Financial Frictions, Market Access, and Technology Adoption: Experimental Evidence from India

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Partnership and Donors

The result of close collaboration:

- PANI
- PEHAL FOUNDATION
- IFMR

And generous donors:

- Economic and Social Research Council
- British Academy/Leverhume Trust
- CAHSS Global Challenges Fund
- Scottish Institute for Research in Economics
- University of Edinburgh, Kings College London, and Birkbeck University of London

Motivation

- The majority of the world's poor live in rural areas and depend on agriculture for their livelihood.
- There have been many technological advancements in recent decades.
- Adoption of successful new models have varied widely.

Motivation

- Since 2013, PANI has been trialling a multi-layered vegetable farming model called Machan.
- Pilot studies on experimental farms have shown this to be highly successful at generating farm profits.
- Yet there are significant obstacles to its widespread adoption.
  - Financial constraints
  - Access to markets

Motivation

- **Question**: Does alleviating financial frictions and providing access to markets encourage adoption of new technology?

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- **Question**: Does alleviating financial frictions and providing access to markets encourage adoption of new technology?
- To answer this, we carried out a randomised control trial evaluating the effect of access to finance and markets on the adoption of Machan farming.

Machan farming

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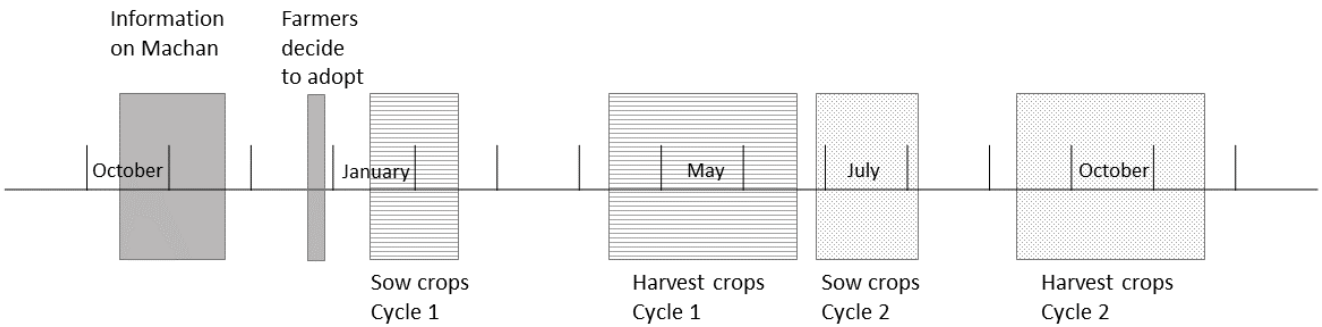
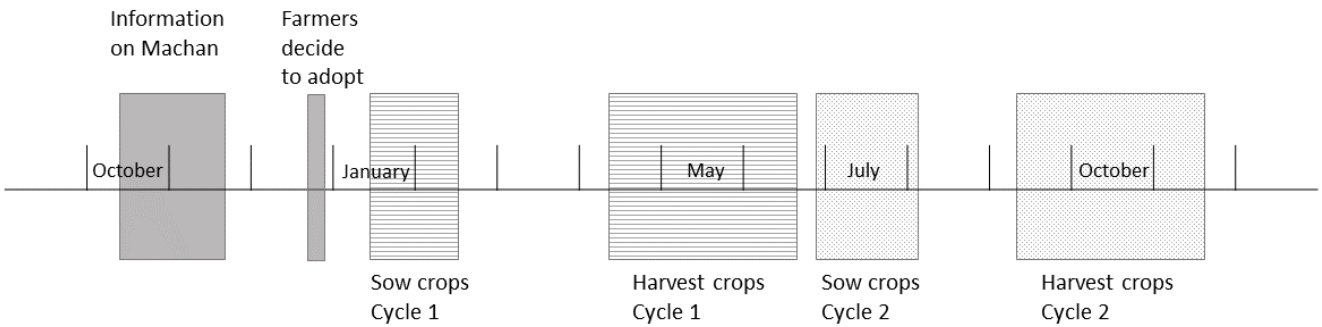


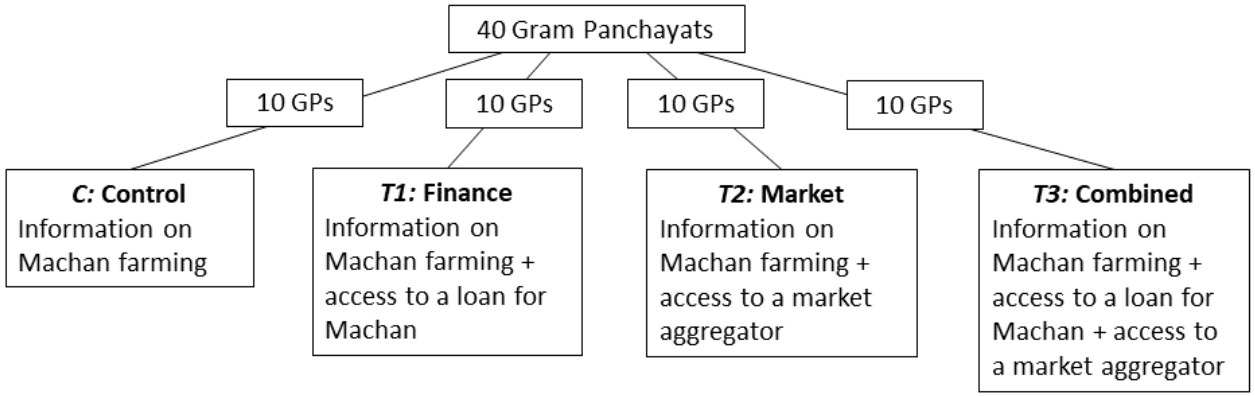
Machan farming



This multi-layered cropping cycle has three key advantages:

- Increase land productivity
- Diversification of crops
- Smooth income over the year

Experimental design



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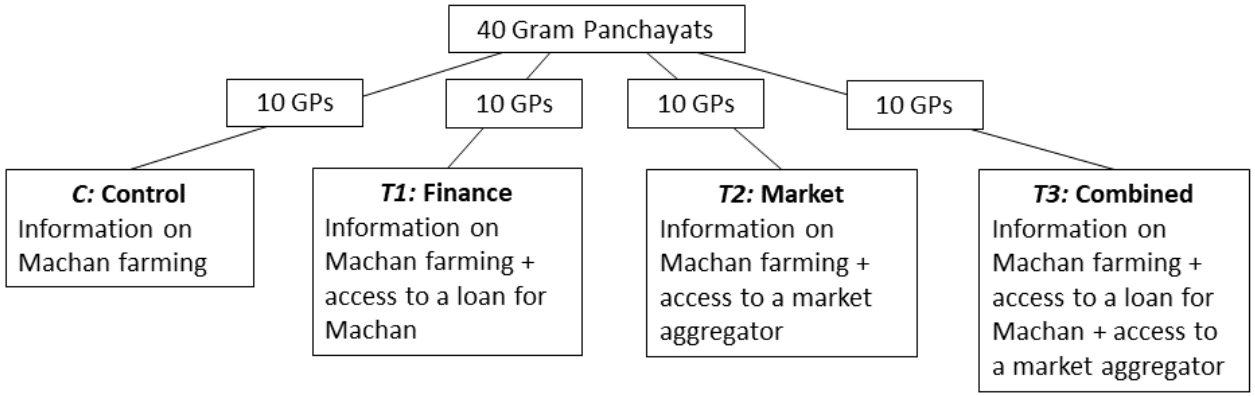
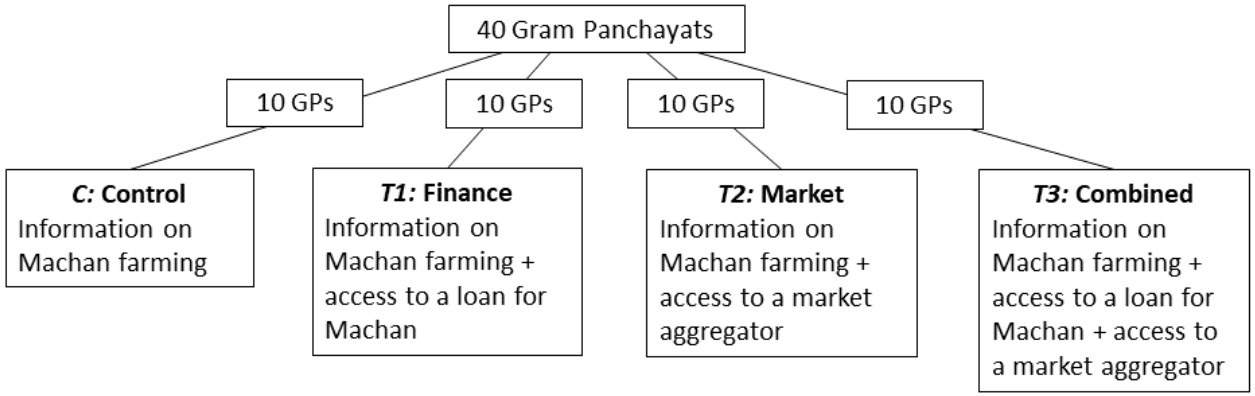


Why choose a randomised control trial?

Experimental design



Why choose a randomised control trial?

- Instead compare before and after?
  - An increase in adoption may just be a reflection of better economic times.

Interventions

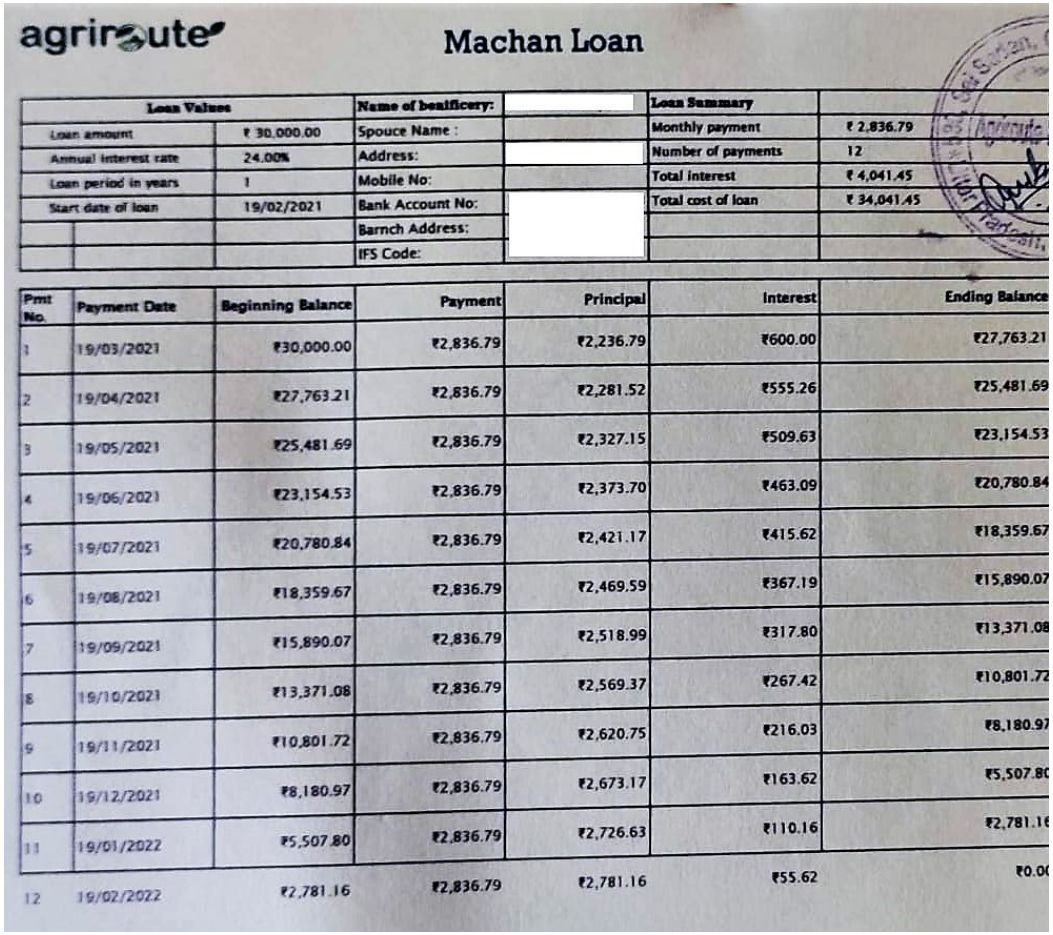
Information on Machan was provided by PANI and included:

- Orientation meeting
- Three videos on how to successfully implement Machan farming
- Demonstration plot and technical assistance

Interventions

A loan for Machan was developed and promoted by PAHEL:

- Machan farmer
- Rs.10,000-Rs.30,000
- 12 months
- 24% interest repaid monthly
- Aadhar card + 2 pictures
- References from the community



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Machan Loan

Loan Values		Name of beneficery:		Loan Summary	
Loan amount	₹ 30,000.00	Spouce Name :		Monthly payment	₹ 2,836.79
Annual interest rate	24.00%	Address:		Number of payments	12
Loan period in years	1	Mobile No:		Total interest	₹ 4,041.45
Start date of loan	19/02/2021	Bank Account No:		Total cost of loan	₹ 34,041.45
		Barnch Address:			
		IFS Code:			

Pmt No.	Payment Date	Beginning Balance	Payment	Principal	Interest	Ending Balance
1	19/03/2021	₹30,000.00	₹2,836.79	₹2,236.79	₹600.00	₹27,763.21
2	19/04/2021	₹27,763.21	₹2,836.79	₹2,281.52	₹555.26	₹25,481.69
3	19/05/2021	₹25,481.69	₹2,836.79	₹2,327.15	₹509.63	₹23,154.53
4	19/06/2021	₹23,154.53	₹2,836.79	₹2,373.70	₹463.09	₹20,780.84
5	19/07/2021	₹20,780.84	₹2,836.79	₹2,421.17	₹415.62	₹18,359.67
6	19/08/2021	₹18,359.67	₹2,836.79	₹2,469.59	₹367.19	₹15,890.07
7	19/09/2021	₹15,890.07	₹2,836.79	₹2,518.99	₹317.80	₹13,371.08
8	19/10/2021	₹13,371.08	₹2,836.79	₹2,569.37	₹267.42	₹10,801.72
9	19/11/2021	₹10,801.72	₹2,836.79	₹2,620.75	₹216.03	₹8,180.97
10	19/12/2021	₹8,180.97	₹2,836.79	₹2,673.17	₹163.62	₹5,507.80
11	19/01/2022	₹5,507.80	₹2,836.79	₹2,726.63	₹110.16	₹2,781.16
12	19/02/2022	₹2,781.16	₹2,836.79	₹2,781.16	₹55.62	₹0.00

Interventions

A market aggregator for Machan was provided by PANI:

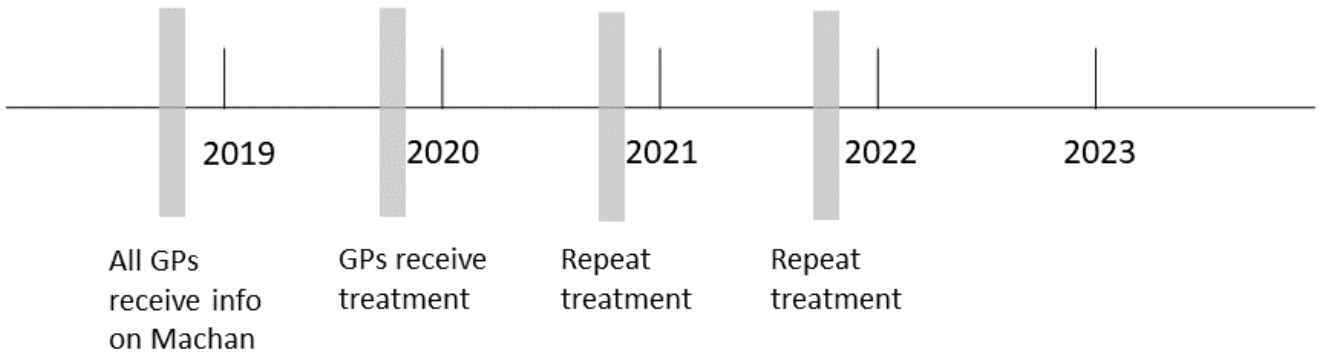
- Two aggregators are identified by joint consensus
- The aggregator should be from the GP, young, literate, familiar with vegetable farming and selling at Mandis
- The role of the aggregator is to:
  - Collect information on farmers and their harvesting schedule, as well as on price of vegetables in all nearby Mandis
  - Inform farmers on market price and costs
  - If farmer wants to sell, coordinate the transport and sales at local Mandi

Sampling

- The study was implemented across 40 GPs in Rehra Bazaar block, Balrampur District, Uttar Pradesh.
- In each GP, PANI conducted a listing of all farmers eligible for Machan promotion based on:
  - Suitability of land
  - Total land area cultivated
  - Experience farming vegetables
  - Availability of family labour
- 4144 farming households were identified by PANI (approximately 100 per GP).

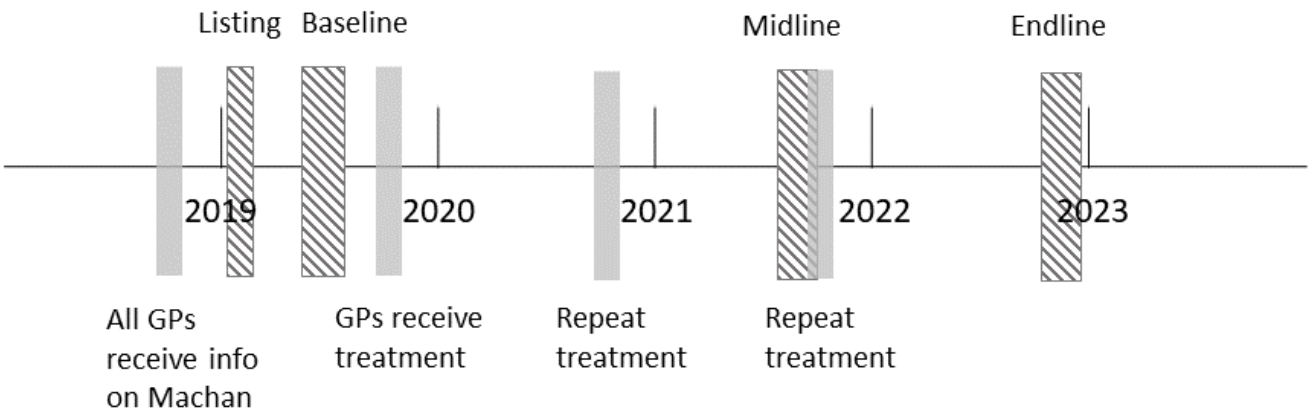
Timeline

The experiment was implemented over three consecutive years.



Timeline

Data collection was closely linked to the experimental timeline.



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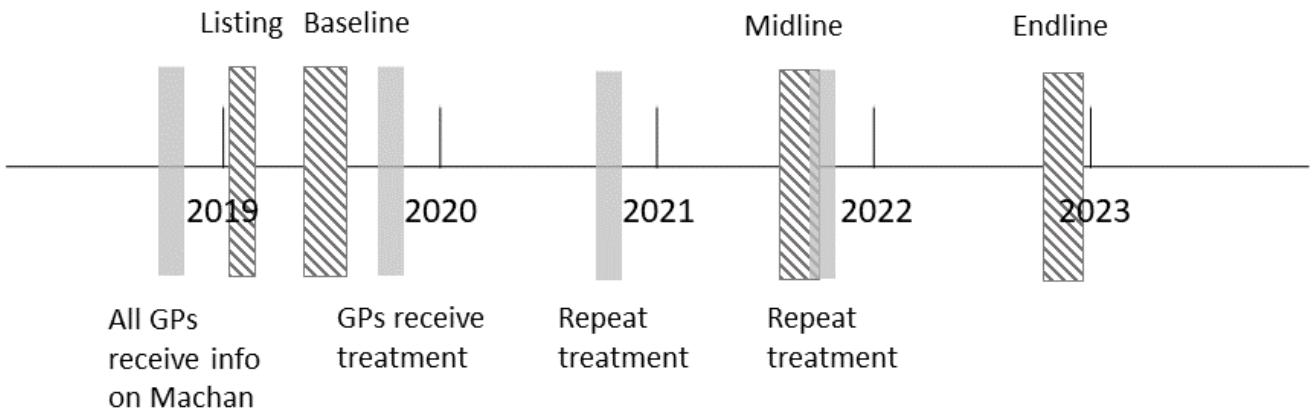

- Pre-intervention baseline survey on household demographics and respondent characteristics.
- Midline survey on adoption in 2020 and 2021.
- Comprehensive endline survey on farming practices.

Treatment effect

We estimate the effect of each treatment intervention compared to the control.

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- Ensure correct implementation of the experimental design:
  - Balance of sample
  - Awareness of interventions
- Control for the effect of Covid-19 on the price of inputs.

Sample characteristics and balance

	C: Control (1)	*T*1: Finance (2)	*T*2: Market (3)	*T*3: Combined (4)	N	p-value (5)
Panel A: Respondent						
HH head (*binary*)	0.633	0.611	0.637	0.619	4144	0.79
Male (*binary*)	0.758	0.733	0.757	0.746	4144	0.68
Age (*binary*)	45.769	45.031	45.258	45.284	4144	0.86
Completed primary school (*binary*)	0.461	0.511	0.534	0.563	3824	0.15
Main occupation is farming (*binary*)	0.853	0.867	0.858	0.866	4144	0.94
Attitude to risk (*index*, 1-3)	1.092	1.097	1.102	1.110	3499	0.83
Panel B: Household						
Number of members (*nb*)	6.957	6.935	7.103	6.912	4144	0.77
Asset ownership (*index*, 0-14)	4.350	4.632	4.624	4.810	3824	0.18
Solid house (*binary*)	0.873	0.888	0.910	0.917	3824	0.17

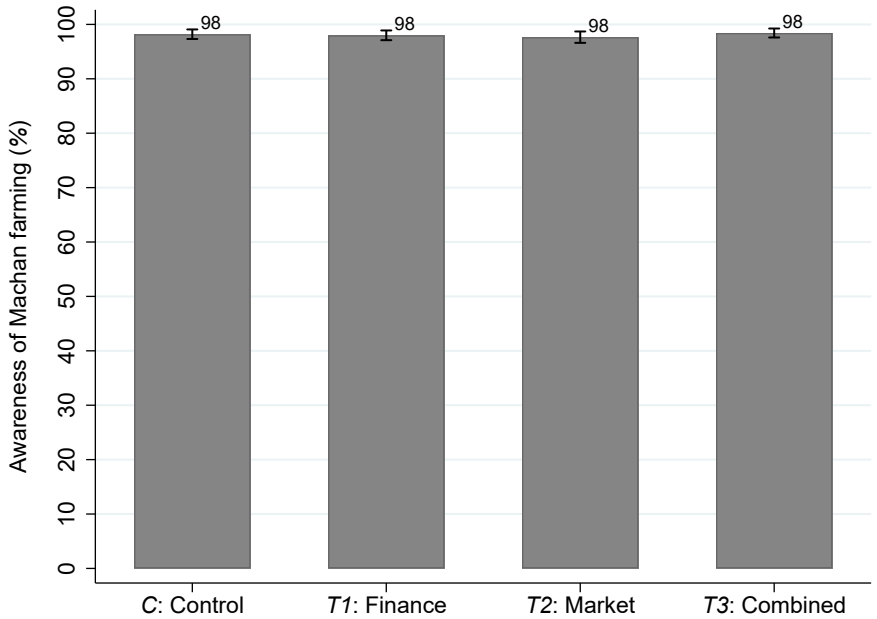
Sample characteristics and balance

	C: Control (1)	$T1$: Finance (2)	$T2$: Market (3)	$T3$: Combined (4)	N	p-value (5)
Panel C: Farming						
Land area cultivated (*ha*)	1.533	1.603	1.809	1.746	3488	0.20
Mechanised equipment (*binary*)	0.071	0.086	0.098	0.106	3824	0.36
Rice-Wheat cropping (*binary*)	0.524	0.517	0.481	0.506	3824	0.94
Panel D: Machan						
Know of PANI (*binary*)	0.591	0.628	0.578	0.627	4144	0.90
Know of Machan (*binary*)	0.823	0.844	0.829	0.875	4144	0.66
Does Machan farming (*binary*)	0.056	0.071	0.077	0.094	4142	0.28

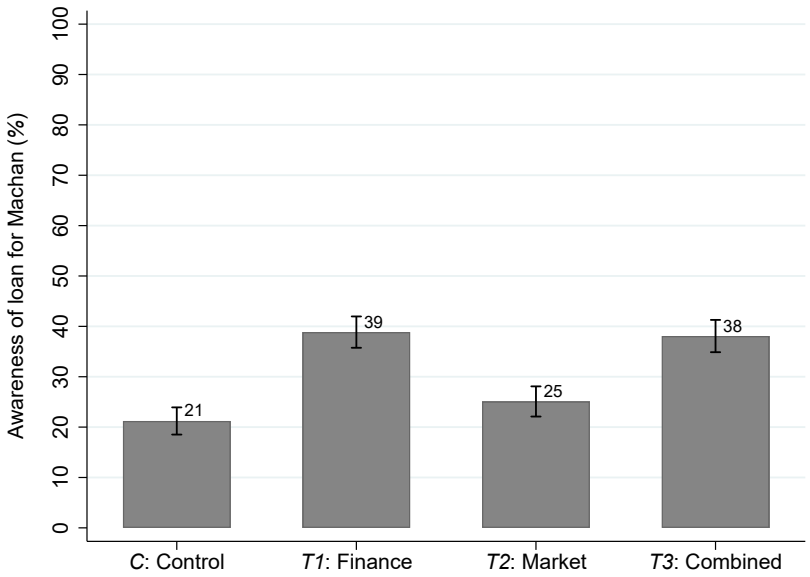
Awareness of the interventions

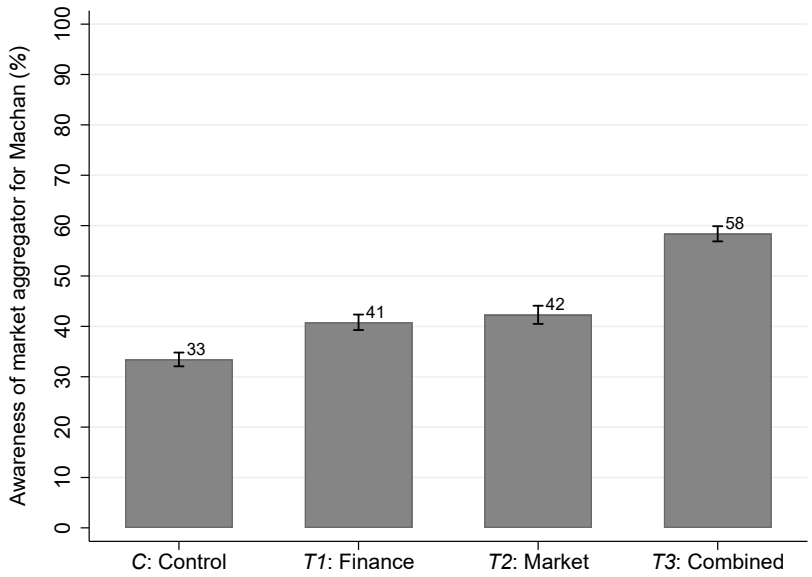
Source of information on Machan were:

1. PANI
2. Network of farmers



Awareness of the interventions

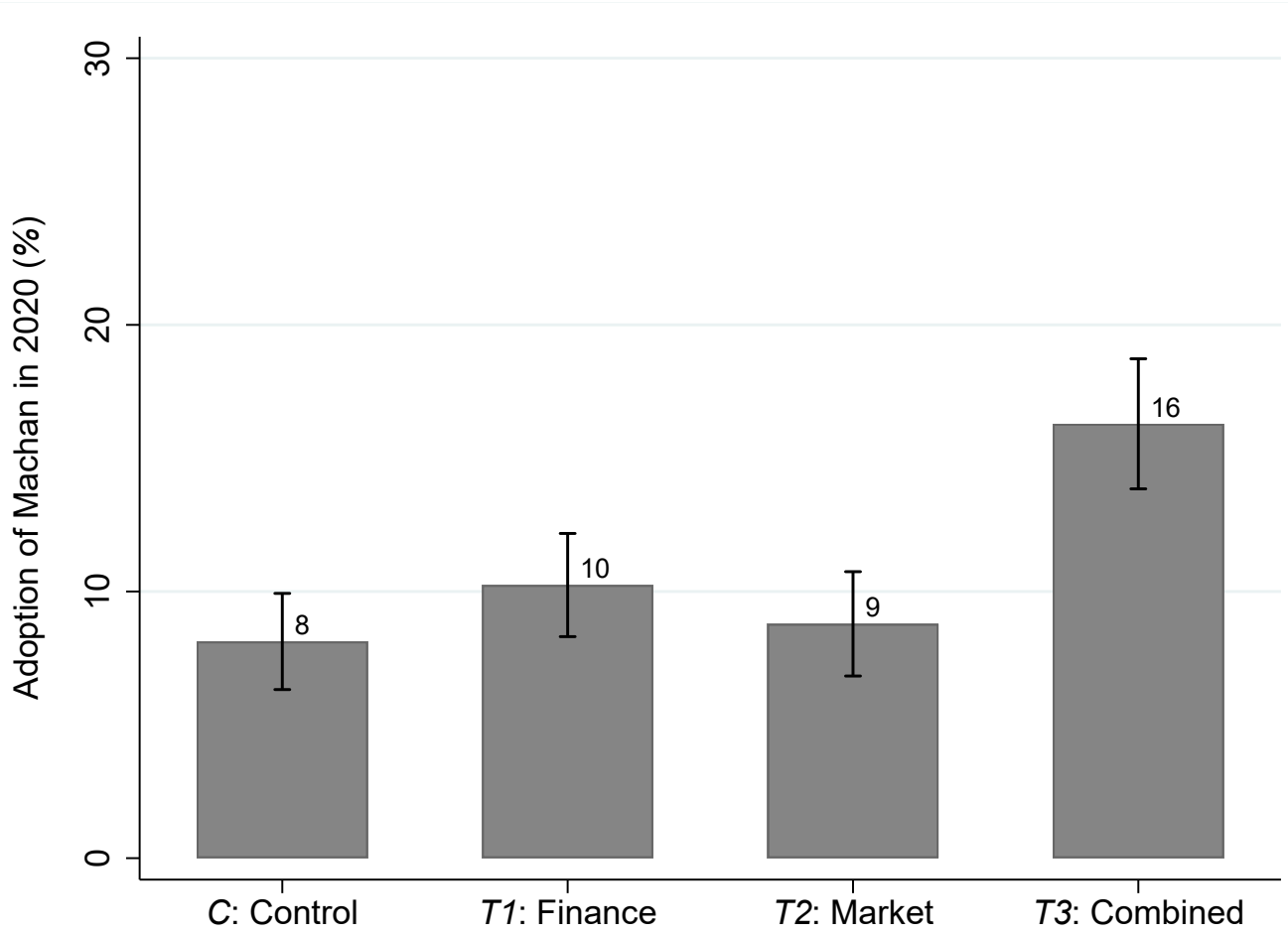




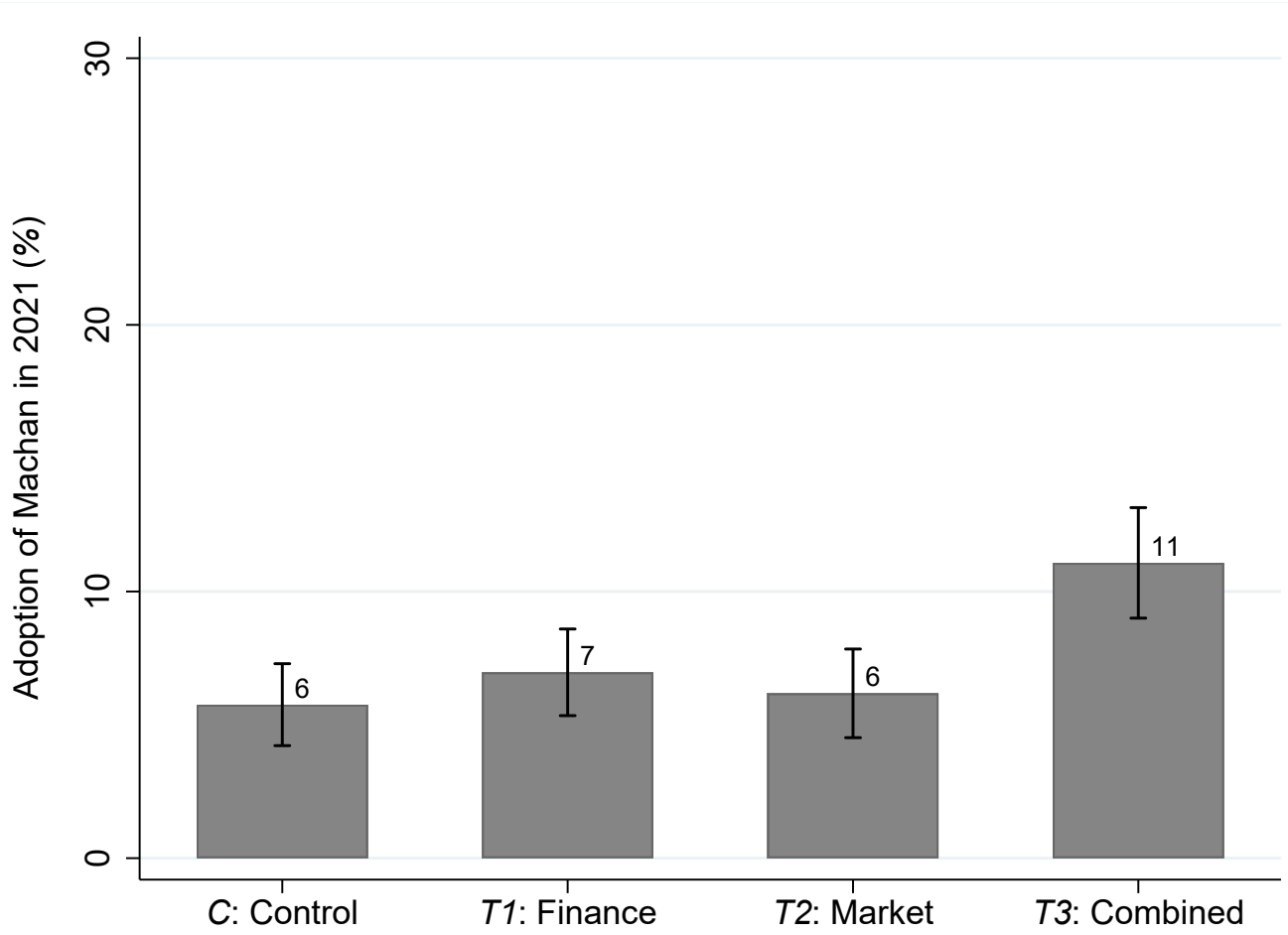
Effect of Covid-19

	C: Control (1)	*T*1: Finance (2)	*T*2: Market (3)	*T*3: Combined (4)	N	p-value (5)
Panel A: Covid-19 Wave 1 (2020)						
Price of fertiliser increased (*binary*)	0.564	0.578	0.528	0.655	3527	0.14
Increase in the price of fertiliser (%)	10.028	9.385	8.931	11.345	3527	0.08
Price of seeds increased (*binary*)	0.472	0.518	0.455	0.536	3527	0.58
Increase in the price of seeds (%)	7.327	7.818	6.522	8.687	3527	0.27
Price of irrigation increased (*binary*)	0.277	0.405	0.333	0.418	3527	0.04
Increase in the price of irrigation (%)	4.483	6.393	4.381	7.347	3527	0.10
Price of labour increased (*binary*)	0.133	0.215	0.085	0.180	3527	0.02
Increase in the price of labour (%)	2.767	3.728	1.533	3.715	3527	0.03

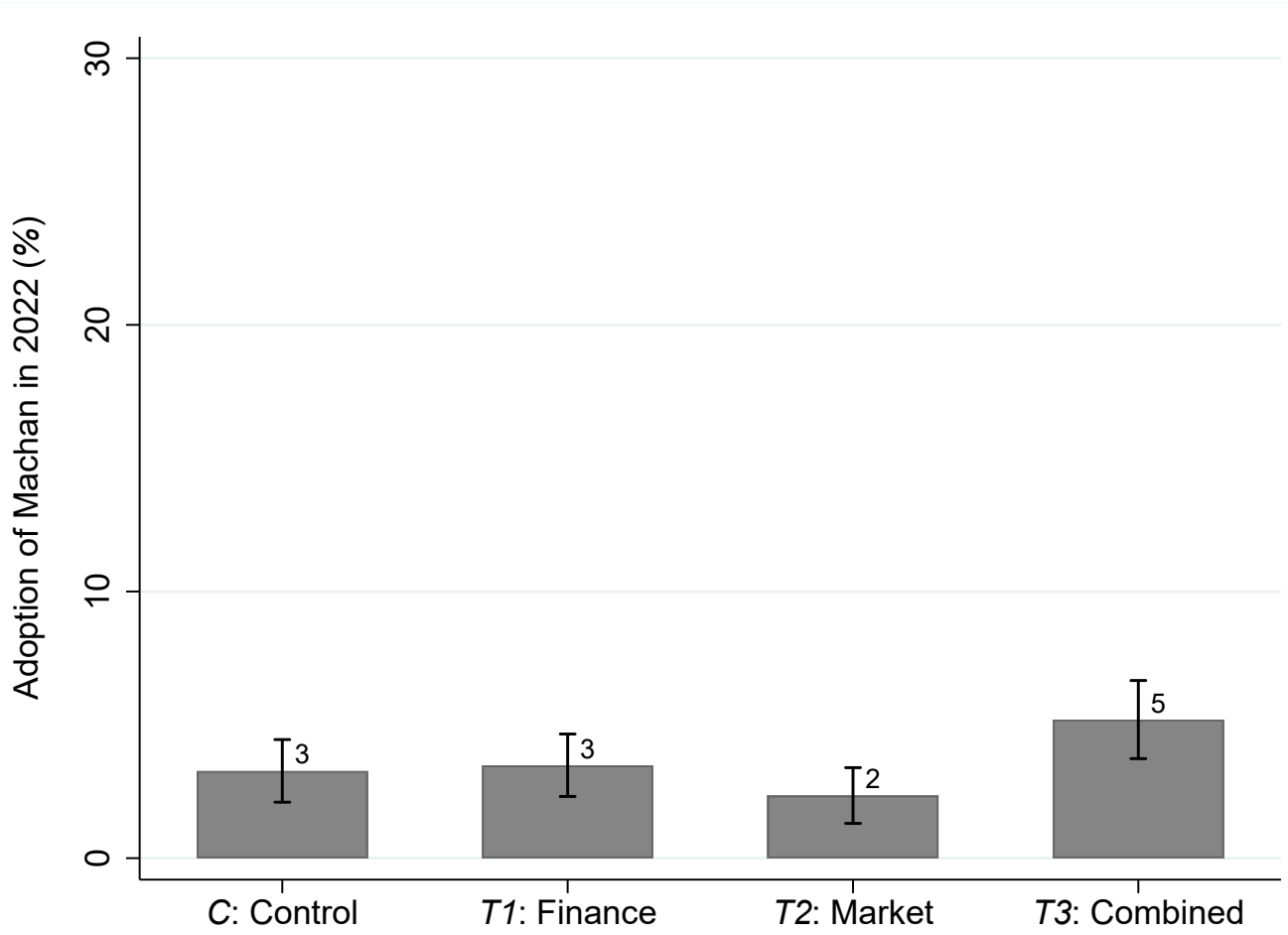
Adoption of Machan - Year 1



Adoption of Machan - Year 2



Adoption of Machan - Year 3



Adoption of Machan

- The combined treatment of access to finance and markets has the largest effect.
  - Double the adoption rate compared to the control
- Dis-adoption of the technology over time.
- Robustness of estimates to varying data measures and estimation process.

Reasons for dis-adoption of Machan

1. Crop loss due to pest/animal => 62%
2. Lack of labour => 37%
3. Lack of available land => 25%
4. Do not understand the technology => 8%
5. Expensive => 4%
6. Access to markets => 1%

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Characteristics of Machan farmers

	Adopter (1)	N	Non-Adopter (2)	N	p-value (3)
Panel A: Respondent					
HH head (*binary*)	0.690	429	0.617	3715	0.00
Male (*binary*)	0.823	429	0.739	3715	0.00
Age (*binary*)	44.441	429	45.433	3715	0.21
Completed primary school (*binary*)	0.620	361	0.506	3463	0.00
Main occupation is farming (*binary*)	0.886	429	0.858	3715	0.09
Attitude to risk (*index*, 1-3)	1.131	335	1.097	3164	0.19
Panel B: Household					
Number of members (*nb*)	7.790	428	6.897	3713	0.00
Asset ownership (*index*, 0-14)	5.000	361	4.563	3463	0.00
Solid house (*binary*)	0.892	361	0.897	3463	0.79

Machan farmers are: more likely to be educated with farming as their main occupation, from larger households with more assets.

Characteristics of Machan farmers

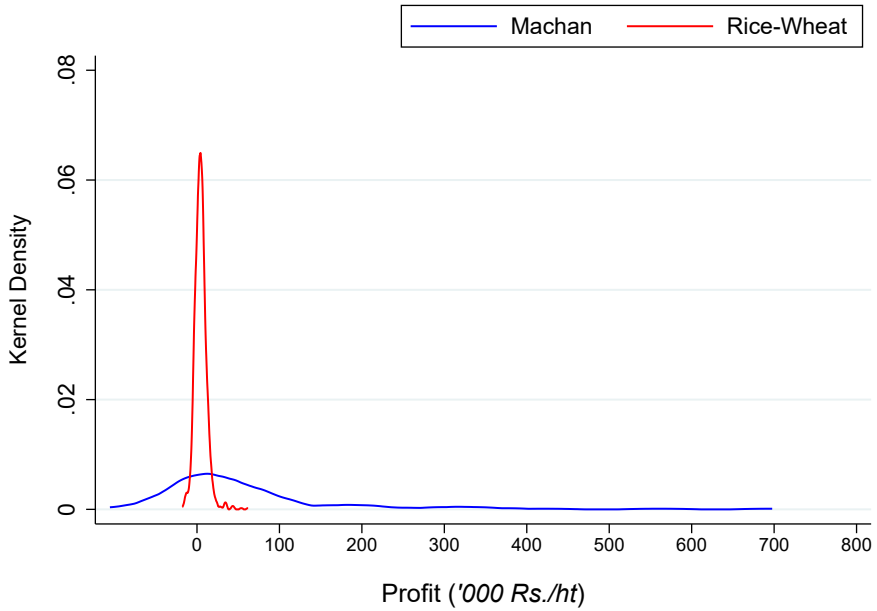
	Adopter (1)	N	Non-Adopter (2)	N	p-value (3)
Panel C: Farming					
Land area cultivated (*ha*)	2.216	314	1.559	2853	0.00
Owns mechanised equipment (*binary*)	0.136	361	0.085	3463	0.01
Rice-Wheat cropping (*binary*)	0.460	361	0.513	3463	0.04
Panel D: Machan					
Know of PANI (*binary*)	0.758	429	0.590	3715	0.00
Know of Machan (*binary*)	0.893	429	0.838	3715	0.00
Does Machan farming (*binary*)	0.242	429	0.055	3713	0.00

Machan farmers are: more likely to have more land and less dependent on rice-wheat cropping. They are more likely to know of PANI and previous experience with Machan.

Comparing Machan with Rice-Wheat cropping

Machan farming:

- Can be very profitable
- Huge variability



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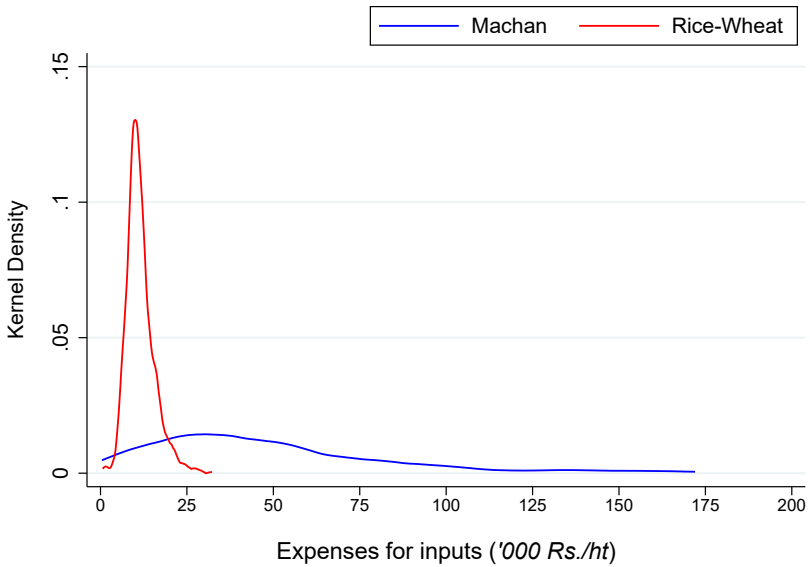

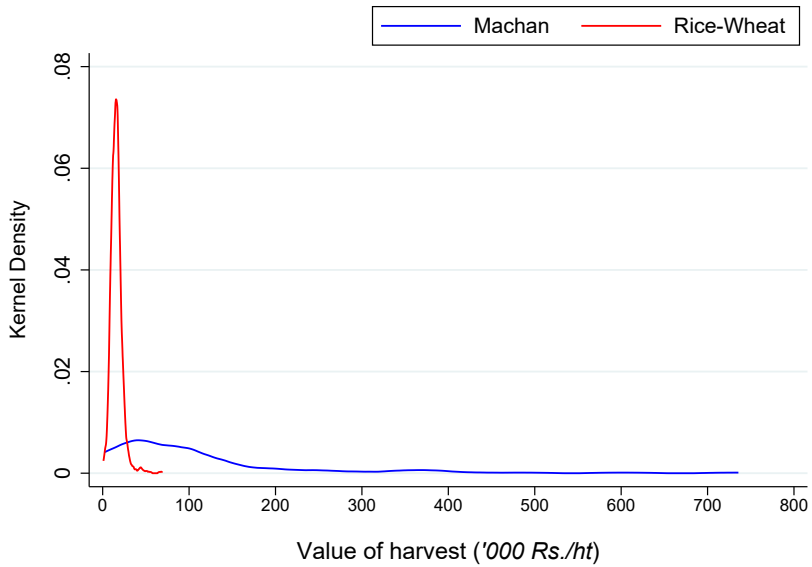

Conclusion

- Providing access to finance and markets has alleviated some constraints faced by potential Machan farmers.
- Machan farming has the potential to be profitable.
- There remains significant barriers to adoption:
  - Crop loss from pest/animal/weather conditions

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- Machan farming has the potential to be profitable.
- There remains significant barriers to adoption:
  - Crop loss from pest/animal/weather conditions
- A potential intervention to address this would be:
  - Crop insurance to cover vegetables


THANK YOU !