Impacts of a digital credit-insurance bundle for landless farmers: Evidence from a cluster randomized trial in Odisha, India

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Motivation

- To expand food production, farmers need to invest more in their farms, but this is often not a viable alternative due to **credit rationing**.

  - **Supply side (quantity)** credit rationing: Lenders restrict potential borrowers' access to desired level of borrowed funds to finance agricultural investments (Stiglitz and Weiss, 1981).

  - **Demand side (risk)** credit rationing: Risk averse borrowers voluntarily withdraw even when qualifying for loans (Boucher et al., 2008).

- Limited supply of credit and insurance due to **information asymmetries** (moral hazard, adverse selection)

  - Many farmers lack collateral and documented land rights, and insurance has high transaction costs.

  - Weather index-based insurance suffers low demand due to basis risk.

- **What if we can overcome information asymmetries at a low cost, using technology?**

KhetScore: Agricultural Credit Bundled with Insurance

- Proprietary credit-scoring approach developed by Dvara E-Registry, combining satellite remote sensing, crop analytics, picture-based monitoring, and machine learning

- Assesses crop production potential as the basis for loan recommendations without relying on land records.

- Bundled picture-based crop insurance coverage (PBI) to de-risk these loans.

Impact evaluation: How does this solution impact smallholders' credit and insurance uptake, well-being, gender parity and agricultural outcomes? To what extent can impacts be explained by credit vs quantity rationing?
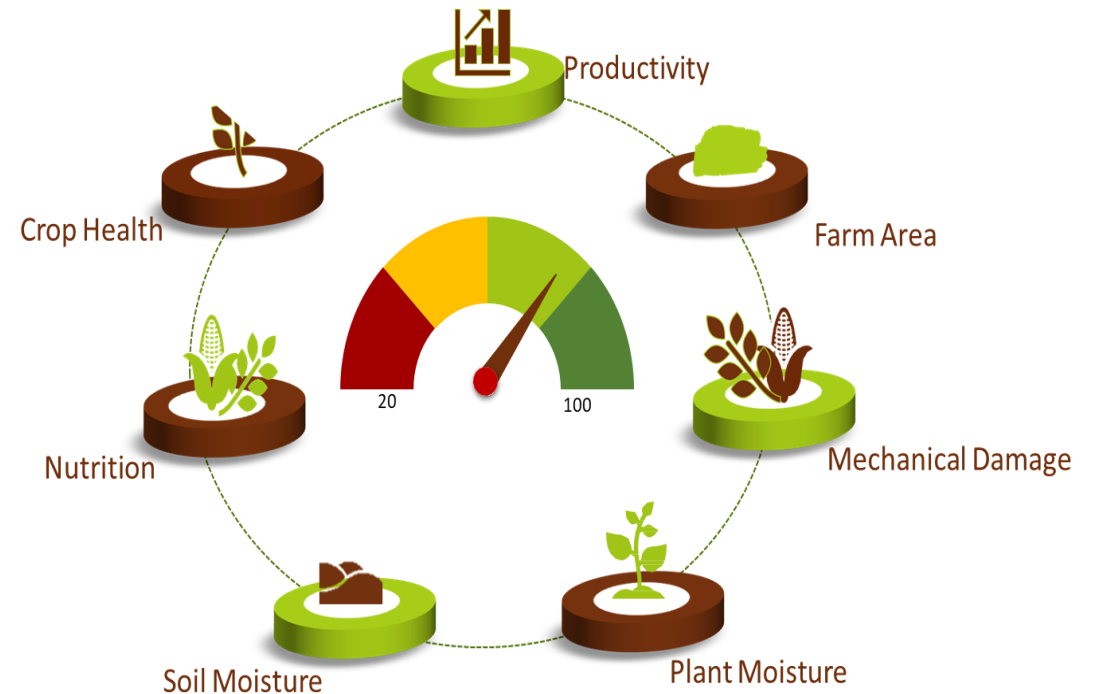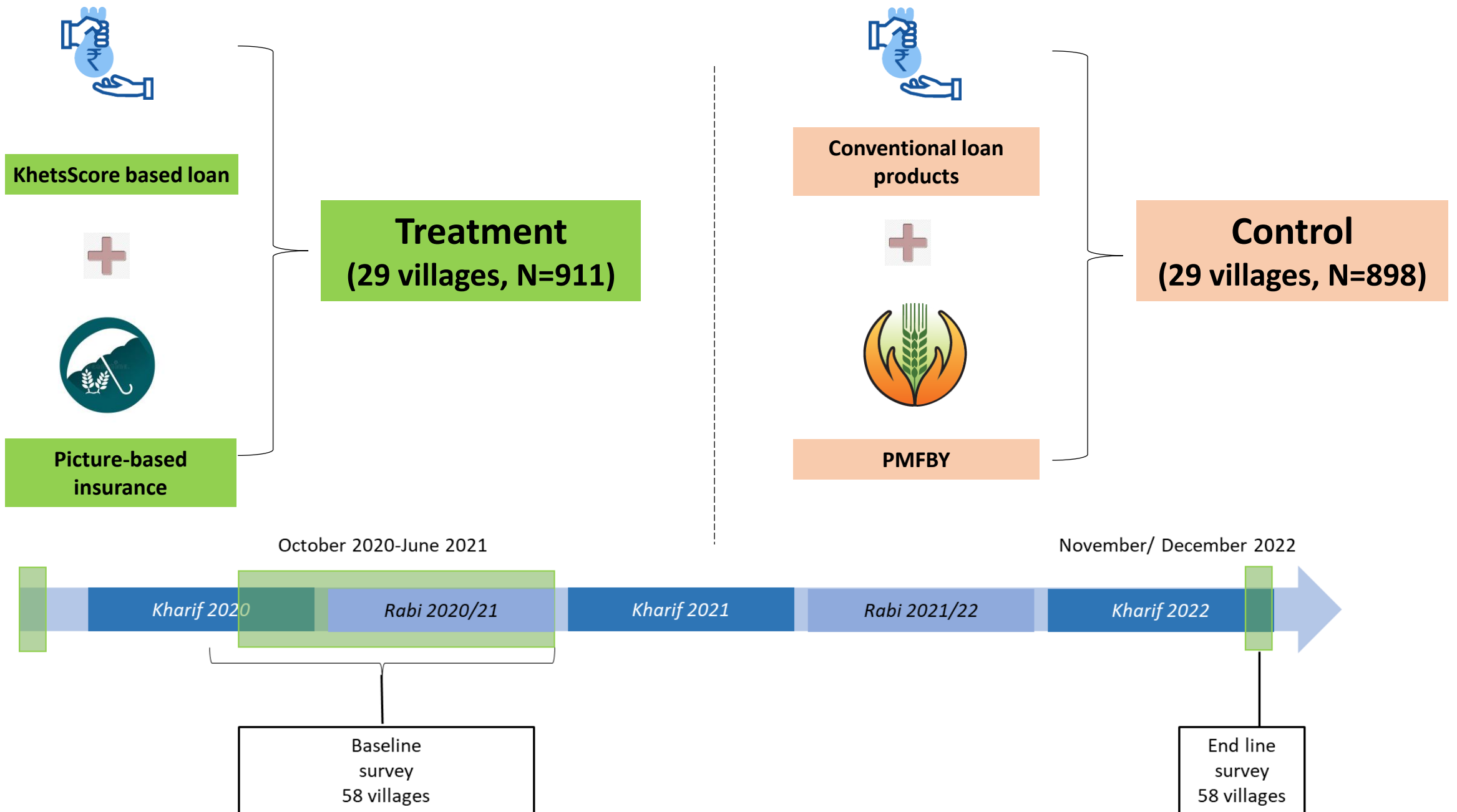
Study Context

Implemented in the state of Odisha

- One of the largest producers of food grain in India, particularly paddy
- Two seasons per year: the summer monsoon (Kharif) season, with farmers mainly producing paddy, and winter (Rabi) season, during which many farmers do not cultivate.
- Increasing investments in high-value crops during Rabi season, by providing credit and insurance, is seen as a way to transform agricultural livelihoods

Jajpur District: Low-lying coastal plains

- Main risks during Kharif season: floods and cyclones
- Irrigation available for Rabi season but limited production
- Sharecropping limits access to government credit and insurance

Treatment
(29 villages, N=911)

KhetsScore based loan

+

Picture-based insurance

Control
(29 villages, N=898)

Conventional loan products

+

PMFBY

October 2020-June 2021

November/ December 2022

Kharif 2020 | Rabi 2020/21 | Kharif 2021 | Rabi 2021/22 | Kharif 2022

Baseline survey 58 villages

End line survey 58 villages

Econometric specification: Intent-to-Treat

Main model for individual i from block b in period $t \in \{0,1\}$:

$$Y_{ib,1} = \alpha + \beta Y_{ib,0} + \boxed{\delta_1 T_{ib}} + X_{ib,0}\,\boldsymbol{\theta} + \varepsilon_{ib}$$

Heterogeneity by gender of the main client:

$$Y_{ib,1} = \alpha + \beta Y_{ib,0} + \gamma Female_{ib} + \boxed{\delta_1 T_{ib} + \delta_2 T_{ib} \times Female_{ib}} + X_{ib,0}\,\boldsymbol{\theta} + \varepsilon_{ib}$$

By baseline credit rationing status (QR_{ib} and RR_{ib} if quantity or risk rationed):

$$Y_{ib,1} = \alpha + \beta Y_{ib,0} + \gamma_1 QR_{ib} + \gamma_2 RR_{ib} + \boxed{\delta_1 T_{ib} + \delta_2 T_{ib} \times QR_{ib} + \delta_3 T_{ib} \times RR_{ib}} + X_{ib,0}\,\boldsymbol{\theta} + \varepsilon_{ib}$$

Outcomes to capture women's mental health of client vs other female HH member:

$$Y_{ib,1} = \alpha + \gamma Other_{ib} + \boxed{\delta_1 T_{ib} + \delta_2 T_{ib} \times Other_{ib}} + X_{ib,0}\,\boldsymbol{\theta} + \varepsilon_{ib}$$

How we measure baseline credit rationing status

Unrationed respondents:

A.   Borrowed in the past 12 months and was granted the amount needed;

B.   Did not borrow because the distance to the bank was too far or did not need a loan.

**Quantity rationed**: **Supply side, could borrow but just not enough.**

A. Borrowed in the past 12 months but was granted less than the amount needed.

B. Didn't borrow because amount granted was insufficient, or no creditworthiness and/or collateral

Risk rationed: Demand side, did not borrow for risk-related reasons.

Did not borrow in the past 12 months for one of the following reasons:

A. Out of fear of losing collateral

B. Loan terms not being flexible enough

C. Application cost being too high

D. Interest rates being too high

Take-up of formal and informal credit
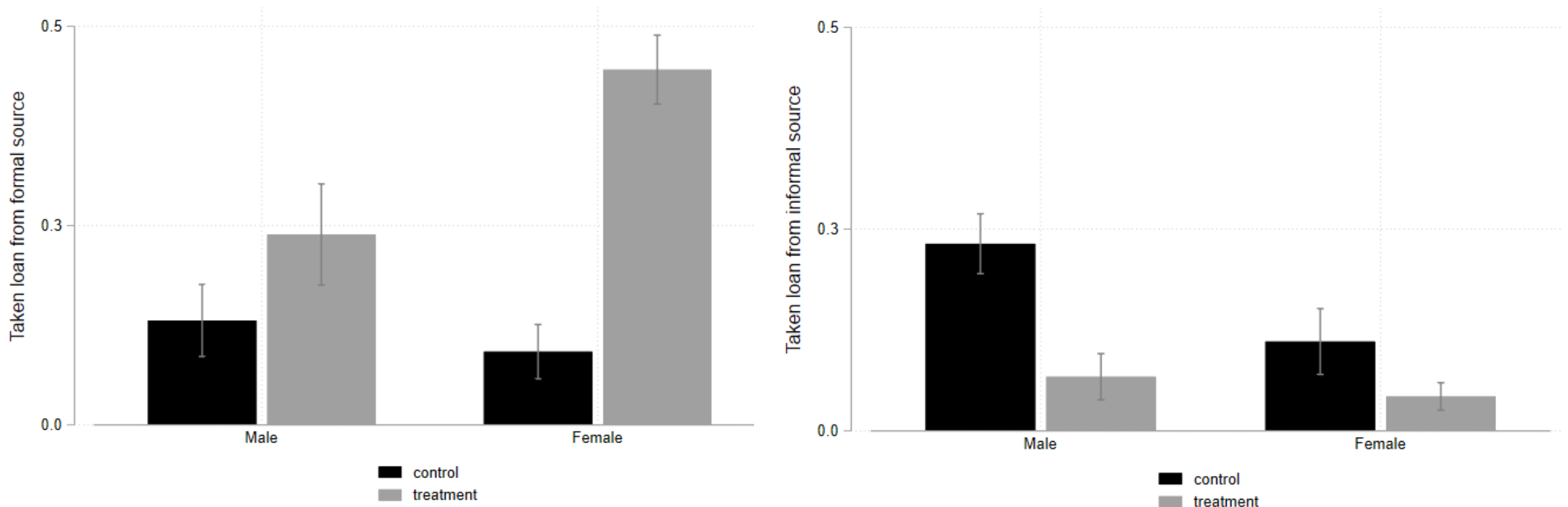
- Increased take-up of loans from formal sources, especially among women
- Substitution from informal to formal loans among men

	Took up credit in past 12 months	Credit from formal source	Credit from informal source	Respondent faced difficulty in repayment
	All	All	All	All
	(1)	(4)	(7)	(10)
Treatment	0.107***	0.228***	-0.128***	-0.412***
	(0.029)	(0.025)	(0.021)	(0.046)
Treatment | Unrationed	0.083*	0.234***	-0.151***	-0.448***
	(0.044)	(0.041)	(0.032)	(0.073)
Total effect | Quantity rationed	0.059	0.209***	-0.151***	-0.450***
p-value	0.284	7.13e-10	1.18e-06	4.71e-10
Total effect | Risk rationed	0.109**	0.234***	-0.141***	-0.443***
p-value	0.027	1.3e-08	1.27e-04	3.19e-09
Treatment| Male	-0.133***	-0.046*	-0.089***	-0.019
	(0.031)	(0.024)	(0.027)	(0.076)
Total effect | Female	0.259***	0.337***	-0.084***	-0.472***
p-value	<2e-16	<2e-16	7.46e-04	9.5e-14
Observations	2,915	2,915	2,915	987
Control group mean	0.275	0.111	0.171	0.709

Notes: Standard errors in parentheses clustered by village. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Control variables include dummy variables for block, age terciles, gender, literacy, caste, pre-existing operations in the village, baseline cultivation in the Rabi season, took credit at baseline, and profits at baseline.

Increase in insurance take-up and renewal

Relative to the control group, both women and men in the treatment group were more likely to have enrolled in insurance and to have renewed these insurance policies.
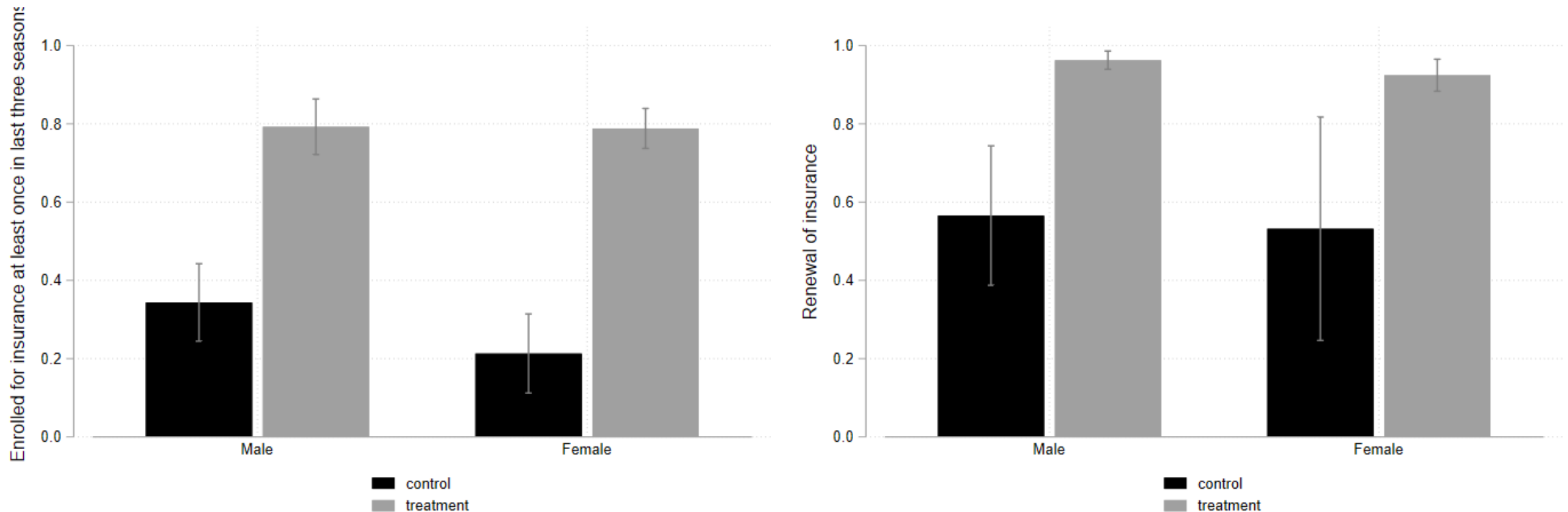
	Insurance uptake	Insurance renewal	Heard of insurance	Knowledge score
	(1)	(2)	(3)	(4)
Panel A				
Treatment	0.617***	0.282***	0.155***	0.498***
	(0.044)	(0.068)	(0.040)	(0.153)
Panel B				
Total effect | Unrationed	0.661***	0.345***	0.184***	0.358
	(0.057)	(0.100)	(0.069)	(0.274)
Total effect | Quantity rationed	0.641***	0.290***	0.167***	0.420***
p-value	<1e-10	5.86e-05	7.77e-04	0.003
Total effect | Risk rationed	0.594***	0.197	0.155**	0.575
p-value	<1e-10	0.143	0.018	0.148
Panel C				
Total effect | Male	0.630***	0.073	0.023	0.521***
	(0.046)	(0.079)	(0.052)	(0.116)
Total effect | Female	0.601***	0.570***	0.312***	0.458
p-value	<2e-16	<2e-16	4.92e-08	0.201
Observations	1,621	950	1,621	687
Control group mean	0.280	0.394	0.308	3.047

Notes: Standard errors in parentheses clustered by village. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. The first three dependent variables are binary, the fourth, "knowledge score" takes integer values 0-6, is the number of correct answers to six crop insurance statements. Control variables include dummy variables for block, age terciles, gender, literacy, caste, pre-existing operations in the village, baseline cultivation in the Rabi season, took credit at baseline, and profits at baseline. The model in columns (1) and (2) controls for baseline insurance uptake.

Overview of findings

| Outcomes of interest	Outcome indicators	
Credit and insurance uptake	Credit and insurance uptake, and ease of repayment	↑ Especially for female farmers
Agricultural outcomes	Whether cultivated paddy, Area cultivated under paddy, Income per acre	
Gender parity	Contributes to household borrowing decisions, and to decisions about how to spend borrowed funds. Women's Empowerment in Agriculture Index	
Well-being	Mental health (stress levels)	

Agricultural Outcomes
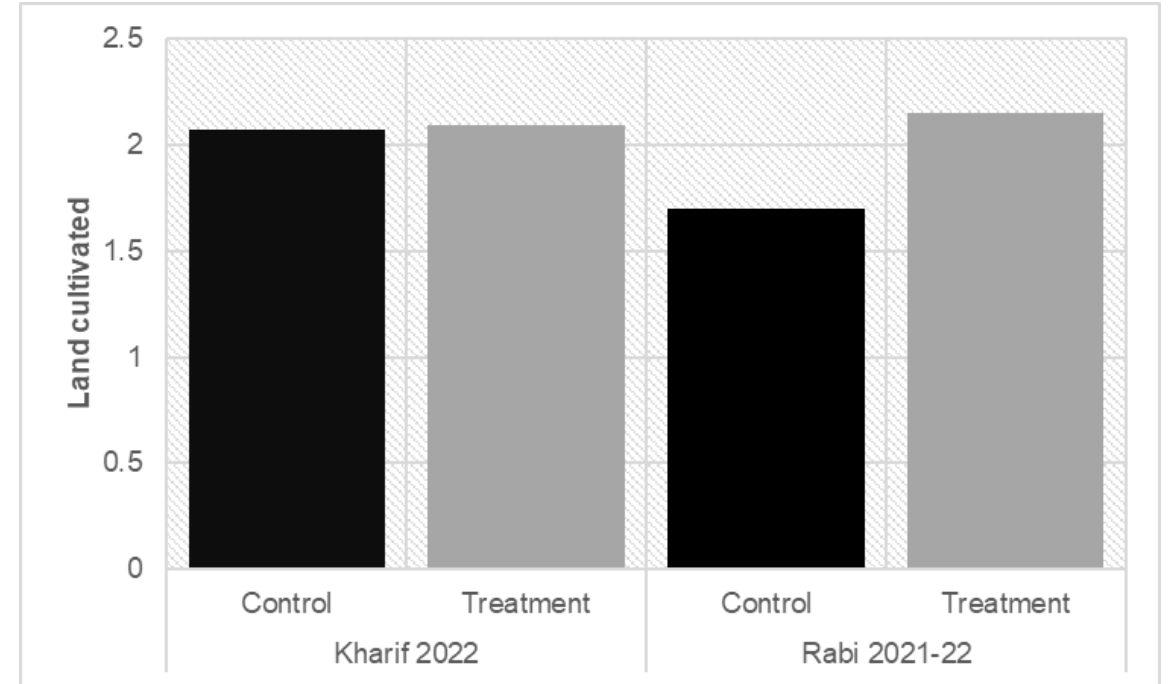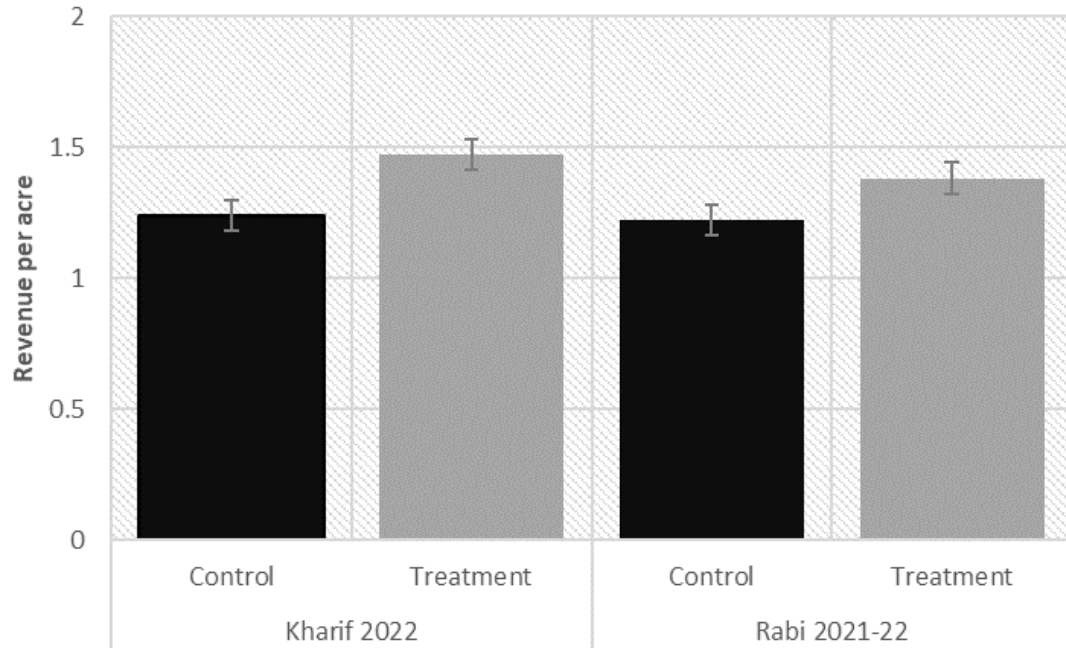
Significant increase in revenue per acre in Kharif, reduced costs and increased area cultivated in Rabi, **improving profitability in both seasons**; **for both women and men**.

When instrumenting KhetScore credit uptake using treatment, **effects of Kharif loans are largest among unrationed farmers**, but **beneficial impacts carry over to quantity rationed farmers**.
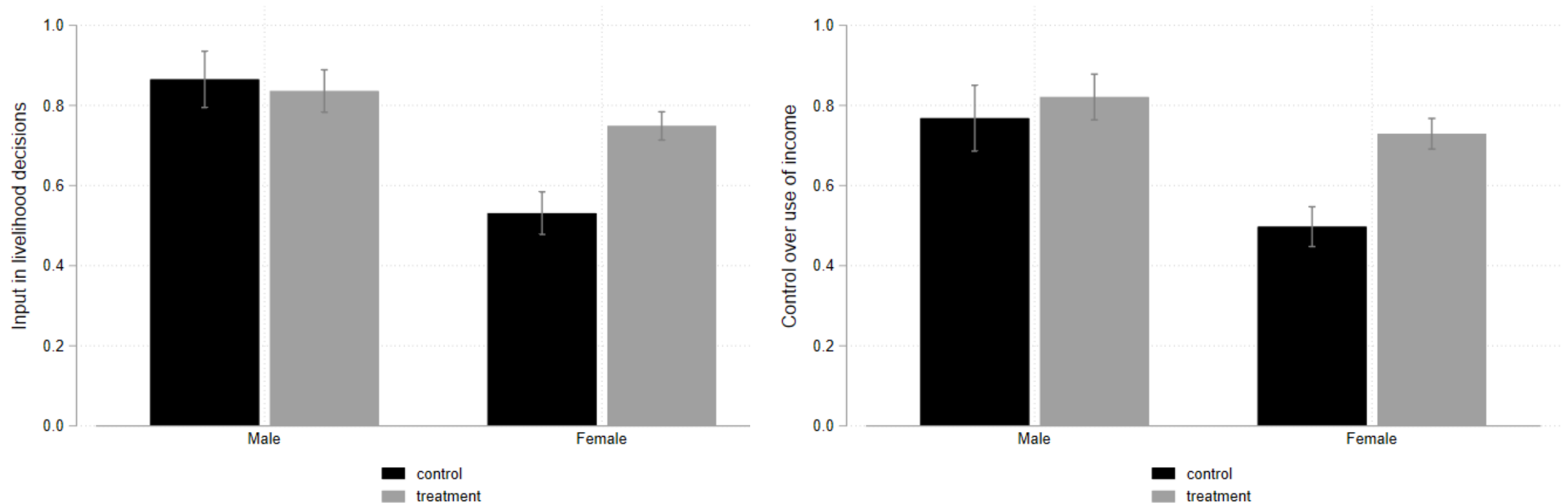
Overview of findings

Outcomes of interest	Outcome indicators	
Credit and insurance uptake	Credit and insurance uptake, and ease of repayment	↑ Especially for female farmers
Agricultural outcomes	Whether cultivated paddy, Area cultivated under paddy, Income per acre	↑ LATE stronger for unconstrained and quantity rationed
Gender parity	Contributes to household borrowing decisions, and to decisions about how to spend borrowed funds. Women's Empowerment in Agriculture Index	
Well-being	Mental health (stress levels)	

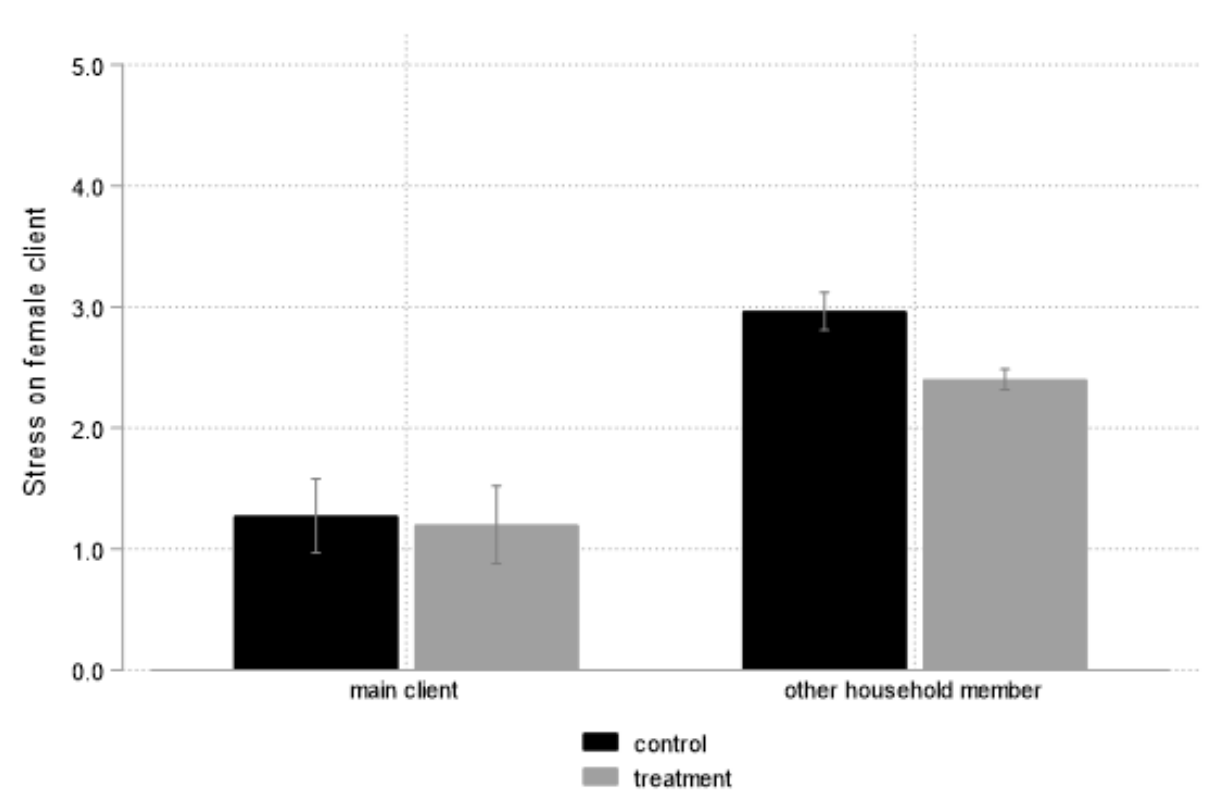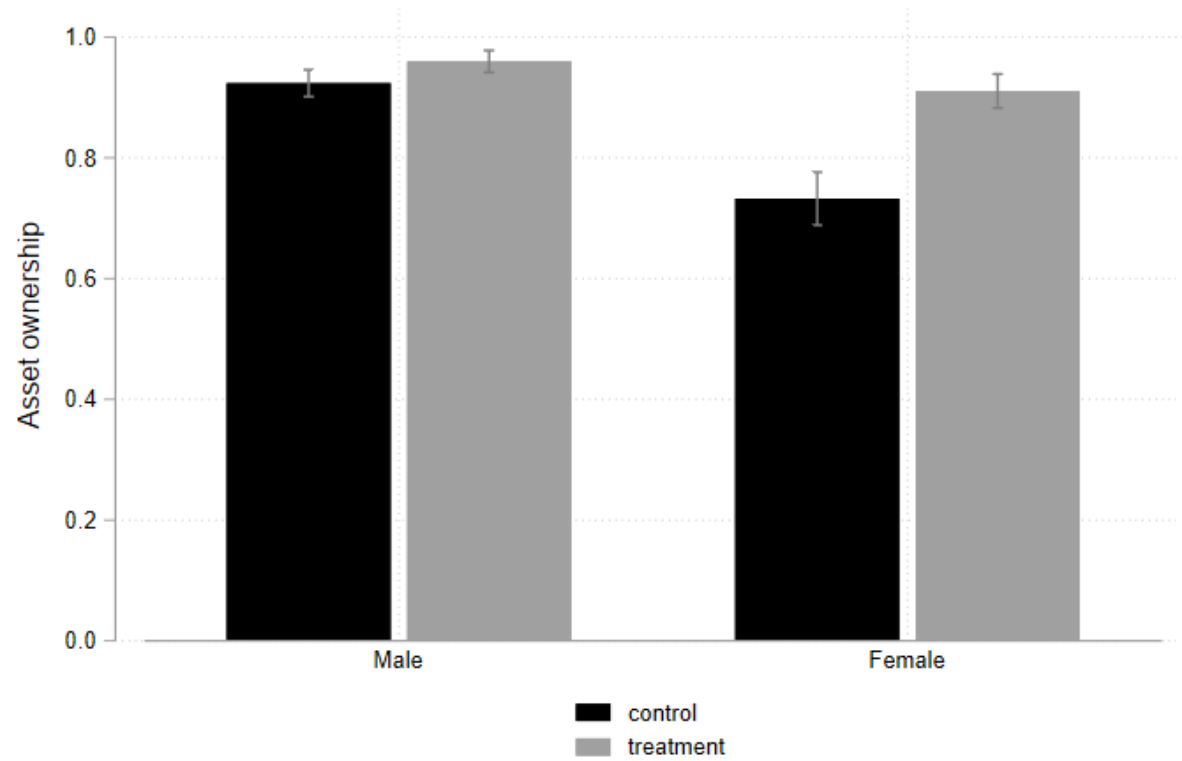# Input in household decision-making (1)
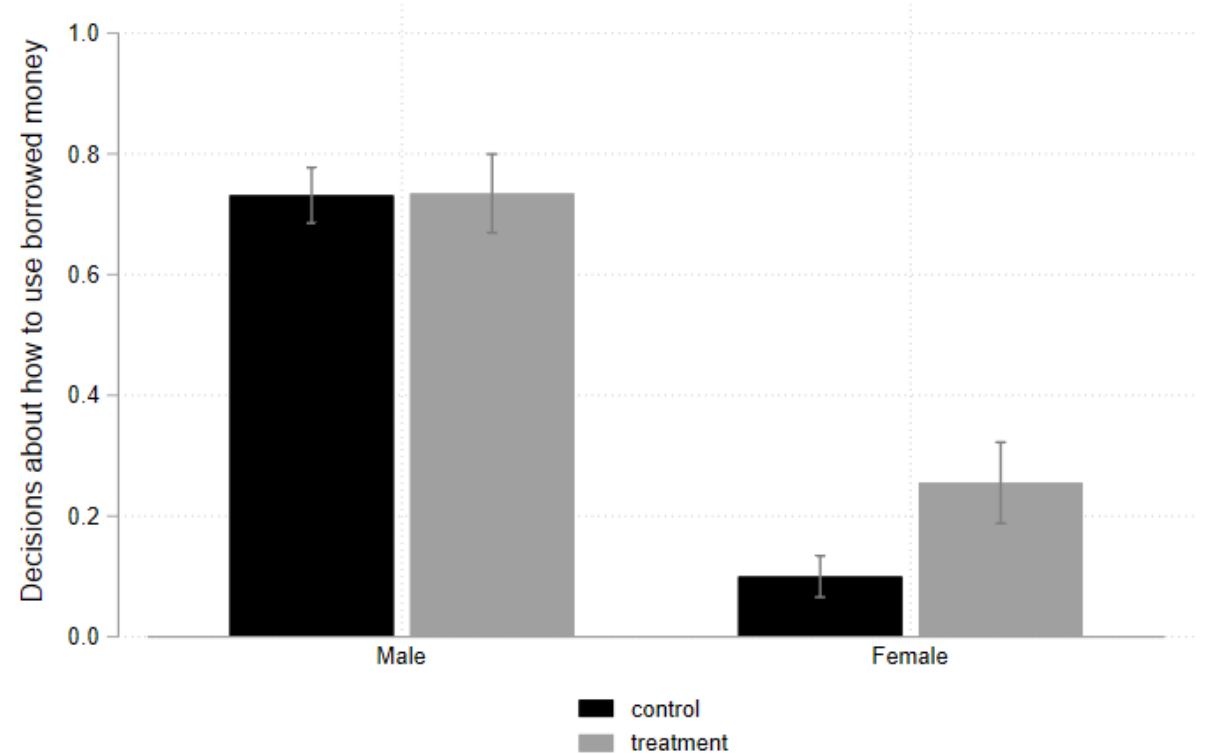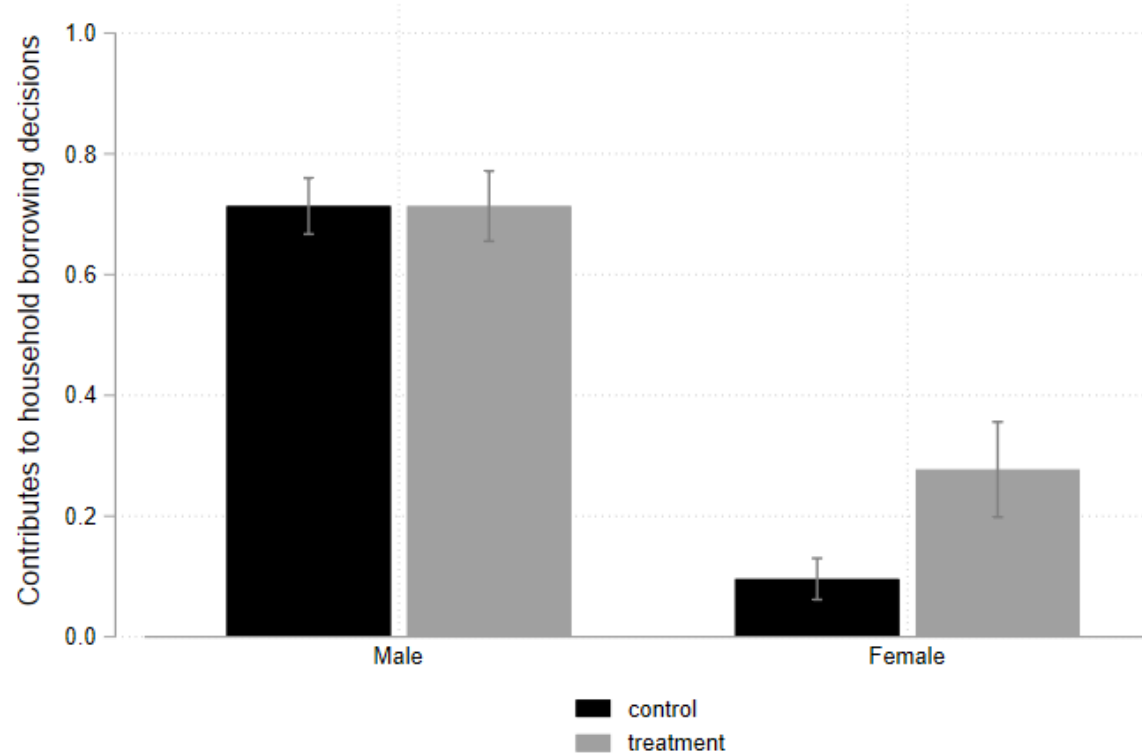
Increased influence of women in the decision to borrow money, and how to use the borrowed money.

Input in household decision-making (2)

Increased empowerment goes beyond just loans: Also increased input in livelihood decisions, control over use of income, and …

… asset ownership and mental health

Overview of findings

Outcomes of interest	Outcome indicators	
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Agricultural outcomes	Whether cultivated paddy, Area cultivated under paddy, Income per acre	↑ LATE stronger for unconstrained and quantity rationed
Gender parity	Contributes to household borrowing decisions, and to decisions about how to spend borrowed funds. Women's Empowerment in Agriculture Index modules	↑
Well-being	Mental health (stress levels)	↑ Only among women co-signees (from households with male clients)

Conclusion

- Providing smallholder farmers agricultural loans with picture-based insurance coverage yields impacts beyond just "reach" (uptake and coverage):
    1. Clients reported encountering *much less* **difficulty** in **repaying loans**, and **improved agricultural outcomes**
    2. Increase in women's **contributions** to **household decision-making** about *whether* to borrow money, and *how* to use borrowed funds
    3. Reduced **stress** (proxy for mental health and wellbeing) among **female family members** of men with loans

- Future work is needed to dig deeper into mechanisms: impacts driven by credit or insurance? Extend analysis based on credit rationing status at baseline
    - Currently ongoing: Randomized trial with credit only and credit + insurance treatment arms.

- Gender findings and heterogeneity by client versus co-signees illustrate the value of surveying men and women from same household, not just male or female **household head**.

Thank you!