received assistance from family or others to cope against most serious shock **[sh_family]**	0.39166***	3.29
Engaged in new ways of generating Y to cope against most serious shock **[sh_new]**	0.15333	1.00
Took any other actions to cope against most serious shock **[sh_actions]**	-0.43923***	-6.22
Amount of years (in the last 10) hhd Y reduced by 25% or more **[sh_25pl_yr]**	0.02828**	2.10
Constant	1.03400***	6.16
Observations	2218	
Pseudo R-squared	0.0973	

*

WTP Insurance – ¼ below or above normal rainfall

	Mean	Median	St. Dev	Nr of hhds with positive WTP	Nr of hhds with negative WTP
WTP (birr)	258.78	272.38	84.54	1485	7
WTP (share on 1000 birr)	25.88	27.23	8.45		

Conclusions

There seems to be unrealized potential for agricultural productivity growth in Ethiopia among smallholders

The credit constraint hypothesis holds only partially. Perhaps because of the GOE system of providing guaranteed credit tied to fertilizer provision

Use of fertilizer quite high in two of the four zones.

Smallholders are quite inefficient in use of inputs. Excess labor and lower inputs and capital.

Credit constraints and risk factors affect the demand for inputs and inorganic fertilizer

Considerable ex-ante demand for weather index insurance

Public supply and distribution for fertilizer system seems to be distorting markets

Thank you