Access to Cash Transfers and Climate Resilience in Agriculture

Sheetal Sekhri   Sabina Yasmin

March 2024

Acknowledgement

Motivation

▶ Smallholder farmers in developing countries rely heavily on subsistence agriculture and their livelihoods are particularly vulnerable to climate change

▶ South Asia highest vulnerability to climate-driven risk (IMF, World Bank Computations, 2021) Graph

▶ More than 750 million experienced damages from climate disasters, estimated damages more than $ 150 billion

▶ Region likely to experience hotter weather, longer monsoon seasons, and increased droughts in next 2 decades (IPCC)

Motivation

- ▶ Governments promoting climate resilience building for farmers
  -
  1. National Adaptation Plan of Action (NAPA) in Nepal
  2. National Innovations on Climate Resilient Agriculture (NICRA) in India

- ▶ Climate-resilient agriculture practices (CRA) look at **adaptive agricultural methods** that can withstand the shocks of climate change and weather extremes

  1. **Soil-related practices**: Zero tillage/no till/direct seeding/direct drilling, Retain crop residues, Reduce follows, Crop rotation, Weeding, Harrowing, Mulching, Use of organic manure
  2. **Water-related practice**s: Drip Irrigation, Laser land leveling, Rainwater Harvesting, Small scale reservoirs, programmed irrigation, Growing less water-intensive crops, Farm ponds/wells
  3. **crop-related practices**: Intercropping/Mixed cropping, Use of stress-tolerant short cycle, early sowing, HYV, or hybrid seed
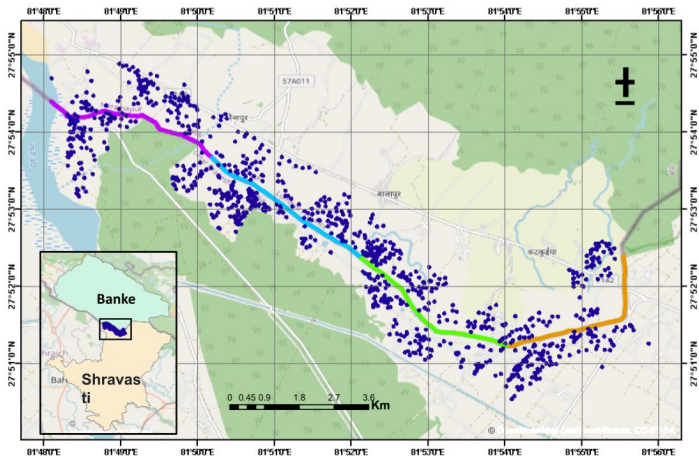
Role of Credit Constraints

▶ Farmers do not necessarily have the know-how and potentially credit or liquidity constrained to adopt CRA practices as a bundle

▶ What is the role of credit and liquidity constraints?

▶ Study a conditional cash transfer scheme in India - Pradhan Mantri Kisan Samman Nidhi (PMKSN 2019)

  1. Small and marginal landholders (up to 2 ha) eligible
  2. Rs 6000 / around 75 dollars paid per land-owning household (husband, wife, and minor children) in 3 installments
  3. Objective- aid procuring inputs and ensuring crop health

Identification- Spatial RD

▶ Launched in 2019 in India

▶ Examine a region of India (with policy) that shares a border with Nepal (without policy)

▶ Compare outcomes of farmers near the border in Shravasti (India) and Banke (Nepal)

▶ Similar geography, climatic risks, agricultural conditions

▶ Rule out:
  1. Differential knowledge
  2. Climate Risks
  3. Take-up of other policies
 4. Take into account coping means (no different)

Context and Relevance for Identification

- Paddy main staple in both districts
- Mainly subsistence, both countries have MSP for paddy
- Agricultural extension service centers equidistant 24 km (India) and 27 Nepal kms from this area, take up similar
- Electricity subsidized in both areas, similar groundwater governance
- Majority farmers in the area not members of community or farmers organizations/institutions like FPO, FPG, PACS, SHG, etc.; or use any available mobile apps like geokrishi, Hamro krishi
- Rice seed markets and other inputs and output markets available in respective countries; markets for output similar distance

Data

- ▶ Grided into 20 cells of 5 km by 200 meters for sampling

- ▶ 20-25 farmers per cell with 100 -200 meter distance in plots

- ▶ Extensive qualitative fieldwork (FGDs, stakeholder meetings, IDIs), Farmer surveys (year 2023), and various satellite data

- ▶ 1003 farmers, 502 Nepal, 501 India, main crop paddy
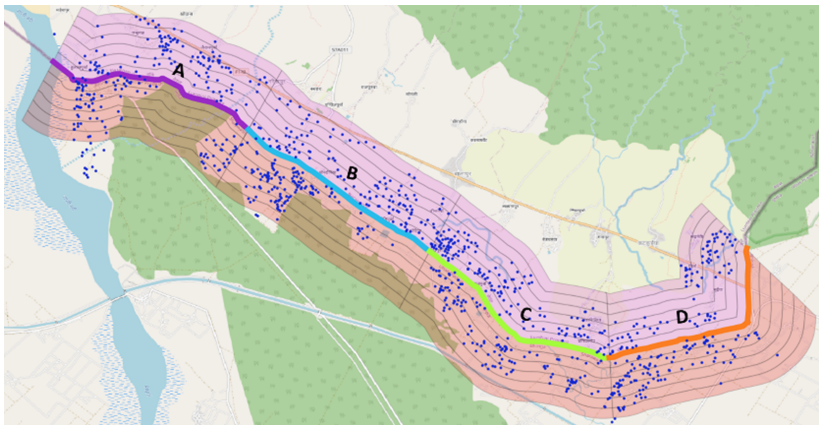
Main Take-away

- Exposure to multi-pronged risks not just one

- High Utilization of the PMKSN in India, very low utilization of any other policies in either country from a very long list made during qualitative fieldwork

- Rice Yield significantly higher in India even after accounting for adaptation

- Water Practices significant drivers, though others adopted too- Bundled intervention

- Women have lower utilization rates of the policy, CRA water practices, and rice yields in India

Literature

- Anticipatory transfers
    1. Anticipatory Cash Transfers for floods Pople et al 2023; Gros 2019, 2020
    2. Early warnings and Cash transfers for droughts World Food Programme Somalia 2022
- Transfer plus other bundling
    1. Cash transfers and vocational training Macours et al 2012
    2. cash transfers and productive grants Marcours et al 2022
    3. Regular cash transfers Premad and Stoeffler 2022
    4. Graduate programs (BRAC style) and cash transfers Hirvonen et al 2023
- Focused on Consumption Smoothing, Information versus Credit constraints, Time horizon, No Gender analysis

Climatic Shocks in Last 5 Years

Percentage Experiencing the Shock

Climatic Shock	Overall	India	Nepal
Flood	91.03	89.82	92.23
Drought	88.73	81.04	96.41
Forest Fire	4.49	1.60	7.37
Hailstorm	16.85	12.18	21.51
Coldwave	17.45	14.77	20.12
Windstorm	43.37	49.90	36.85
Unseasonal Rain	60.12	63.07	57.17
Landslide	0.40	0.40	0.40

Impact on Agricultural Activities Climatic Shocks Last 5 Years

Percentage Experiencing Different Intensity

Climatic Shock	Insignificant	Mild	Moderate	Major	Severe
Flood	0.4	1.2	6.8	43.5	39.4
Drought	0.1	3.5	10.4	50.9	24.1
Forest Fire	0.9	0.5	1.1	1.2	0.8
Hailstorm	2.2	4.3	6.9	3.1	0.4
Cold Wave	1.8	7.6	4.2	3.9	0.0
Windstorm	2.8	15.1	12.4	12.1	1.1
Unseasonal Rain	0.9	14.5	7.9	26.3	10.7
Landslide	0.0	0.1	0.1	0.1	0.1

Climatic Shocks in Last Year (in Percentage)

	Last Year	
Climatic Event	Did not Happen	Happened
Flood	2.79	97.21
Drought	4.39	88.24
Forest Fire	13.36	51.05
Hailstorm	6.48	32.10
Cold Wave	1.69	17.55
Windstorm	0.70	6.78
Unseasonal Rain	0.00	0.50

Intensity of Shocks Last Year (in percentage)

Percentage Experiencing Different Intensity Last Year

Climatic Event	Insignificant	Mild	Moderate	Major	Severe
Flood	0.41	1.85	9.23	54.77	33.74
Drought	0.56	4.29	14.58	56.72	23.84
Forest Fire	4.10	24.80	24.41	35.35	11.33
Hailstorm	2.48	24.53	26.71	34.47	11.80
Cold Wave	1.14	27.84	22.73	37.50	10.80
Windstorm	1.47	1.47	1.47	92.65	2.94
Unseasonal Rain	0.00	0.00	0.00	100.00	0.00

Damages by Various Climatic Shocks in Last Year (in percentage)

Impact on Agriculture (Last Year)

Climatic Shock	Insignificant	Mild	Moderate	Major	Severe
Flood	1.13	3.38	16.21	55.08	24.21
Drought	0.45	5.99	17.18	56.72	19.66
Forest Fire	5.66	29.69	24.02	30.47	10.16
Hailstorm	2.17	35.09	27.33	26.71	8.70
Cold Wave	3.98	36.93	25.57	28.41	5.11
Windstorm	4.41	5.88	2.94	76.47	10.29
Unseasonal Rain	20.00	20.00	0.00	40.00	20.00

Shocks at the Border
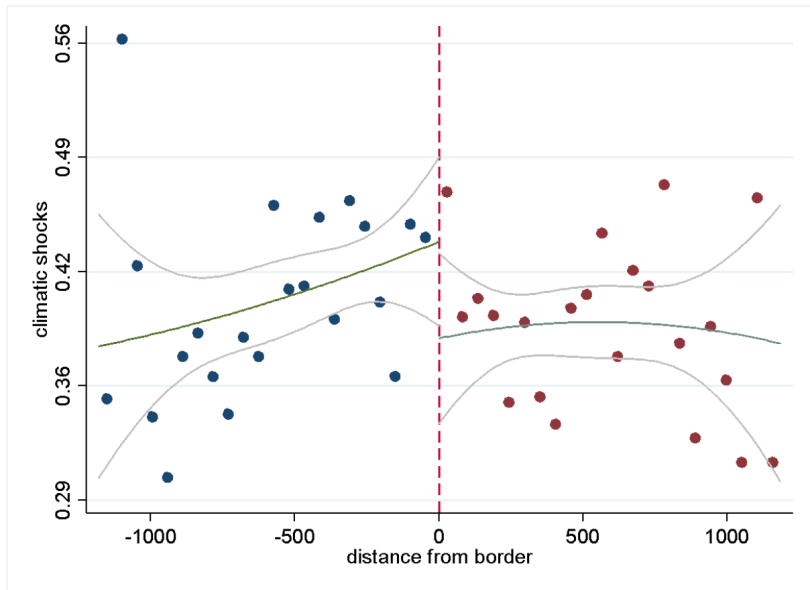
Policies in India and Nepal Takeup

Policy	India		Nepal	
Name of	% Aware	% Enrolled	% Aware	% Enrolled
PMKSY	9.18	1.60	0.0	0.0
District-level Contingency	9.78	0.60	0.0	0.0
PMKSN	88.82	56.29	0.0	0.0
Grameen Beej	9.38	0.20	0.0	0.0
Emergency & Early Recovery	0.00	0.00	0.6	0.0
Kisan I and II	0.00	0.00	0.6	0.0
AFSP	0.00	0.00	0.4	0.2
NAPA	0.00	0.00	0.00	0.00
NICRA	0.00	0.00	0.00	0.00

PMKSY stands for Pradhan Mantri Krishi Sinchai Yojana. District-level Contingency Plan includes controls for damages by climatic shocks like flood, drought, hailstorm, and many others.
PMKSN stands for Pradhan Mantri Krishi Samman Nidhi.
Grameen Beej Yojana provides high quality seeds to farmers.
Emergency and Early Recovery denotes the support provided to flood-affected households of Western Terai in Nepal.
Kisan I and II stands for Knowledge-Based Integrated Sustainable Agriculture in Nepal I and II.
AFSP denotes the Nepal Agriculture and Food Security Project.
National Adaptation Programme of Action (NAPA) helps to identify activities necessary to adapt to climate change.
NICRA stands for National Innovations on Climate Resilient Agriculture.
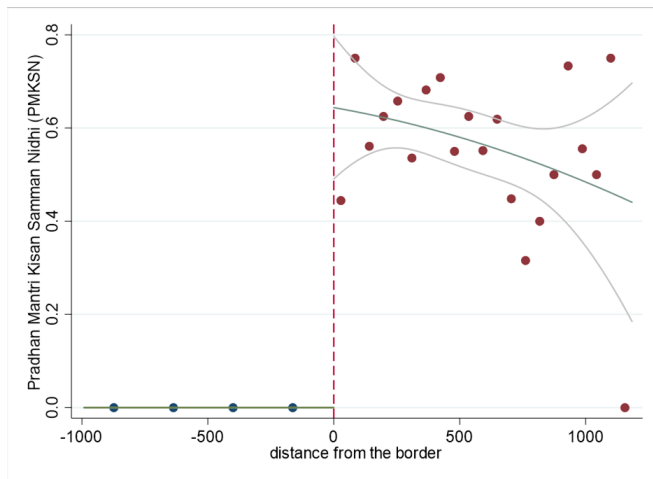
Credit Policy (PMKSN) Adoption

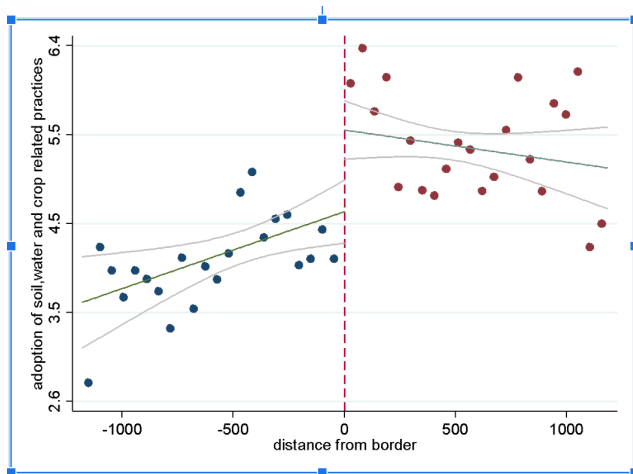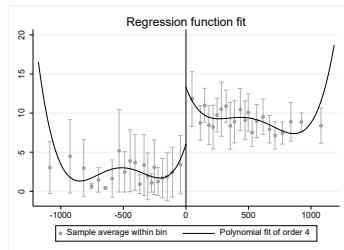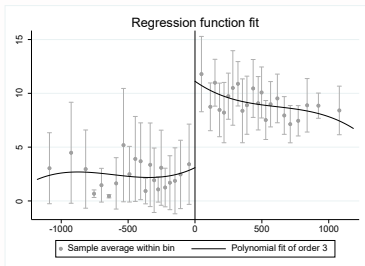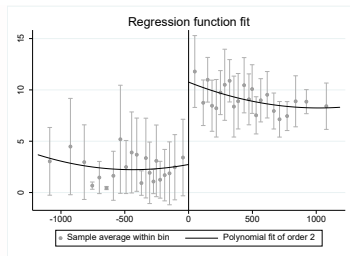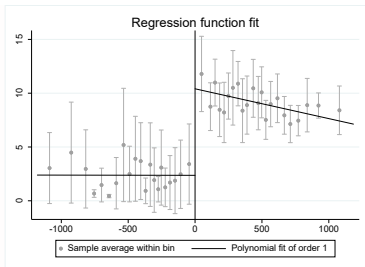Figure: Cash Transfer Policy Adoption

Practices

Figure: Soil, Water, and Crop Practices

Agricultural Outcomes

Productivity of Rice

Rice Yield- Non-Parametric

	Rice Yield (Quintal/Acre)		
	(1)	(2)	(3)
Variables:			
Treatment	7.597***	5.792***	4.632**
	(2.455)	(1.697)	(2.024)
Controls:			
Demographic and SES Controls	No	Yes	Yes
Adaptation Controls	No	No	Yes
N	242	390	297
Kernel	Uniform	Uniform	Uniform
Bandwidth Value	252.444	357.815	285.469

Rice Yield - Parametric (400 meters BW)

	Rice Yield (Quintal/Acre)					
	Linear			Quadratic		
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	7.710***	5.925***	4.957**	7.953**	5.554	5.390
	(1.711)	(1.801)	(2.018)	(3.656)	(3.600)	(3.745)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	438	438	438	438	438	438
R^2	0.26893	0.35083	0.36626	0.27179	0.35285	0.36878

Notes: Each regression controls for the interaction of the running and the treatment variable. Demographic and SES controls include gender, age, farm size, farm experience, education, shock index, and asset index of the farmers. Adaptation includes migration, agricultural expenses, livelihood schemes, awareness of smart climate practices, and other loans. Significance ***: 0.01, **: 0.05, *: 0.1. Robust standard errors in parentheses.

Climate Resilience Practices- Water (Non-Parametric)

	Water Practices		
	(1)	(2)	(3)
Treatment	0.473**	0.604**	0.794***
	(0.236)	(0.248)	(0.25)
Controls:			
Demographic and SES Controls	No	Yes	Yes
Adaptation Controls	No	No	Yes
N	195	190	168
Kernel	Uniform	Uniform	Uniform
Bandwidth Value	208.575	211.244	198.145

Water Practice

Micro-Irrigation

Climate Resilience Practices- Soil (Non-Parametric)

	Soil Practices		
	(1)	(2)	(3)
Treatment	0.383	0.827	0.499
	(0.593)	(0.637)	(0.628)
Controls:			
Demographic and SES Controls	No	Yes	Yes
Adaptation Controls	No	No	Yes
N	122	113	124
Kernel	Uniform	Uniform	Uniform
Bandwidth Value	150.611	146.314	156.847

Climate Resilience Practices- Crop (Non-Parametric)

	Crop Practices		
	(1)	(2)	(3)
Treatment	0.654*	0.703*	0.092
	(0.38)	(0.395)	(0.365)
Controls:			
Demographic and SES Controls	No	Yes	Yes
Adaptation Controls	No	No	Yes
N	229	203	183
Kernel	Uniform	Uniform	Uniform
Bandwidth Value	233.848	224.085	207.043

Rice Yield by Gender- Full Sample

| | Rice Yield (Quintal/Acre) | | | | | |
| | Linear | | | Quadratic | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	10.655***	7.016***	6.505***	10.888***	7.574***	6.847***
	(1.508)	(1.683)	(1.720)	(2.003)	(2.059)	(2.096)
Treatment $\times$ Gender	-2.697**	-1.298	-1.142	-2.611**	-1.194	-1.032
	(1.091)	(1.058)	(1.040)	(1.099)	(1.061)	(1.047)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	957	957	957	957	957	957
R^2	0.22713	0.31665	0.33674	0.22990	0.32016	0.34049

Notes: Each regression controls for the interaction of the running treatment variables. Demographic and SES controls include gender, age, farm size, farm experience, education, shock index, and asset index of the farmers. Adaptation includes migration, agricultural expenses, livelihood schemes, awareness of smart climate practices, and other loans. Significance ***: 0.01, **: 0.05, *: 0.1. Robust standard errors in parentheses.

PMKSN by Gender- Full Sample

| | PMKSN Adoption | | | | | |
| | | Linear | | | Quadratic | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.833***	0.747***	0.819***	0.906***	0.824***	0.879***
	(0.086)	(0.090)	(0.095)	(0.093)	(0.097)	(0.102)
Treatment × Gender	-0.219***	-0.174**	-0.174**	-0.213***	-0.166**	-0.167**
	(0.068)	(0.070)	(0.070)	(0.068)	(0.069)	(0.070)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	1,003	964	964	1,003	964	964
R^2	0.40466	0.42118	0.42782	0.40860	0.42648	0.43185

Notes: Each regression controls for the interaction of the running treatment variables. Demographic and SES controls include gender, age, farm size, farm experience, education, shock index, and asset index of the farmers. Adaptation includes migration, agricultural expenses, livelihood schemes, awareness of smart climate practices, and other loans. Significance ***: 0.01, **: 0.05, *: 0.1. Robust standard errors in parentheses.

Water Practices by Gender- Full Sample

| | Adoption of Water Practices | | | | | |
| | Linear | | | Quadratic | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.382***	0.385***	0.435***	0.533***	0.537***	0.558***
	(0.133)	(0.142)	(0.153)	(0.151)	(0.161)	(0.169)
Treatment × Gender	-0.297***	-0.252**	-0.245**	-0.286***	-0.240**	-0.233**
	(0.109)	(0.110)	(0.109)	(0.108)	(0.110)	(0.109)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	1,003	964	964	1,003	964	964
R^2	0.03656	0.05418	0.08598	0.04746	0.06494	0.09475

Notes: Each regression controls for the interaction of the running treatment variables. Demographic and SES controls include gender, age, farm size, farm experience, education, shock index, and asset index of the farmers. Adaptation includes migration, agricultural expenses, livelihood schemes, awareness of smart climate practices, and other loans. Significance ***: 0.01, **: 0.05, *: 0.1. Robust standard errors in parentheses.

Robustness

▶ Conduct RD validity tests

  1. Large number of demographic, SES, geographic balanced
     `Graphs`
  2. Running variable smooth `Mcrary Test`
  3. Placebo- no effect if the boundary 200 meters into India
     `Placebo Graph`

▶ Sensitivity Tests- robust to bandwidths, kernels, control
  functions
  `Tests`

▶ Alternate mechanisms - other policies, adaptation
  differentials, migration, remittances, supply constraints for
 inputs, input subsidies `Tests`

Conclusion

▶ Cash Transfers can facilitate the adoption of Climate resilience building agricultural practices

▶ Women might need to be targeted as they do not avail of policy-delivered cash transfers as much

▶ To this end, more research can help us learn how to target cash transfers better for women

Validity Checks
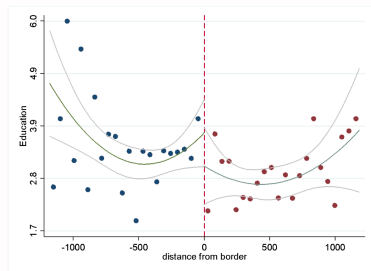
Demographic and SES Variables
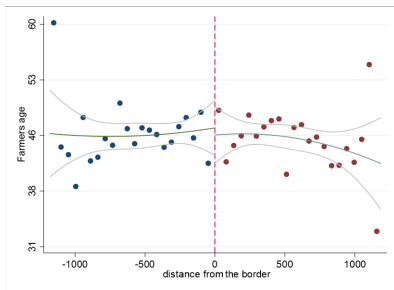
Farmer's Age
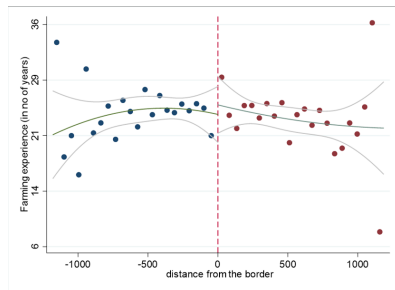
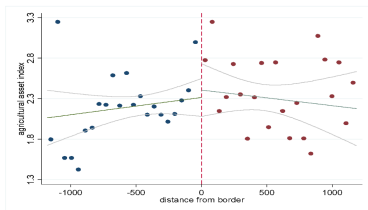F arming Experience (in Years)

Demographic and SES Variables
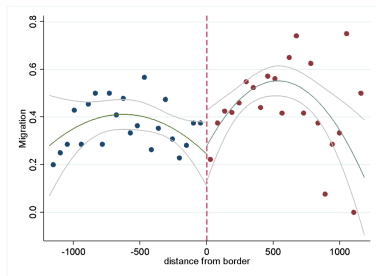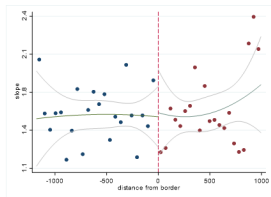

Migration

Education
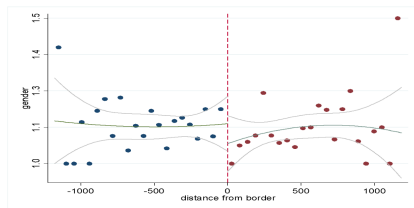
Agricultural Assets   Gender Female

Geography Variable Balance
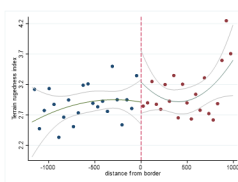
Slope   Terrain Ruggedness   Elevation
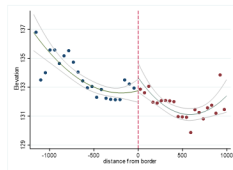
Adaptation
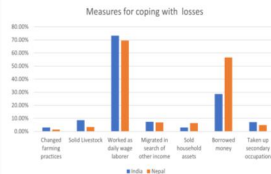
Remittances

McCrary's Test

Figure: Running Variable Discontinuity Check

Back:Robustness

Placebo Test

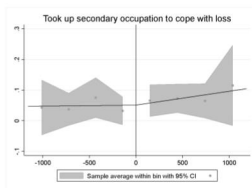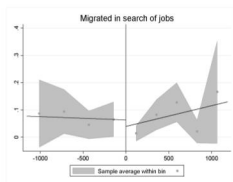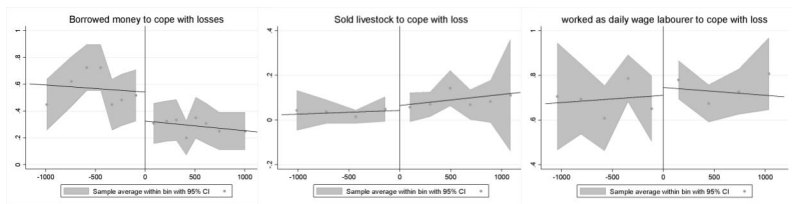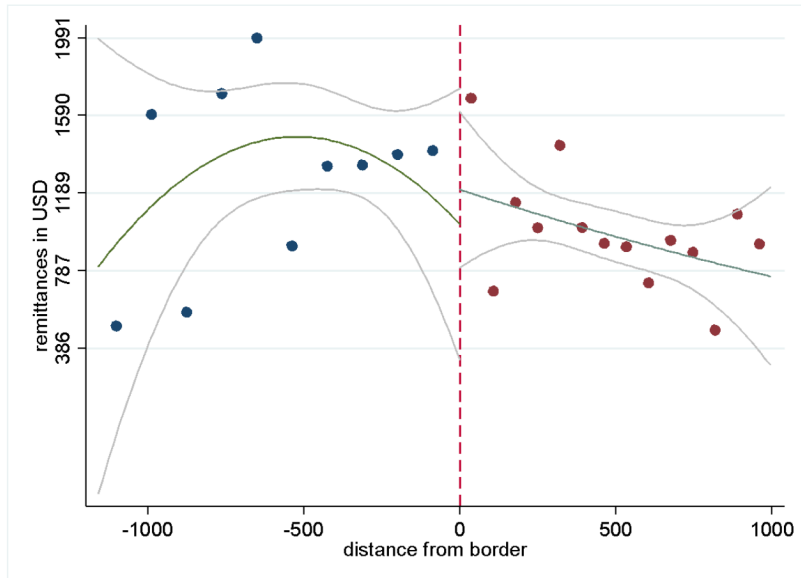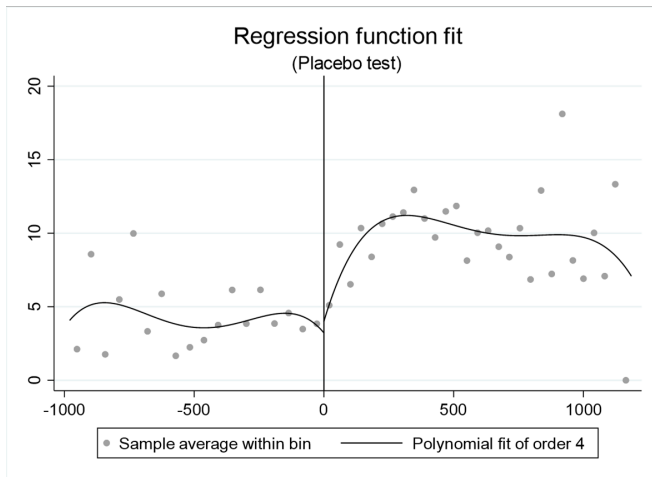
Figure: Rice Yield if Border is moved into India by 200 meters

Back:Robustness

Rice Yield- Robustness Kernel Triangular

	Rice Yield (Quintal/Acre)		
	(1)	(2)	(3)
Treatment	7.875**	5.769**	5.645**
	(3.383)	(2.634)	(2.566)
Controls:			
Demographic and SES Controls	No	Yes	Yes
Adaptation Controls	No	No	Yes
N	222	284	292
Kernel	Triangular	Triangular	Triangular
Bandwidth Value	241.258	276.924	281.13

Rice Yield- Full Sample

| | Rice Yield (Quintal/Acre) | | | | | |
| | Linear | | | Quadratic | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	7.684***	5.537***	5.200***	8.087***	6.227***	5.677***
	(0.866)	(1.003)	(1.084)	(1.369)	(1.406)	(1.480)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	957	957	957	957	957	957
R^2	0.22098	0.31580	0.33608	0.22413	0.31943	0.33995

Rice Yield- Alternate Specification Parametric (Full Sample)

| | Rice Yield (Quintal/Acre) | | | | | |
| | Linear | | | Quadratic | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	7.727***	5.533***	5.194***	7.747***	5.636***	5.268***
	(0.856)	(1.010)	(1.084)	(0.869)	(0.993)	(1.081)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	957	957	957	957	957	957
R^2	0.22070	0.31579	0.33605	0.22071	0.31631	0.33677

Rice Yield- Alternate Specification Parametric (Bandwidth 400 meters)

| | Rice Yield (Quintal/Acre) | | | | | |
| | | Linear | | | Quadratic | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	7.604***	5.867***	4.878**	7.662***	5.894***	4.923**
	(1.740)	(1.803)	(2.022)	(1.725)	(1.805)	(2.025)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	438	438	438	438	438	438
R^2	0.26561	0.34994	0.36513	0.26762	0.35032	0.36563

Back:Robustness

Rice Yield- Conley Errors Parametric (400mts BW)

| | Rice Yield (Quintal/Acre) | | | | | |
| | Linear | | | Quadratic | | |
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	7.710***	5.925***	4.957***	7.953***	5.554***	5.390**
	(1.338)	(1.317)	(1.774)	(2.283)	(1.884)	(2.103)
Adaptation Controls	No	No	Yes	No	No	Yes
Demographic and SES Controls	No	Yes	Yes	No	Yes	Yes
Observations	438	438	438	438	438	438
R^2	0.27	0.35	0.36	0.27	0.35	0.37

Conley (0.23km) standard-errors in parentheses

Back:Robustness

Climate-driven Risk Indicator
regional median, 25th and 75th percentiles
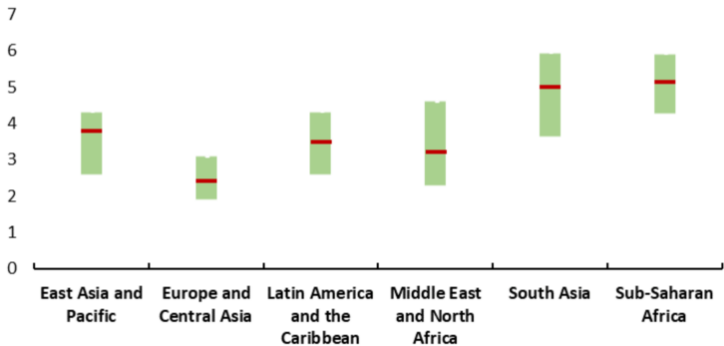
Source: IMF Climate Change Dashboard, Feyen et al. (2020), and World Bank calculations using a sample of 187 countries in 2020.

Back:Motivation