Bundling crop insurance and certified seeds:

a five-year perspective from Kenya

Francesco Cecchi
Wageningen University
MwAPATA-IFPRI Joint Seminar

23 November 2022

Motivation: Agricultural Intensification

Intensification is key for development

- Agriculture $= 2/3$ of labour force and $1/3$ of GDP
  (Brune et al. 2016)
- 4 times more effective in reducing poverty than other sectors' growth
  (FAO, 2012)
- Modern inputs (including seeds) = key for intensification, income $\uparrow$
  (Just and Zilberman 1983)

Adoption of modern inputs remains partial

- Lack of information, liquidity, and (perceived) risks
  (Feder et al. 1985)
- Low-quality counterfeit seeds
  (Bold et al. 2017)

Motivation: Agricultural Intensification

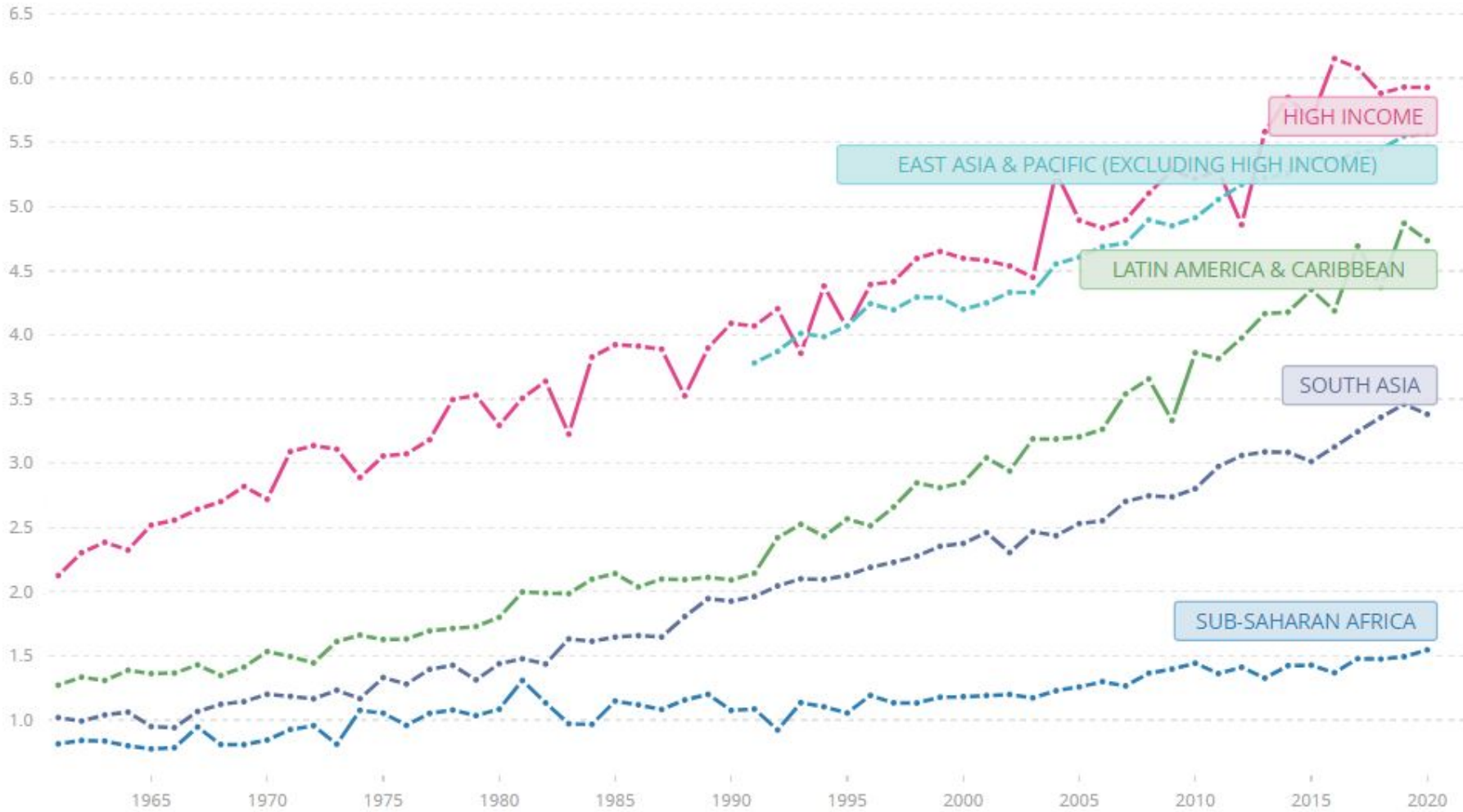
Intensification is key for development

- Agriculture = 2/3 of labour force and 1/3 of GDP
  (Brune et al. 2016)
- 4 times more effective in reducing poverty than other sectors' growth
  (FAO, 2012)
- Modern inputs (including seeds) = key for intensification, income ↑
  (Just and Zilberman 1983)

Adoption of modern inputs remains partial

- Lack of information, liquidity, and (perceived) risks
  (Feder et al. 1985)
- Low-quality counterfeit seeds
  (Bold et al. 2017)

Cereal yields (metric tons per hectare)



Motivation: Uninsured risks

Weather shocks = major problem for smallholders

- Uncertainty distorts choices
- Underinvestment on inputs
- Low productivity and degradation of resources
- Consequences on current and future income

Insurance = income risks $\downarrow$ = investments $\uparrow$

- Uninsured risk, not credit, is binding investment constraint (Karlan et al. 2015)
- Drought-tolerant rice increases other farm investments (Emerick et al. 2016)
- Bundle with tangible product to increase insurance uptake (ILO, 2017)

Motivation: Uninsured risks

Weather shocks = major problem for smallholders

- Uncertainty distorts choices
- Underinvestment on inputs
- Low productivity and degradation of resources
- Consequences on current and future income

Insurance = income risks $\downarrow$ = investments $\uparrow$

- Uninsured risk, not credit, is binding investment constraint (Karlan et al. 2015)
- Drought-tolerant rice increases other farm investments (Emerick et al. 2016)
- Bundle with tangible product to increase insurance uptake (ILO, 2017)

First contribution (2017)

We offer a FREE crop insurance product
CONDITIONAL on uptake of certified seeds

Can this help to break the vicious cycle of under-investment?

Published as:
Does bundling crop insurance with certified seeds crowd-in investments? Experimental evidence from Kenya (2020). E Bulte, F Cecchi, R Lensink, A Marr, M Van Asseldonk Journal of Economic Behavior and Organization 180, 744-757.

Research questions

Does a free insurance...

- Increase uptake of certified seeds?
- Crowd-in investments in complementary inputs?
- Danger: crowd-out intensity of investments (moral hazard)?

Outline

The experiment

Offer a free multi-peril hybrid crop insurance (MPCI)

- Part index based, part indemnity based (offered by APA insurance)
- Covers drought, excess rain, pests, fire, hail, etc.
- Indemnity is paid if below 65% of long-term average
- Crop inspections throughout season

Conditional on purchase of certified seeds

- Four crops: maize, sorghum, soya and sunflower
- Insurance cost per acre varies: maize 609 KSh, sunflower 232 KSh
- More certified seed packets = more insurance
- Only seeds certified by KEPHIS, show packet unique ID

Empirical strategy

- 803 smallholders in Meru County, 40 farmer groups
- Individual level randomization: 45% assigned to treatment
- 2.9% attrition = final sample of 780

$$Y_i = \beta_0 + ITT_i\beta_1 + X_i'\beta_2 + UAI_i\beta_3 + \varepsilon_{ig} \quad (1)$$

Y_i = Outcome
ITT_i = Intention to treat
X_i' = Vector of individual controls
UAI_i = Unit Area of Insurance spatial dummies
Standard errors clustered at the farmer group level (40)

Descriptives and balance here
Attrition here

Outline

Purchase of certified seeds increases

	(1) Uptake certified seeds	(2) Certified maize	(3) Certified sorghum	(4) Certified Sunflower	(5) Certified soya	(6) Total certified seeds
ITT	0.146***	349.190***	40.713**	3.822	7.746	401.471***
	(0.045)	(122.020)	(16.450)	(4.635)	(5.816)	(129.991)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
UAI f.e.	Yes	Yes	Yes	Yes	Yes	Yes
Mean control group	0.449	855.414	24.021	4.234	6.509	890.179
Observations	780	780	780	780	780	780
Clusters	40	40	40	40	40	40
R^2	0.094	0.099	0.10	0.058	0.065	0.11

Robust standard errors in parentheses clustered at the farmer group level (40). Additional controls include Age, Age^2, Male, Education years, Household size, Catholic, Wealth index, Livestock units, Bank account, One supplier only, and UAI fixed effects. See Appendix Table A2 for a full detail of the control variables and their coefficients. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Farm investments: crowding-in other inputs?

	(1) Fertilizer	(2) Chemicals	(3) Machine rental	(4) Hiring of labour	(5) Total non-seed
ITT	459.397**	89.282	556.721***	601.490**	1690.651***
	(222.405)	(107.539)	(173.599)	(295.429)	(475.321)
Additional controls	Yes	Yes	Yes	Yes	Yes
UAI f.e.	Yes	Yes	Yes	Yes	Yes
Mean control group	3568.518	1118.825	2163.733	5732.316	12579.34
Observations	780	780	780	780	780
Clusters	40	40	40	40	40
R^2	0.13	0.12	0.16	0.22	0.23

Robust standard errors in parentheses clustered at the farmer group level (40). Additional controls include Age, Age^2, Male, Education years, Household size, Catholic, Wealth index, Livestock units, Bank account, One supplier only, and UAI fixed effects. See Appendix Table A3 for a full detail of the control variables and their coefficients. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Land use

	(1) Maize acres	(2) Sorghum acres	(3) Sunflower acres	(4) Soya acres	(5) Total land farmed	(6) Certified seed acres
ITT	0.181**	0.107**	0.040**	0.049**	0.293**	0.081***
	(0.070)	(0.045)	(0.015)	(0.024)	(0.132)	(0.029)
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
UAI f.e.	Yes	Yes	Yes	Yes	Yes	Yes
Mean control group	1.25	0.13	0.04	0.01	2.55	0.17
Observations	780	780	780	780	780	780
Clusters	40	40	40	40	40	40
R^2	0.20	0.082	0.067	0.026	0.24	0.071

Robust standard errors in parentheses clustered at the farmer group level (40). Additional controls include Age, Age^2, Male, Education years, Household size, Catholic, Wealth index, Livestock units, Bank account, One supplier only, and UAI fixed effects. See Appendix Table A4 for a full detail of the control variables and their coefficients. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Intensive margin?

	(1) Fertilizer	(2) Chemicals	(3) Machine rental	(4) Hiring of labour	(5) Total non-seed
ITT	32.663	-12.743	154.925*	326.130***	498.638*
	(152.283)	(75.573)	(77.449)	(101.578)	(253.546)
Additional controls	Yes	Yes	Yes	Yes	Yes
UAI f.e.	Yes	Yes	Yes	Yes	Yes
Mean control group	2114.33	629.37	986.66	2399.38	6127.57
Observations	778	778	778	778	778
Clusters	40	40	40	40	40
R^2	0.15	0.055	0.045	0.035	0.070

Robust standard errors in parentheses clustered at the farmer group level (40). Additional controls include Age, Age^2, Male, Education years, Household size, Catholic, Wealth index, Livestock units, Bank account, One supplier only, and UAI fixed effects. See Appendix Table A5 for a full detail of the control variables and their coefficients. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Outline

Lessons learned

Crop insurance conditional on purchasing certified seeds incentivizes 'desirable' farming practices

- Not surprising: increased demand for certified seeds
- Smallholders also increase extensive margin farming efforts
  - Higher expenditures on complementary inputs
  - More land farmed (from where?)
- Use of inputs per acre does not go up, but neither down
  - No strong evidence of moral hazard being at play

Policy implications

Policy makers can promote the adoption of farm inputs by offering insurance in return, or viceversa

- Zambia's Farmer Input Support Program (FISP) offers inputs discount conditional on insurance purchase. What's best?
  - Depends: on which product is more easily understood and varied
- Is this something that can be left to input companies?
  - No: cost of MPCI insurance (+25% of seed price) may impede further unsubsidised development of seed-insurance bundles, assuming liquidity constraints
- Alternatives?
  - Option 1: leaner, automatized parametric insurance contracts with lower margins (future work: blockchain based contracts)
  - Option 2: innovations that keep attractive indemnity-based multi-peril component, but make it less costly (next: Picture Based Insurance)

Second contribution (2019-2022)

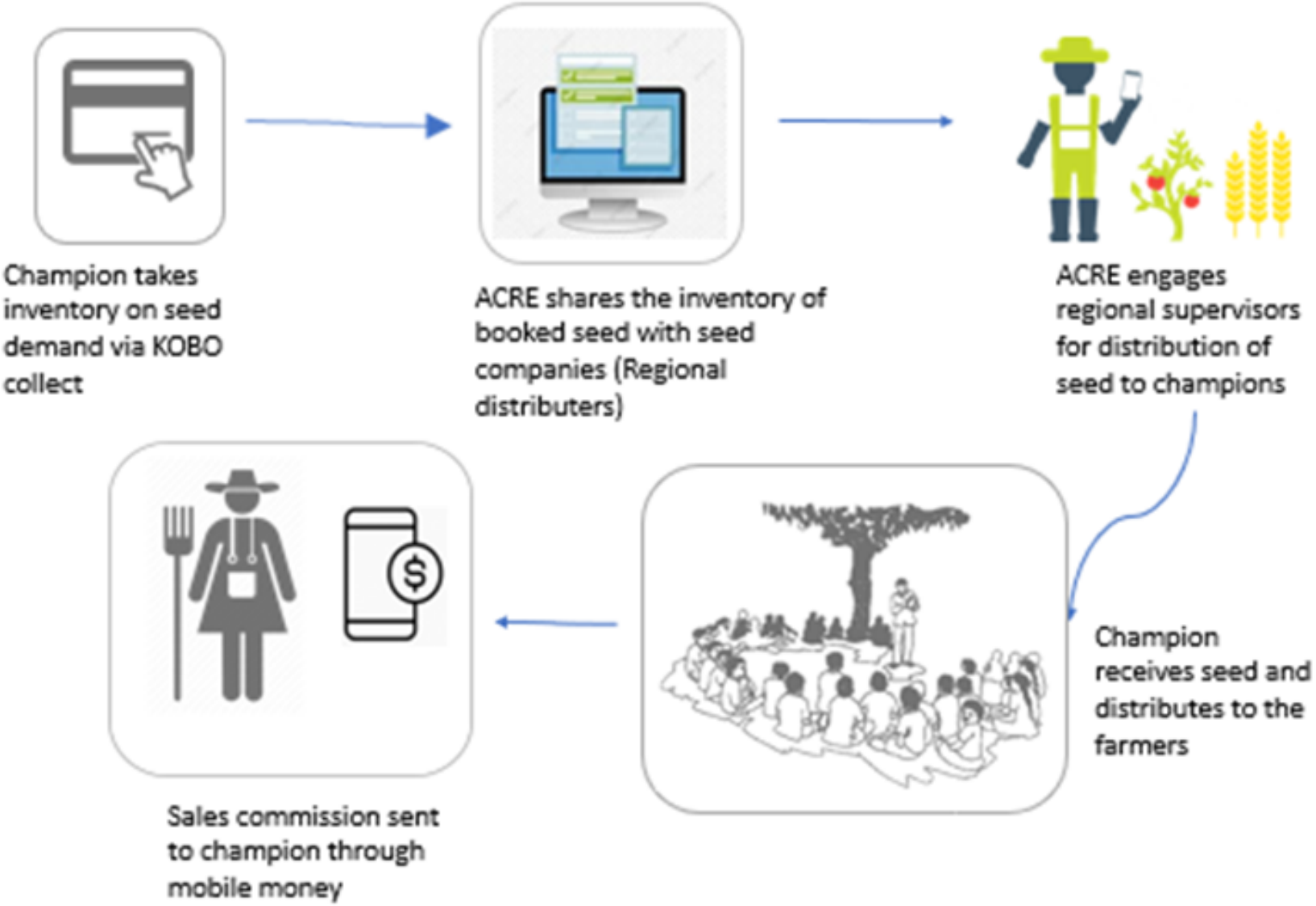
We promote stress-tolerant seed varieties through trial packs

We monitor project farmers through SeeitGrow app

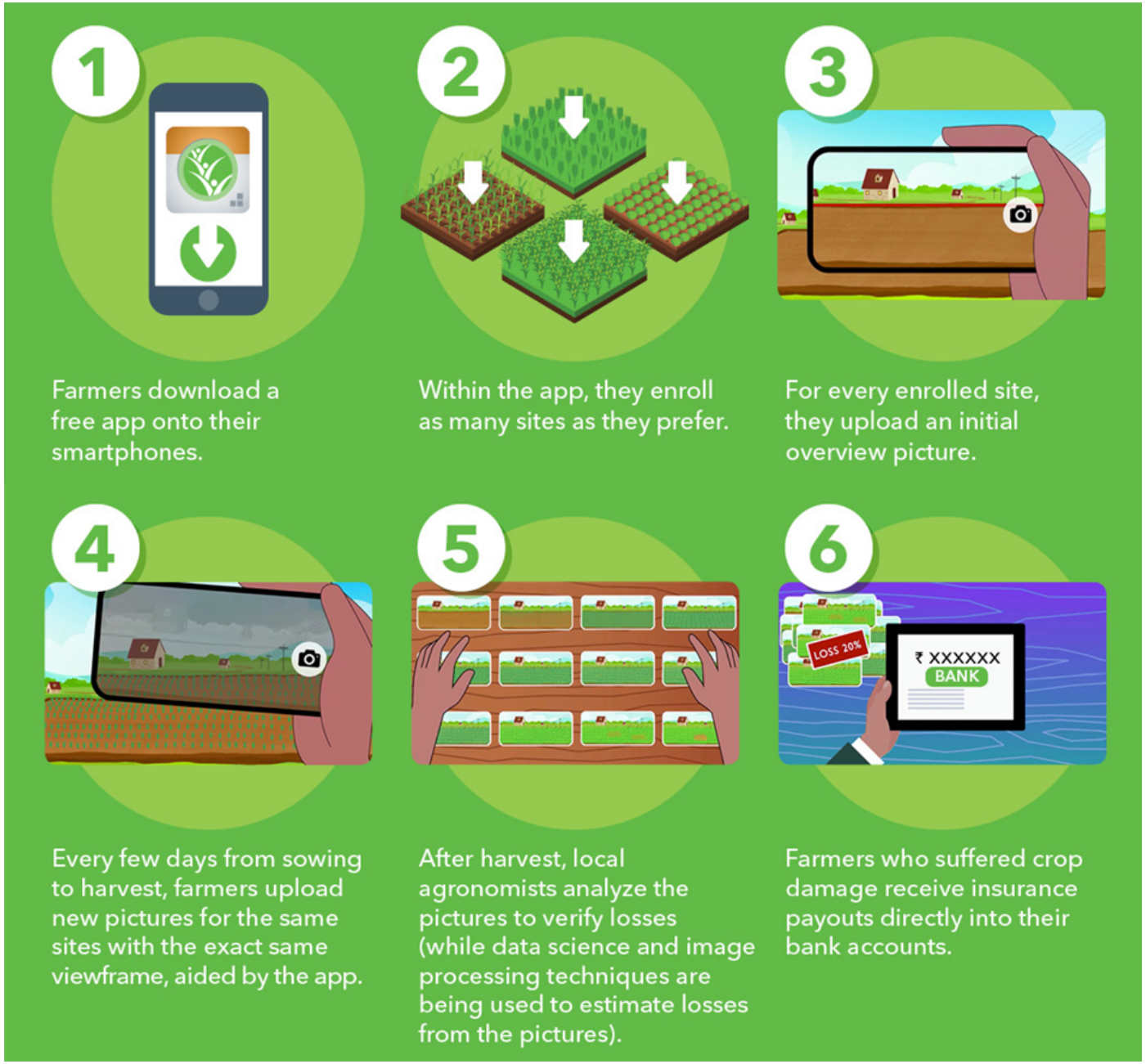
We offer an insurance product (either WBI or PBI)
AND/OR
certified STV seeds at market price (through champion farmers)

UNCONDITIONAL: will we find the same impact on investments?

Booking seeds through Champion Farmers



SeeitGrow and Picture Based Insurance

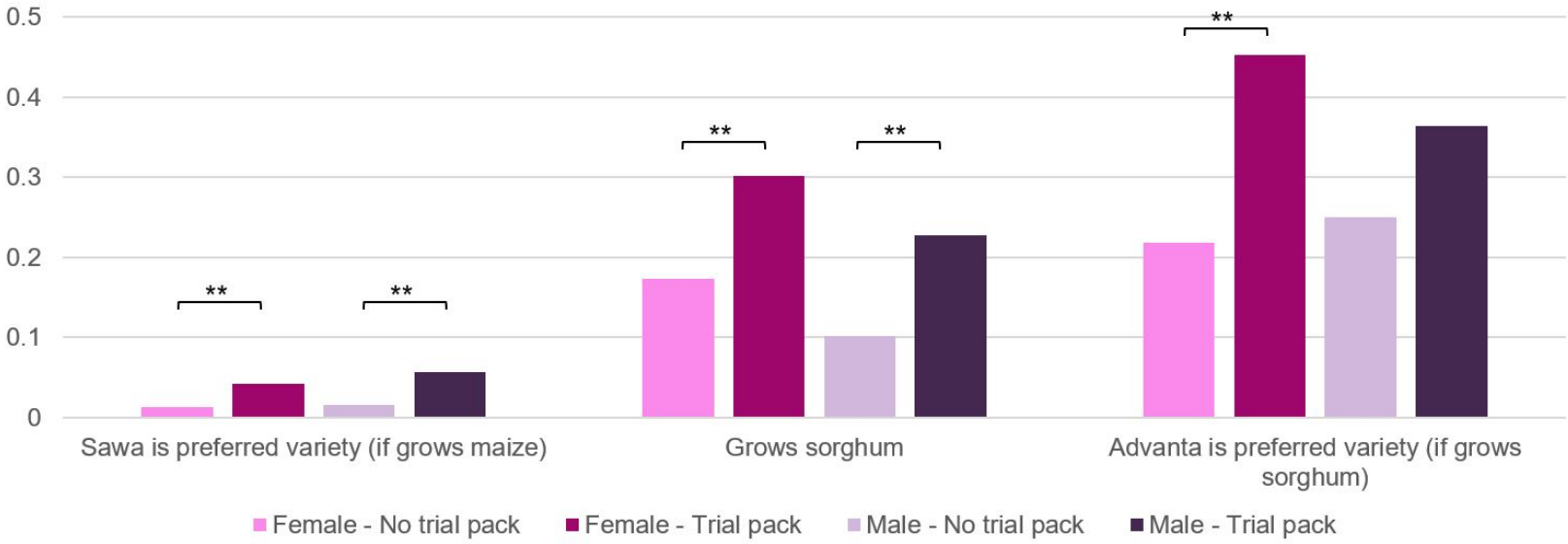


Finding 1: 15-66% of farmers grows a local variety, and all popular improved varieties were released >15 years ago.

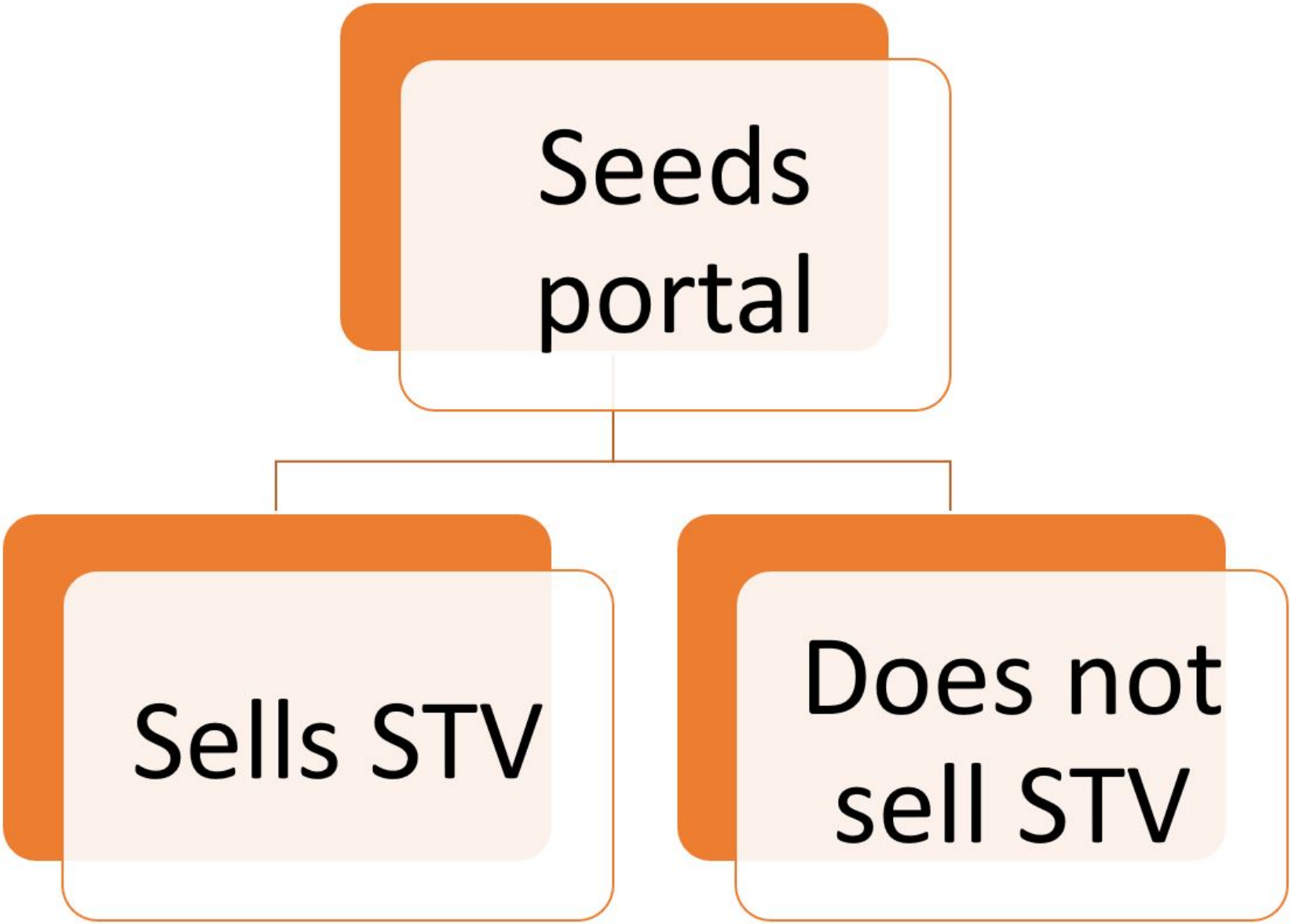
Maize varieties	Company	% of farmers	Year of release	Sorghum varieties	Company	% of farmers	Year of release
Duma 43	SeedCo	34	2003	Local sorghum		66	?
Local maize		15	?	Gadam	KALRO	11	1994
WH505	Western seed	11	2003	Sila	SeedCo	7	2006
DK8031	Monsanto	9	2003	Seredo	KALRO	7	1970
H513	Kenya seed	4	1995	Advanta	Advanta seeds	5	2018

Green gram varieties	% of farmers	Year of release	Bean varieties	Company	% of farmers	Year of release
Local green gram	32		Mwitemania/GLP92	KALRO	20	1982
KS20 (Anko/Makueni)	27	n/a	Yellow Bean		18	
N26 (Nylon)	27	n/a	Wairimu/ Red Bean	Kenya seed	14	2008
Cotton	11	n/a	Rose Coco/GLP2	KALRO	14	1982
N21	1	n/a	Nyayo		8	

Finding 2: Providing trial packs of new(er) STV varieties increased demand at midline among uninsured farmers



*Source: Project midline survey data. ** Significant at 1% level.*

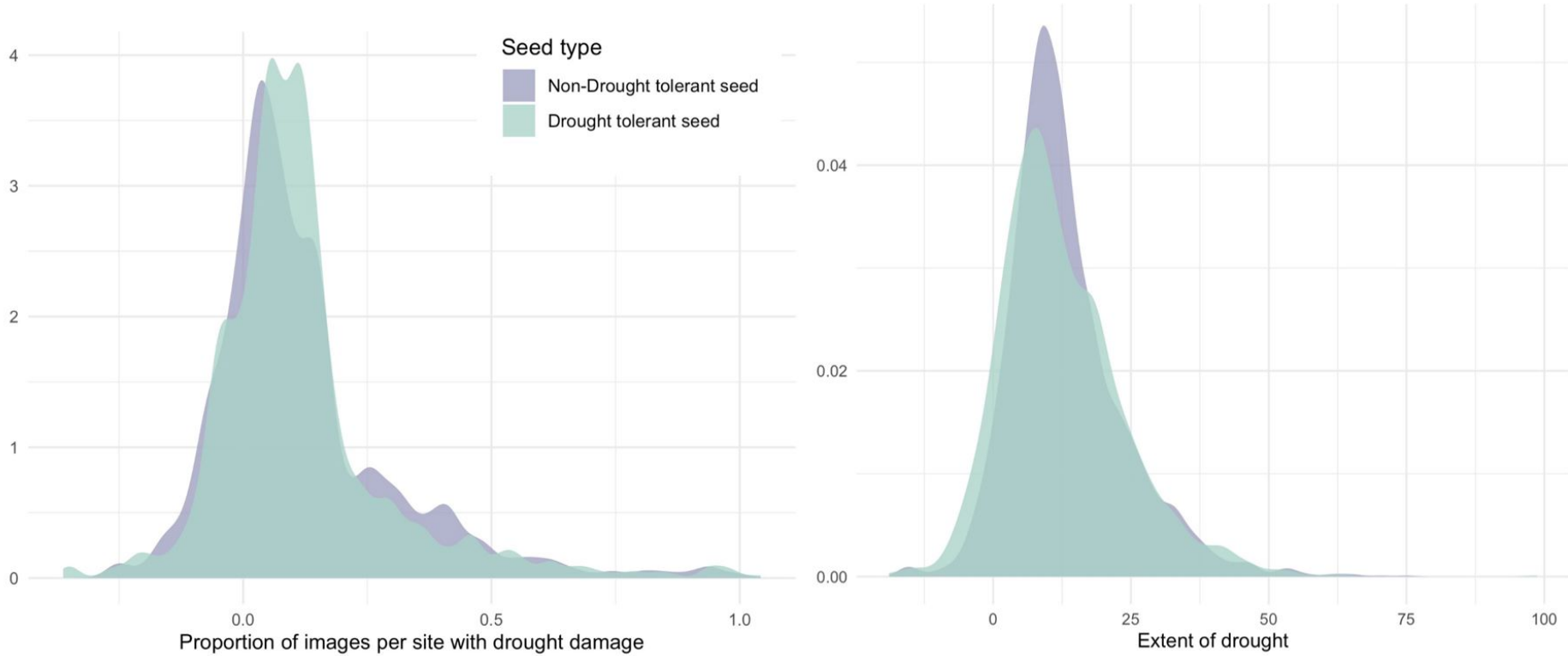

Seeds portal
Sells STV
Does not sell STV

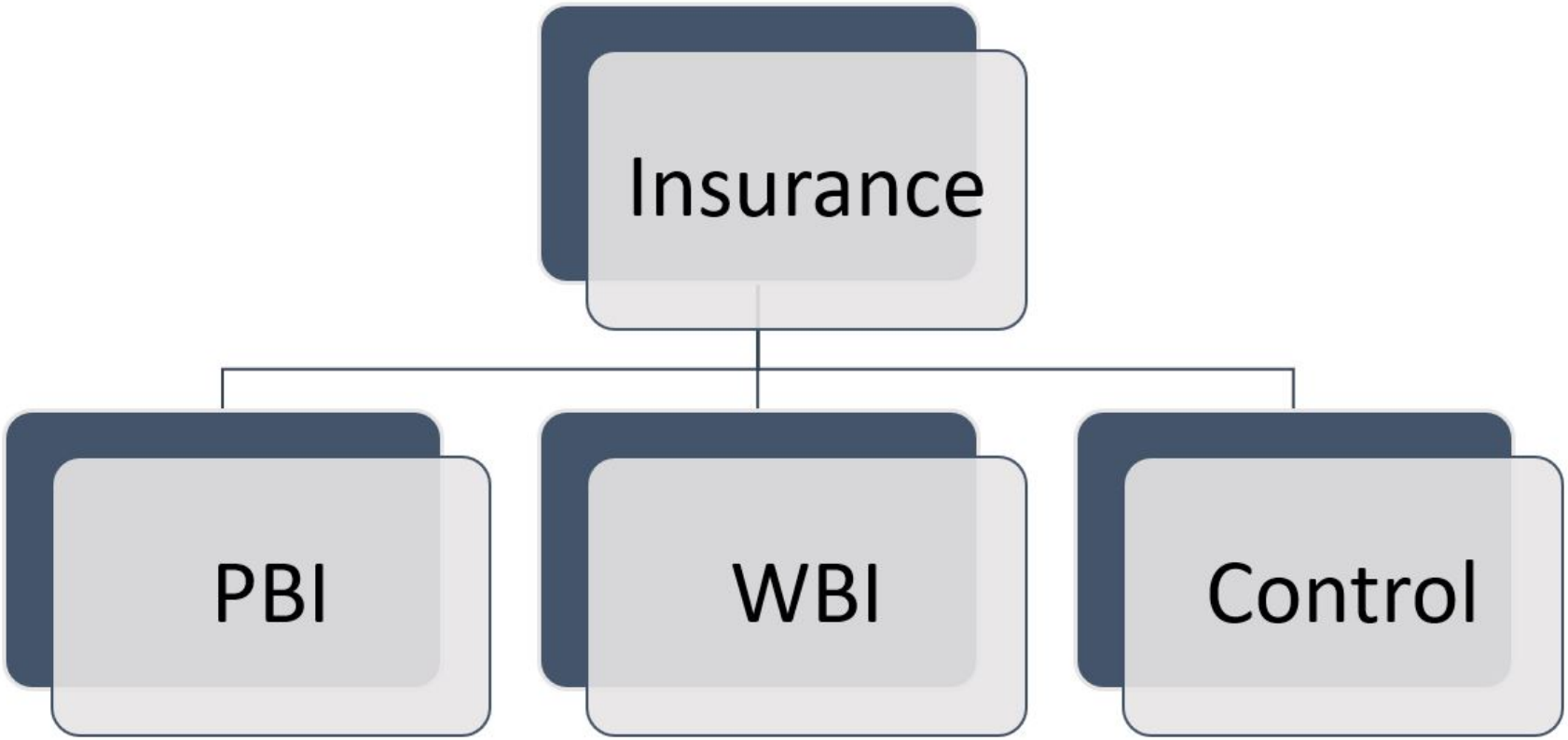
Finding 3: Promoting drought-tolerant varieties through champion farmers did not impact farm-level outcomes

	Men		Women	
DT varieties sold by champion?	**No STV**	**STV**	**No STV**	**STV**
Share of land with DT seed	0.047	0.047	0.041	0.042
Quantity of DT seeds	0.020	0.215*	0.111	0.116
Expenditure on maize and sorghum p/acre (in KES)				
Seeds	2,201	1,881	1,723	1,674
Fertilizer	8,439	6,375**	7,012	6,470
Herbicides	140	147	85.5	122
Pesticides	485	420	414	405
Mechanical and animal traction	1,358	1,293	1,160	1,429
Hired labor	5,071	4,651	5,219	4,902
Total expenditure	15,493	12,886*	13,891	13,329
Yields (Kg/ha)	698	581	431	448
Observations	464	438	774	797

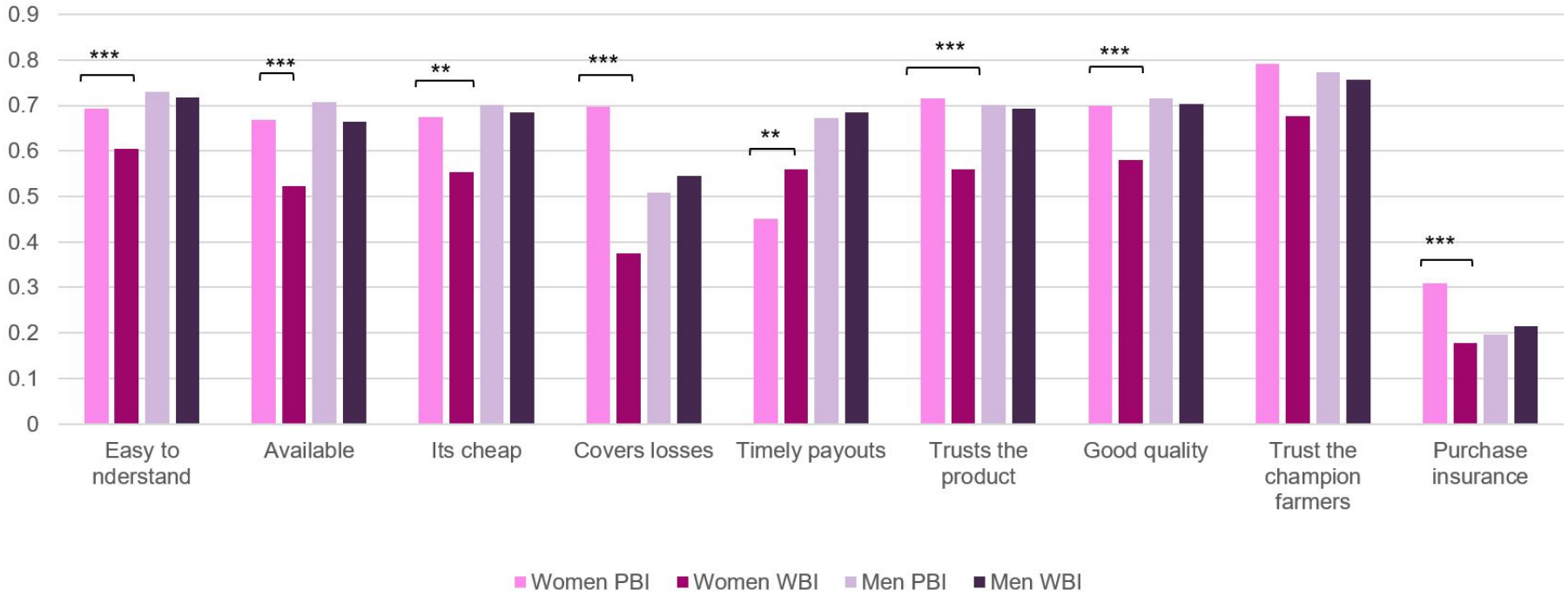
** Significant at 10% level ** Significant at 5% level*

Finding 4: Growing DT varieties was associated with lower chance and extent of damage (but not higher yield)




Insurance
PBI
WBI
Control

Finding 5: Providing PBI improves perceptions and increases demand relative to WBI, but only for women



** Significant at 10% level ** Significant at 5% level *** Significant at 1% level*

Finding 6: Both WBI and PBI increase investments in production (irrespective of STV sales)

	Men			Women		
	Control	**WBI**	**PBI**	**Control**	**WBI**	**PBI**
Expenditure on…						
Seeds	2,013	2,442	2,383	1,941	2,177	2,148
Fertlizer	5,182	6,731*	6576*	4,491	6,098**	5,550**
Herbicides	100	129	127	90.8	106	104
Pesticides	353	346	307	310	383	303
Fungicides	4.01	8.77	8.26	1.19	10.6**	3.10
Irrigation	19.5	0.47	34.2	6.11	34.1*	6.85
Mechanization	1,203	1,672**	888*	1,300	986**	803***
Hired labor	3,942	5,315***	4,585	4,140	4963*	4,981**
Total expenditure	12,816	16,644***	14,909*	12,281	14,759**	13,901*
Observations	412	209	281	686	293	592

Lessons learned

Promoted unconditionally from one another, insurance and seeds do not seem to have a strong complementary

- Farmers still largely use traditional seeds, and virtually seeds no that haven't been in the market for at least 15 years
  - Last mile problem or risk aversion?
- Trial packs induce experimentation (reduce adoption risk)
  - Greater use of new STV varieties and greater diversification of crops
  - But only among the uninsured (substitute risk management practices?)
- Picture based insurance preferred to weather index insurance
  - Greater appeal, higher purchase rates
  - No strong evidence of moral hazard being at play: both increase investments
  - No effect of STV sales through (last mile) champion farmers

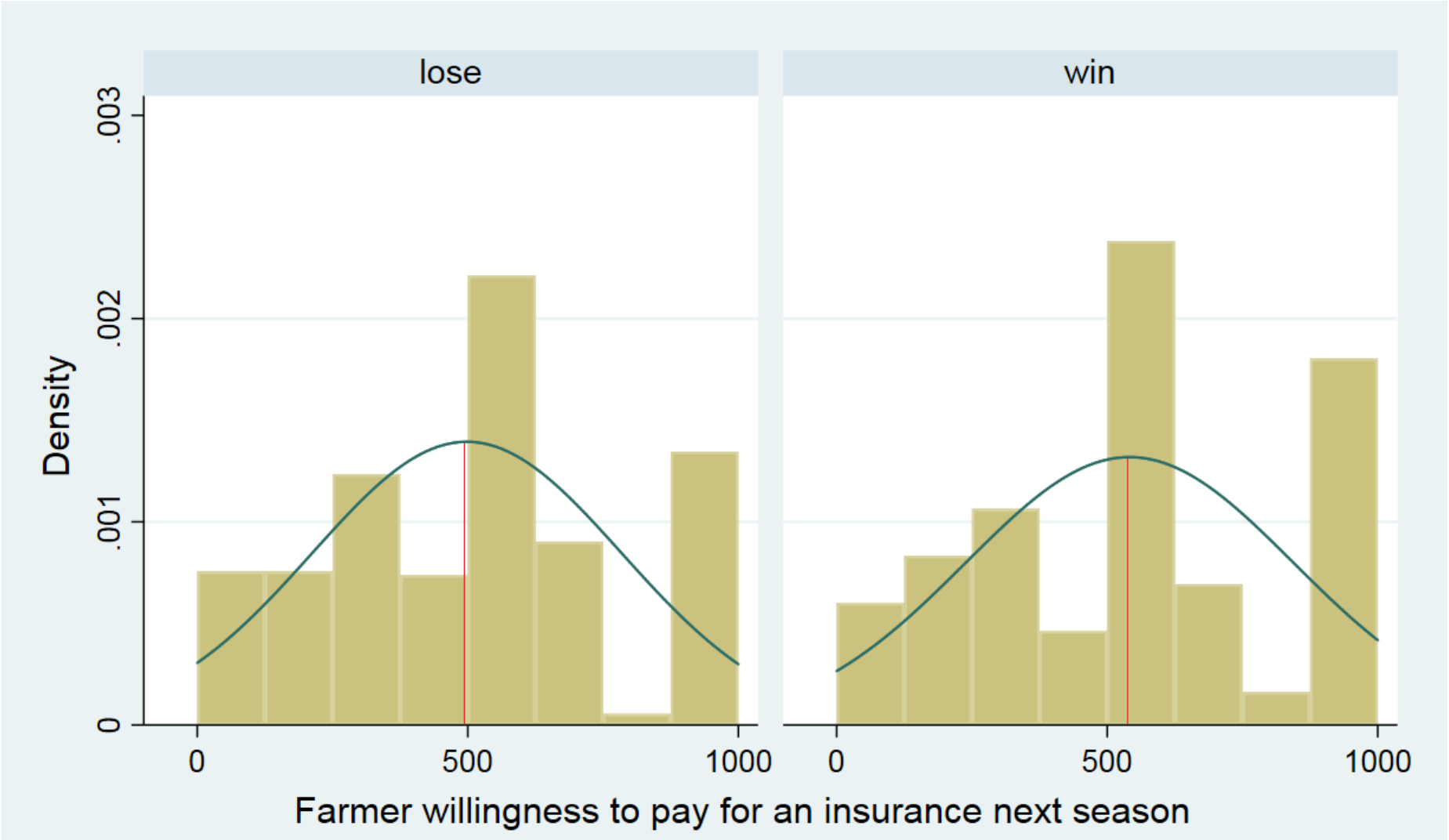
Policy implications

PBI is preferred by farmers, but

- Are farmers ready to use it independently?
  - No: digital literacy and smartphone usage still too low
  - More promising to use within cooperatives, with help of facilitators
- Is it commercially sustainable?
  - Manual verification costs are high and very time-consuming
  - Not unless verification is automated (now 86% machine learning accuracy)
- What is the road ahead?
  - Use PBI as optional 'add-on' to WBI, as backstop to reduce basis risk
  - 'Add-on' could cover risks uninsurable through indexes (e.g. GRV)

Thank you!

Willingness to pay?



WTP and expectations

	(1) Willingness to pay	(2) Expected income bad year	(3) Bad year income as fraction of average
ITT	40.451**	4420.875***	0.027**
	(19.124)	(1504.024)	(0.012)
Additional controls	Yes	Yes	Yes
UAI f.e.	Yes	Yes	Yes
Mean control group	498.27	9120.89	0.37
Observations	780	618	618
Clusters	40	40	40
R^2	0.041	0.11	0.035

Robust standard errors in parentheses clustered at the farmer group level (40). Additional controls include Age, Age^2, Male, Education years, Household size, Catholic, Wealth index, Livestock units, Bank account, One supplier only, and UAI fixed effects. See Appendix Table A6 for a full detail of the control variables and their coefficients. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Selection and share of certified seeds

	(1)	(2)		(3)		(4)		(5)	
	Certified inputs	Certified Maize		Certified Sorghum		Certified Soya		Certified Sunflower	
		select	share	select	share	select	share	select	share
ITT	0.148***	0.155	0.006	0.358***	-0.04	0.313*	0.377	0.438***	0.108
	(0.045)	(0.186)	(0.02)	(0.115)	(0.12)	(0.171)	(0.25)	(0.157)	(0.111)
[adj. p-value]	[0.008]			[0.008]				[0.022]	
Produced crop last year		0.896**		0.367*		0.678		0.847**	
		(0.456)		(0.197)		(0.607)		(0.402)	
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
UAI fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	780	780	751	780	134	780	37	780	64
# of Clusters	40	-	-	-	-	-	-	-	-
R-squared	0.11								

LPM regression with robust standard errors clustered at the farmer group level in (1). Columns (2)-(5) are estimated using a Heckman two stage selection model with a dummy on whether the farmer had produced this crop at all in the previous season as excluded variable in the first stage. In square brackets we report the p-value adjusted for multiple hypothesis testing (5) if the unadjusted $p < 0.05$. Additional controls include age, age squared, male respondent dummy, years of education, household size, catholic dummy, asset index, livestock TLU, share invested in risk preferences game, total land, number of fields having access to, bank account dummy, value of total bank savings, and a dummy for if the farmer group was supplied by only one input supplier. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Variables	Lost		Won		Δ
	N	Mean	N	Mean	
Insured	434	0.08	346	0.53	0.46***
Age	434	46.37	346	45.99	-0.38
Male	434	0.09	346	0.09	0
Education	434	6.21	346	6.38	0.17
Catholic	434	0.31	346	0.36	0.05
Household Size	434	5.6	346	5.73	0.13
Wealth index	434	0.02	346	-0.03	-0.05
Food insecurity index	434	-0.04	346	0.04	0.08
Livestock (Tropical Livestock Units)	434	3.71	346	3.51	-0.2
Land available (previous year)	434	3.75	346	3.85	0.1
Produced maize (previous year)	434	0.99	346	0.97	-0.01
Produced sorghum (previous year)	434	0.06	346	0.08	0.02
Produced soya (previous year)	434	0.01	346	0.01	0
Produced sunflower (previous year)	434	0.02	346	0.01	-0.01
Drought expected	434	0.43	346	0.41	-0.02
Excessive rain expected	434	0.25	346	0.31	0.06*
Pest expected	434	0.69	346	0.67	-0.02
Farm shock index (this season)	434	0.44	346	0.45	0.01
M-pesa account	434	0.8	346	0.84	0.03
Bank account	434	0.24	346	0.29	0.04
Any credit (previous year)	434	0.02	346	0.03	0.01
Credit size desired	434	12,330	346	12,653	322
Share invested in risk game	434	0.29	346	0.32	0.02
Openness	434	0	346	-0.01	-0.01
Conscientiousness	434	-0.02	346	0.03	0.05
Extraversion	434	0.01	346	-0.06	-0.06
Agreeableness	434	-0.01	346	0	0.01
Neuroticism	434	0.03	346	-0.03	-0.06

* $p < .05$, ** $p < .01$, *** $p < .001$.

Variables	Sample	Mean	Attrition	Mean	Δ
Lottery won	780	0.44	23	0.52	-0.08
Insured	780	0.28	23	0.26	0.02
Age	780	46.21	23	46.48	-0.27
Male	780	0.09	23	0.17	-0.09
Years of education	780	6.29	23	6.78	-0.49
Household size	780	5.66	23	6.35	-0.69*
Land available (previous year)	780	3.79	23	3.13	0.66
Produced maize (previous year)	780	0.98	23	1	-0.02
Produced Sorghum (previous year)	780	0.07	23	0.09	-0.02
Produced soya (previous year)	780	0.01	23	0	0.01
Produced sunflower (previous year)	780	0.02	23	0	0.02
Drought expected	780	0.42	23	0.52	-0.1
Excessive rain expected	780	0.28	23	0.3	-0.03
Pest expected	780	0.68	23	0.57	0.12
Mpesa account	780	0.82	23	0.74	0.08
Bank account	780	0.26	23	0.22	0.04
Any credit (previous year)	780	0.03	23	0	0.03
Credit size desired (x1000)	780	12.47	23	13.59	-1,113.49
Share invested in risk game	780	0.3	23	0.41	-0.11

* $p < .05$, ** $p < .01$, *** $p < .001$.