Shocks, Labor and Gender: Evidence from Panel Data in Rural India

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Extreme Weather Events

- Global warming has lead to rise in temperature

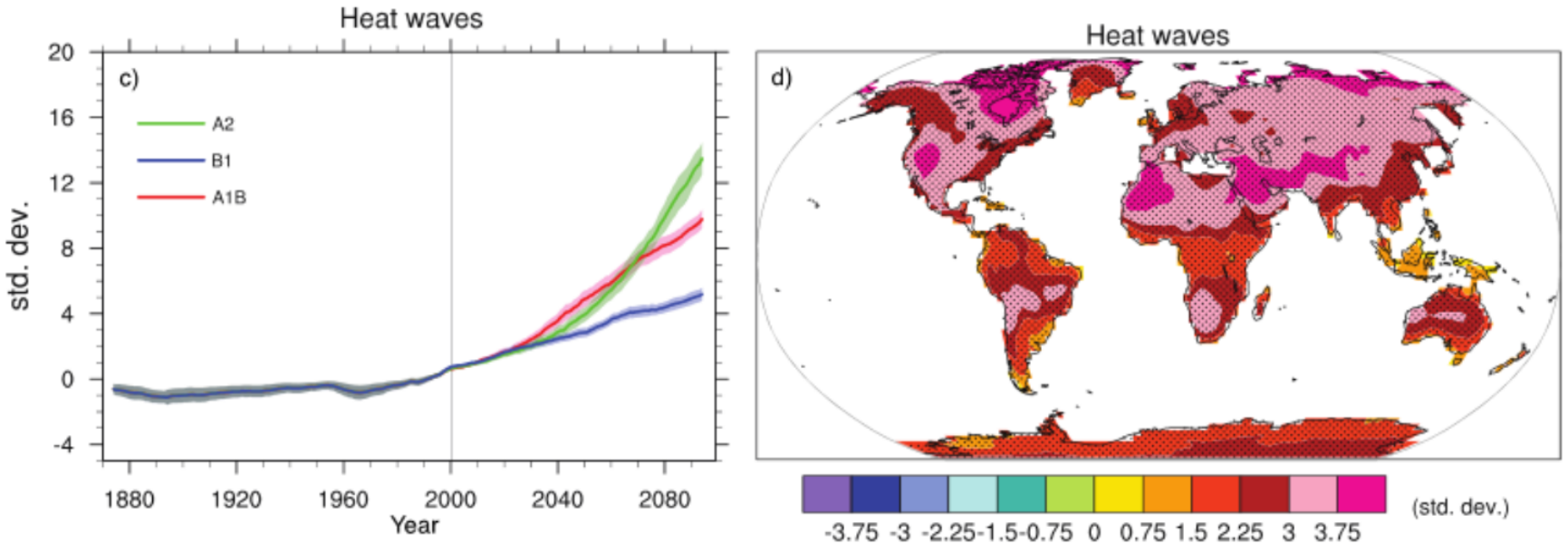
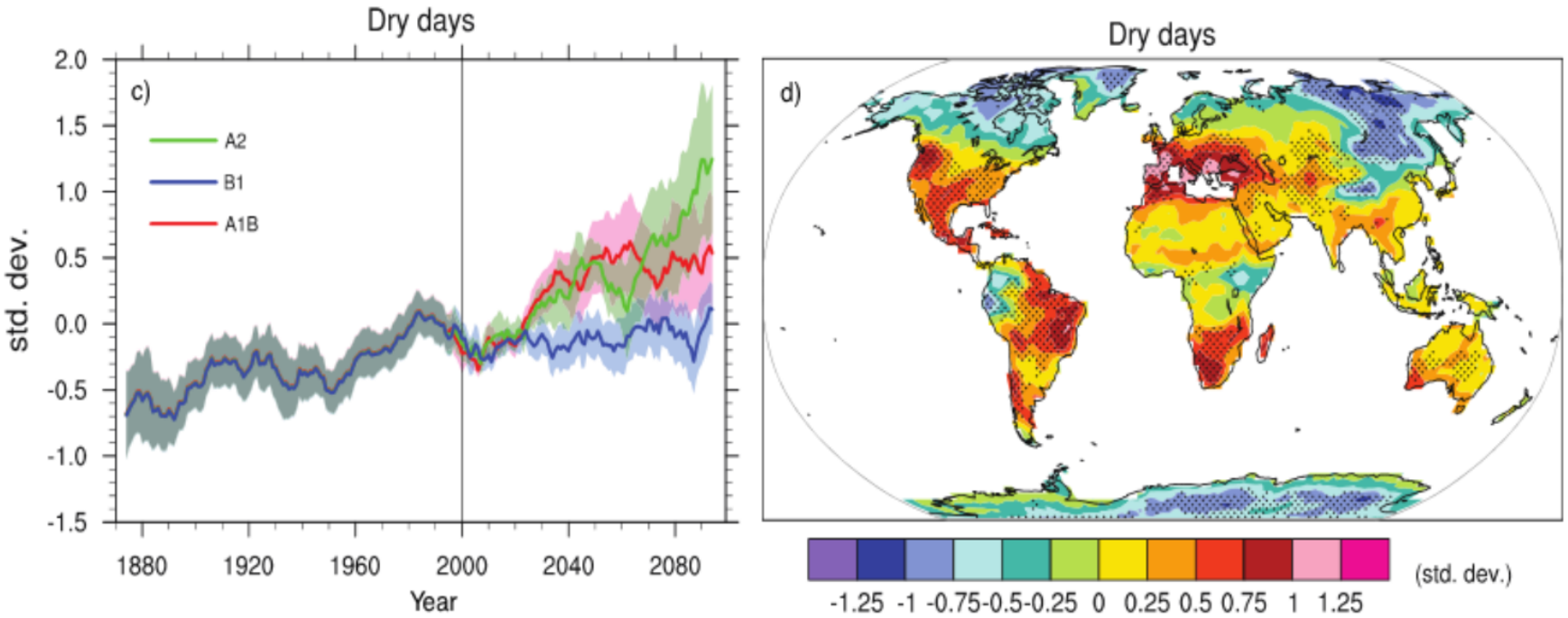


Figure: Source: IPCC Report

Motivation

- Accompanied by increased frequency of extreme weather events, including droughts, which are predicted to rise further if climate change continues unabated (World Bank 2013)



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Motivation

- In India a drought has been reported at least once every 3 yrs in last five decades (Mishra et al. 2009)

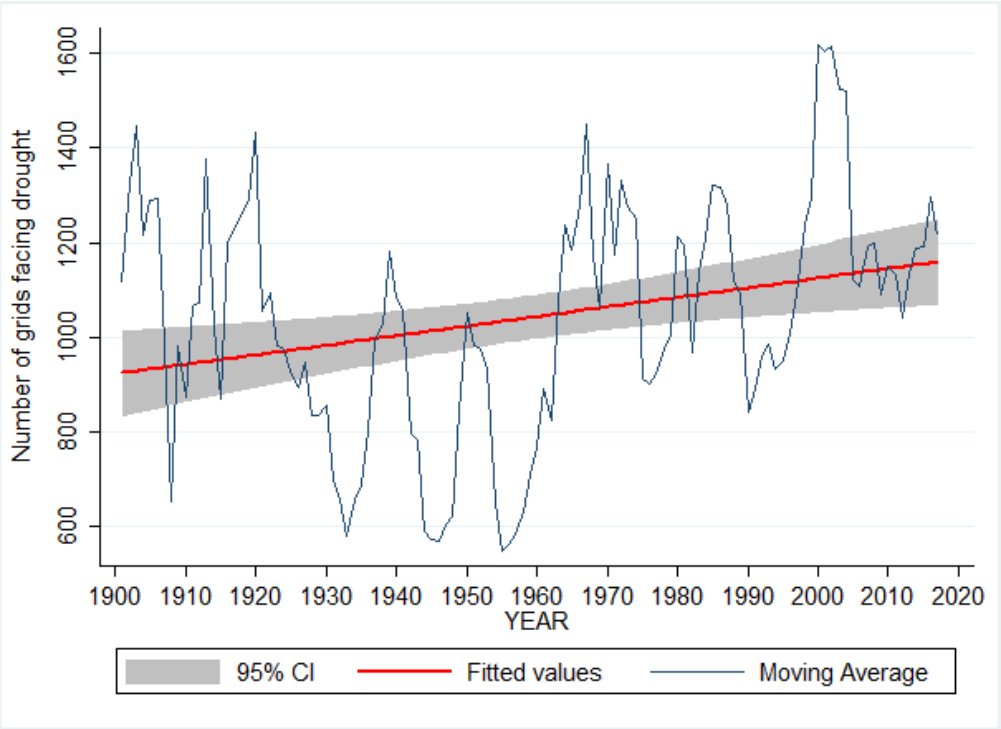

Figure: 5 yr MA of droughts in India 1901-2017 (Source: IMD)

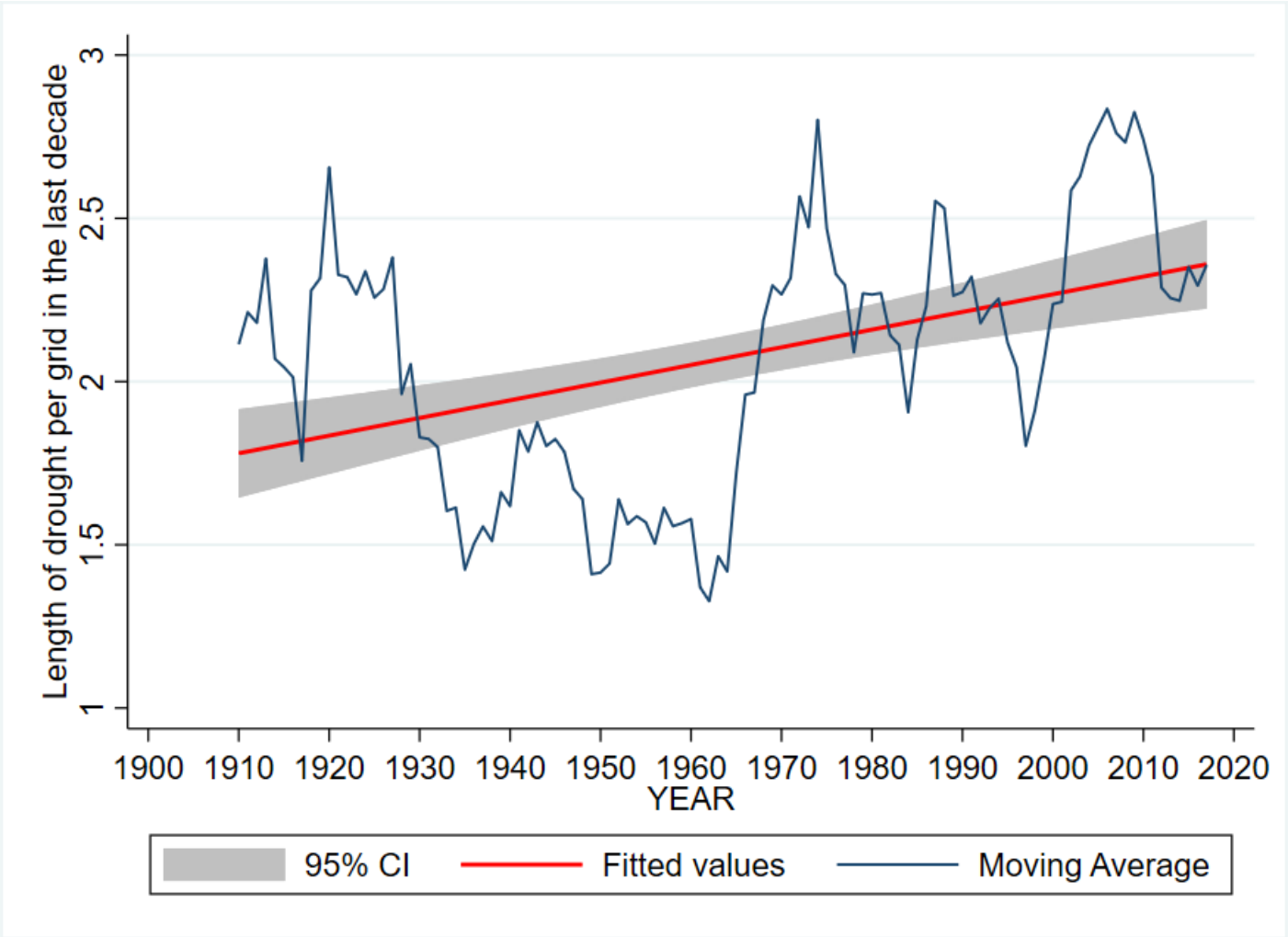

Figure: Five year moving average of length of droughts between 1901-2017 across India (Source: IMD)

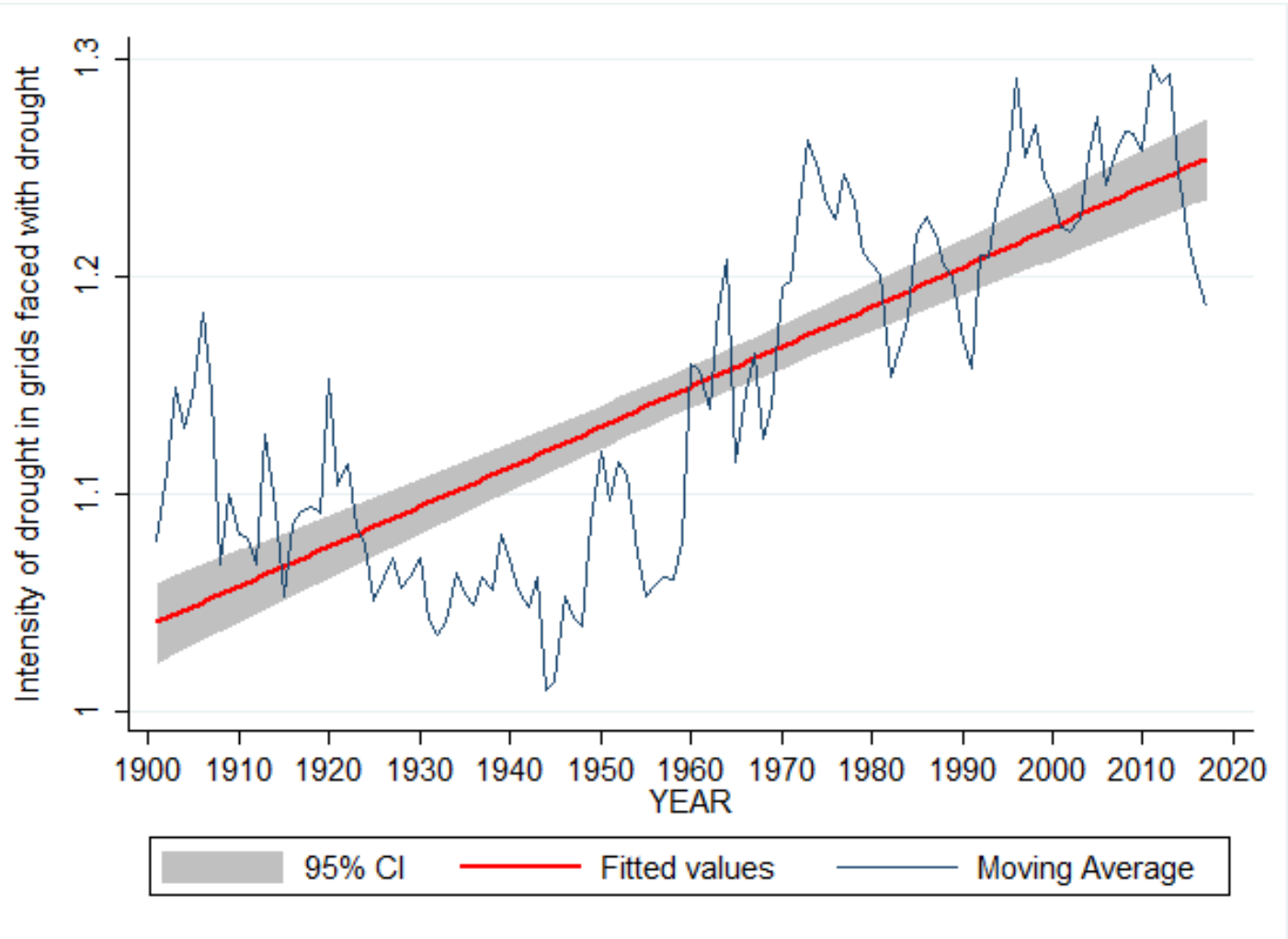

Figure: Five year moving average of intensity of droughts between 1901-2017 across India (Source: IMD)

Why does it matter?

- More than 75% of the world cropped area dependent on rain (India: 52%)
  - Drought hits agricultural output (Hertweck and Brey 2017), income (Yang 2007) and food security (Schlenker 2010)
- Significant proportion of the workforce is dependent on agriculture (India: 40%)
- Large gender disparities in employment rates (rural women: 35%, men 90%)
  - Of the employed rural women about to 75% are engaged in farm work

Reference

- **The Gendered Effects of Droughts: Production Shocks and Labor Response in Agriculture**
  Farzana Afridi (ISI Delhi), Kanika Mahajan (Ashoka University) and Nikita Sangwan (ISI Delhi)

- **Weather Shocks and Labour Use in Agriculture: A Gender Perspective**
  ongoing work

What we do?

- We use high frequency, household and individual level panel data that captures seasonal labor inputs during 2010-14 across 8 agro-climatic zones of India to understand the labour impacts of negative productivity shocks.
- Study individuals' labor response across farm and non-farm sectors to adverse productivity shocks, accounting for unobservable heterogeneity in their characteristics to analyse whether these impacts are gender neutral or not.
- What explains any observed gender differences in labor response?

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Existing Literature: Insufficient gender lens

- Yield, income of farm households adversely affected due to rainfall shocks (Fishman, 2011; Burke & Emerick 2016).
- Potential adverse effect on earnings: Rainfall shocks may reduce daily wage for labor (Hertweck & Brey 2017) but areas with greater access to non-farm opportunities see a lower reduction in real wages when droughts occur (Jayachandran 2006)
- Absence of social insurance and incomplete credit markets, diversification of labor to non-farm sector (Kochar 1999; Rose 2001; Emerick 2018)
- Permanent migration due to climatic shocks and gendered impacts (Dillon et al. (2011); Gray & Mueller (2012); Baez et al. (2017): Mixed evidence)

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- Short-term labor adjustments, men may be better placed to take advantage of available coping mechanisms (Heath & Mobarak, 2015; Andrabi et al., 2013) yet much less is known about gender differences
  - ⇒ No differential impact in take up of non-farm work by gender using retrospective employment history in China (Huang et al. (2020))
  - ⇒ Male urban employment increases more than female urban employment in China during low rainfall years (Minale (2018))

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Data

- Labour & agricultural data: Village Dynamics in South Asia (VDSA) longitudinal survey data by ICRISAT
  - 30 villages across 8 states, Semi-Arid Tropics (SAT) and Humid Tropics regions Map
  - 40 households per village, Agricultural year (July to June)
  - Data on employment, agricultural cultivation and inputs
  - Monthly employment and earnings of all individuals recorded as household members
  - Individual employment panel, 2010-14 (aged 15 and above, 5,931 individuals from 1,367 households)
    - Participation, Workdays, Earnings by sector, Workplace location

Summary Statistics

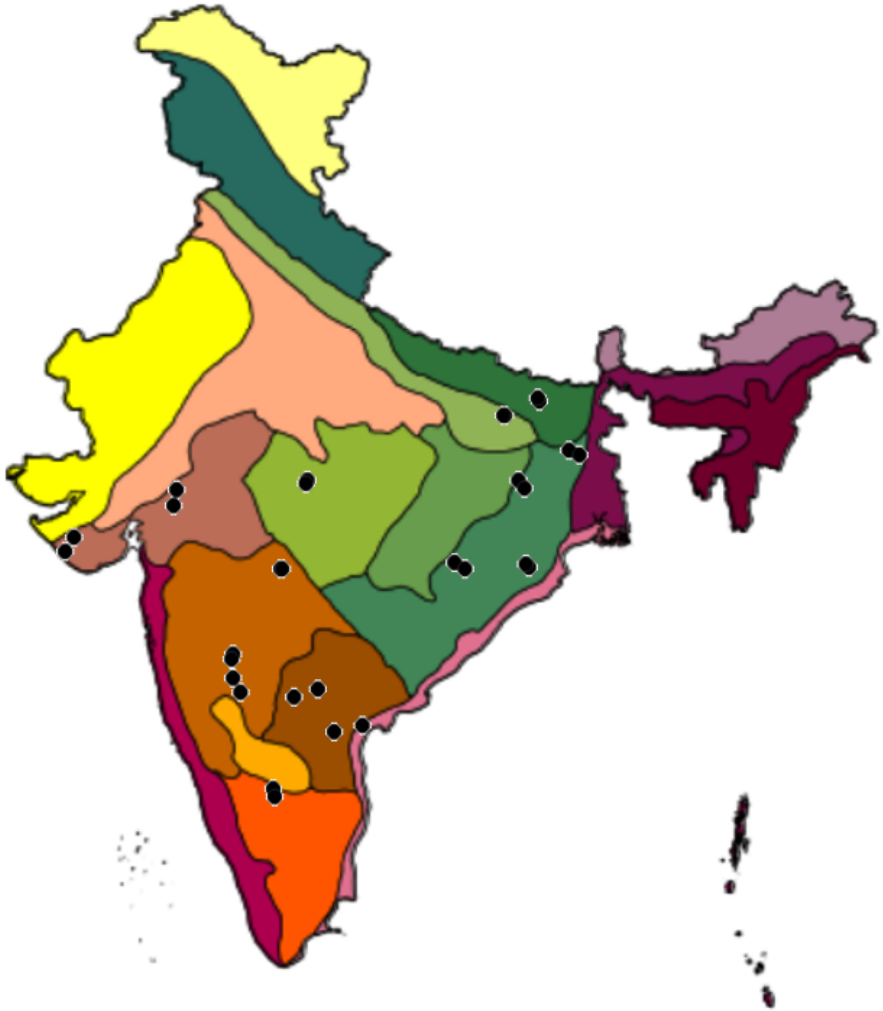

Figure: Location Map (Source: `http://vdsa.icrisat.ac.in/`)

Back

Data

- Climate Data: India Meteorological Department (IMD)
  - Daily gridded (0.25 x 0.25 degree) rainfall data (1971-2015)
  - Match the latitude-longitude of each sampled village to the nearest point on the grid
  - Drought: Monsoon rainfall (June-Sep) falls in the bottom two deciles of the long run average rainfall (1971-2014) for a village.
  - Is this a good measure?

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Drought: Farm Output and Productivity (ICRISAT)

	Rice		All Crops	
	ln(Output) (1)	ln(Yield) (2)	ln(Revenue) (3)	ln(Profit) (4)
Drought	-0.561**	-0.332*	-0.277	-0.495***
	(0.256)	(0.181)	(0.191)	(0.171)
Observations	114	114	11,606	11,606
R-squared	0.865	0.720	0.383	0.438
Mean Y	35067.19	4133.66	8404.209	-12540.13
Village FE	✓	✓		
Year FE	✓	✓	✓	✓
Household FE			✓	✓
Season FE			✓	✓
Other controls			✓	✓

Measure of drought accurately captures the scarcity of water

Empirical Strategy

$$y_{ihvmst} = \beta_0 + \beta_1 Drought_{vt} + \beta_2 X_{ihvst} + \delta Z_{hvt} + \pi S_{vt} + D_i + D_s + D_t + \epsilon_{ihvmst}$$

y_{ihvst}: outcome for individual i in household h, in village v, in month m, in season s and year t; for workdays and earnings using the Inverse Hyperbolic Sine (IHS) transformation

$Drought_{vt}$ =1 if a village v in year t faces a drought and zero otherwise

X_{ihvst}: individual characteristics (marital status)

Z_{hvt}: household level time-varying characteristics (demographic characteristics, index of real value of durables in the first year of the survey interacted with a linear time trend)

S_{vt}: upper two deciles of monsoon rainfall in a village in a given year

D_s: season fixed effect

D_t: year fixed effect

D_i: individual fixed effect

Standard errors clustered at the village-season level

Results: Overall Labor Market Outcomes

	Labor Force		Employed		Unemployed	
	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Intensive Margin (Workdays)						
Drought	-0.081	0.026	-0.153**	0.036	0.144*	-0.150*
	(0.082)	(0.047)	(0.073)	(0.048)	(0.079)	(0.089)
Difference	-0.107*		-0.190***		0.294***	
	(0.059)		(0.055)		(0.082)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.679	0.642	0.675	0.628	0.330	0.369

Greater fall in women's LFP relative to men's

Results: Work by sector

	Farm						Livestock		Non-farm	
	Total		Paid		Family		Family			
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)	Female (9)	Male (10)
Panel A: Intensive Margin (Workdays)										
Drought	-0.052	-0.068	0.016	-0.137**	-0.053	-0.039	-0.210***	-0.020	0.024	0.225***
	(0.092)	(0.079)	(0.051)	(0.058)	(0.086)	(0.073)	(0.080)	(0.074)	(0.066)	(0.061)
Difference	0.016		0.153**		-0.015		-0.189**		-0.201***	
	(0.076)		(0.065)		(0.077)		(0.085)		(0.071)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.615	0.613	0.623	0.527	0.605	0.632	0.678	0.687	0.629	0.704

Men diversify to non-farm sector from farm sector, women do not

Results: Monthly Wage Earnings

	Monthly Earnings				Monthly Earnings (Conditional)				Daily Wage Rate			
	Paid Farm		Non-farm		Paid Farm		Non-farm		Paid Farm		Non-farm	
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)	Female (9)	Male (10)	Female (11)	Male (12)
Drought	0.005	-0.185***	-0.010	0.175**	-0.381***	-0.034	-0.100	-0.090**	-0.114***	0.036	-0.073	-0.081***
	(0.056)	(0.064)	(0.072)	(0.075)	(0.079)	(0.106)	(0.092)	(0.040)	(0.037)	(0.059)	(0.048)	(0.029)
Difference	0.189**		-0.186**		-0.347***		-0.010		-0.151**		0.008	
	(0.073)		(0.085)		(0.119)		(0.083)		(0.065)		(0.051)	
Observations	134,709	145,202	134,709	145,202	23,647	17,627	16,645	67,809	23,647	17,627	16,645	67,809
R-squared	0.622	0.526	0.642	0.723	0.425	0.498	0.725	0.728	0.619	0.628	0.777	0.781

Conditional on working women experience a relatively larger fall in farm wage rates

Mechanism: Mobility

- Mobility
  - Analyses of work location
  - Gender Norms (burden of home production and sexual purity)
    - Heterogeneity checks

Mechanisms: Place of Work

	Within Village		Outside Village		Migration		Distance to Work	
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)
Drought	0.004	-0.010	-0.000	0.017***	0.001	0.008**	-0.012	0.199***
	(0.006)	(0.006)	(0.003)	(0.006)	(0.001)	(0.003)	(0.028)	(0.074)
Difference	0.014**		-0.018***		-0.007**		-0.211***	
	(0.007)		(0.006)		(0.003)		(0.071)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.659	0.603	0.588	0.675	0.643	0.721	0.606	0.701
Mean Y	0.25	0.29	0.04	0.29	0.02	0.13	77.10	2179.13

Men cast a wider network in search of work relative to women

Potential Role of Social Protection: Employment Guarantee

	VDSA		NREGS Portal	
	Female (1)	Male (2)	Female (3)	Male (4)
Drought	0.127	0.011	0.370***	0.335***
	(0.157)	(0.276)	(0.074)	(0.073)
Difference	0.115		0.035*	
	(0.243)		(0.019)	
Observations	5,195	5,641	405,105	405,105
R-squared	0.640	0.521	0.700	0.697
Mean Y	3.6	3.39	2774.52	3394.71
Individual FE	✓	✓		
Year FE	✓	✓	✓	✓
GP FE			✓	✓
Other controls	✓	✓	✓	✓

Provision of employment close to home helps women cope with negative income shocks more than men

Summary

Extreme weather events have gendered effects if women's labor mobility is constrained

- Men substitute to non-farm work in response to drought shocks.
- Women drop-out of labor force entirely, while of those working, disproportionately more women are engaged in riskier agricultural work.
- Persistent extreme weather events due to climate change may exacerbate existing gender inequities in the labor market.
- Policy that mitigates production risks in agriculture should have a gender focus, e.g. job guarantees (NREGA), can help women cope with such shocks.

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APPENDIX

Results: Overall

	Labor Force		Employed		Unemployed	
	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Extensive Margin (Participation)						
Drought	-0.006	0.006*	-0.012*	0.005	0.016*	-0.016
	(0.007)	(0.003)	(0.006)	(0.003)	(0.008)	(0.010)
Difference	-0.012**		-0.017***		0.032***	
	(0.006)		(0.005)		(0.009)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.654	0.569	0.651	0.560	0.295	0.348
Mean Y	0.69	0.92	0.68	0.92	0.06	0.1
Panel B: Intensive Margin (Workdays)						
Drought	-0.081	0.026	-0.153**	0.036	0.144*	-0.150*
	(0.082)	(0.047)	(0.073)	(0.048)	(0.079)	(0.089)
Difference	-0.107*		-0.190***		0.294***	
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Drought	-0.009	-0.003	0.005	-0.016***	-0.011	-0.002	-0.016*	0.003	0.003	0.021***
	(0.010)	(0.008)	(0.005)	(0.006)	(0.010)	(0.008)	(0.009)	(0.009)	(0.006)	(0.005)
Difference	-0.005		0.021***		-0.009		-0.019**		-0.018***	
	(0.008)		(0.007)		(0.008)		(0.009)		(0.007)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.603	0.582	0.611	0.519	0.596	0.598	0.681	0.669	0.612	0.690
Mean Y	0.45	0.54	0.18	0.12	0.36	0.5	0.42	0.44	0.12	0.47
Panel B: Intensive Margin (Workdays)										
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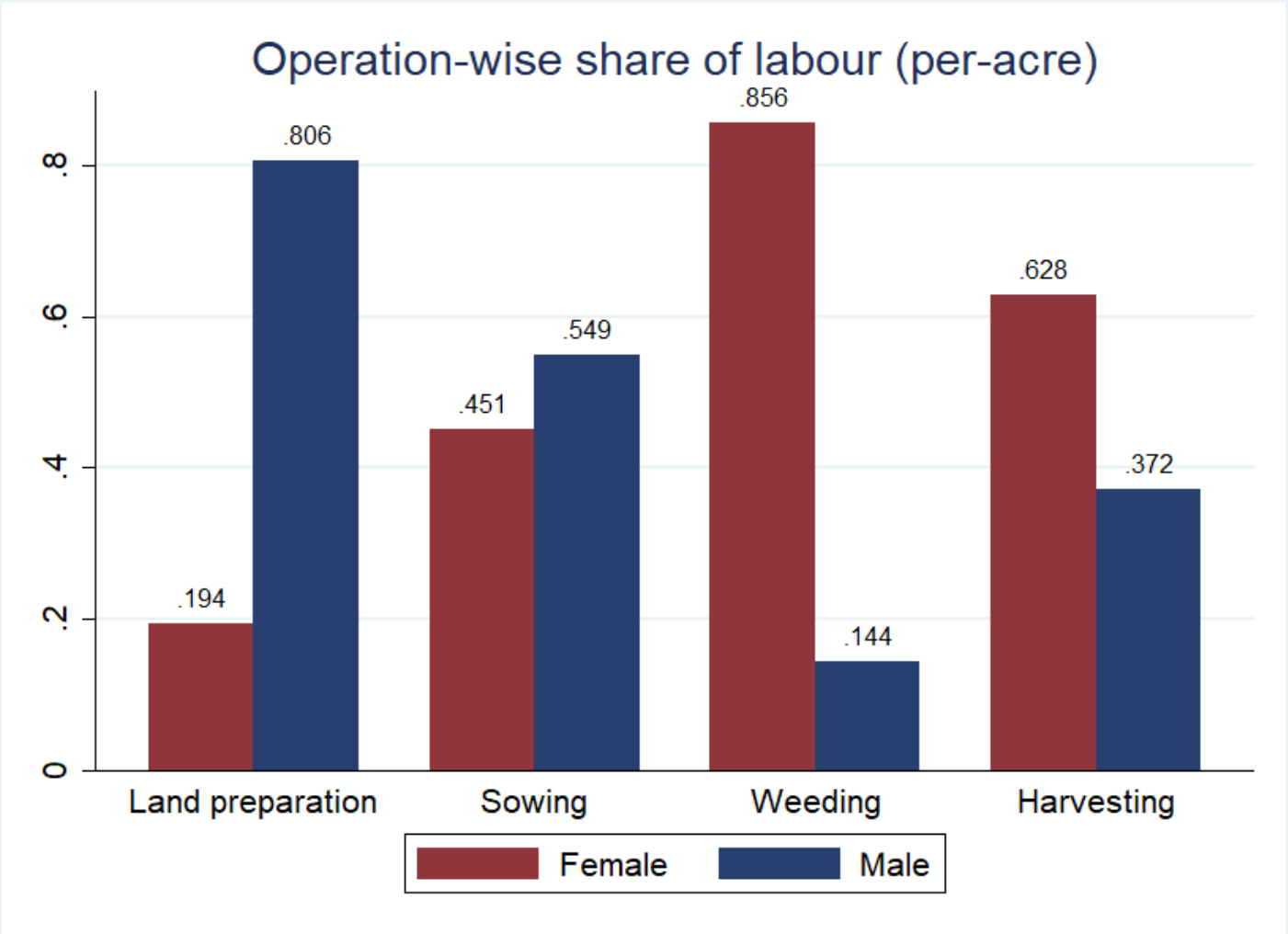
EXTENSIONS

Labor demand (per-acre)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Overall		Family Farm		Hired Farm	
	Total	Female	Male	Female	Male	Female	Male
Drought	-0.172***	-0.422***	-0.0435	-0.243*	-0.0685	-0.381***	0.161
	(0.0491)	(0.0805)	(0.0630)	(0.128)	(0.0749)	(0.123)	(0.123)
Difference		-0.379***		-0.175		-0.541***	
		(0.101)		(0.122)		(0.150)	
Observations	8,653	8,653	8,653	8,653	8,653	8,653	8,653
R-squared	0.561	0.526	0.578	0.707	0.644	0.503	0.530

Greater fall in demand for female labor. Driven by a greater fall in hired labor


Operation-wise share of labour (per-acre)
0
.2
.4
.6
.8
.194
.806
.451
.549
.856
.144
.628
.372
Land preparation
Sowing
Weeding
Harvesting
Female
Male

Results: Labor demand by operation (per-acre)

Operation	Preparation		Sowing		Weeding		Harvesting	
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)
Drought	-0.0262	0.107	0.114	0.168*	-0.613***	-0.243**	-0.453***	-0.00973
	(0.101)	(0.110)	(0.105)	(0.0981)	(0.160)	(0.0955)	(0.128)	(0.138)
Difference	-0.133		-0.0534		-0.370**		-0.443***	
	(0.174)		(0.0990)		(0.164)		(0.167)	
Observations	8,653	8,653	8,653	8,653	8,653	8,653	8,653	8,653
R-squared	0.438	0.541	0.455	0.478	0.501	0.405	0.440	0.413
Mean Y	13.55	37.62	12.5	13.88	91.37	16.46	149.55	71.47

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Table 6
Effect of women's workdays on household expenditure (per-capita).

Categories	Food (1)	Non-food (2)	Education (3)	Medical (4)	Addiction (5)	Fuel/Energy (6)
Paid Workdays	0.0073**	−0.0292***	0.0169	−0.0574***	−0.0345***	−0.0030
	(0.0031)	(0.0063)	(0.0185)	(0.0133)	(0.0105)	(0.0048)
Unpaid Workdays	0.0170***	−0.0068	0.0273	−0.0237	0.0018	0.0043
	(0.0030)	(0.0066)	(0.0194)	(0.0151)	(0.0116)	(0.0047)
Observations	12,375	12,375	12,375	12,375	12,375	12,375
R-squared	0.7883	0.5303	0.5870	0.4129	0.7005	0.7289
p-val[Paid = Unpaid]	0.01	0	0.64	0.04	0.01	0.19
Controls	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓	✓

Source: http://vdsa.icrisat.ac.in/VDSA micro level household data (2009–2014).
Note: All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. The row 'p-val[Paid = Unpaid]' reports the p-value of the test of difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Results: Decision-making within the household

VARIABLES	Women decision	Men Decision	Joint decision
Drought	-0.092***	0.061	0.176**
	(0.032)	(0.072)	(0.073)
Observations	4,256	4,256	4,256
R-squared	0.621	0.444	0.462

Fall in decisions made independently by women and increased joint-decision making

Work in progress

- Examine the labor responses of all members of the household (Inter-sectionality of gender, age, caste)
- Persistence of the impact of weather shocks
- Role of mechanisation as a coping strategy

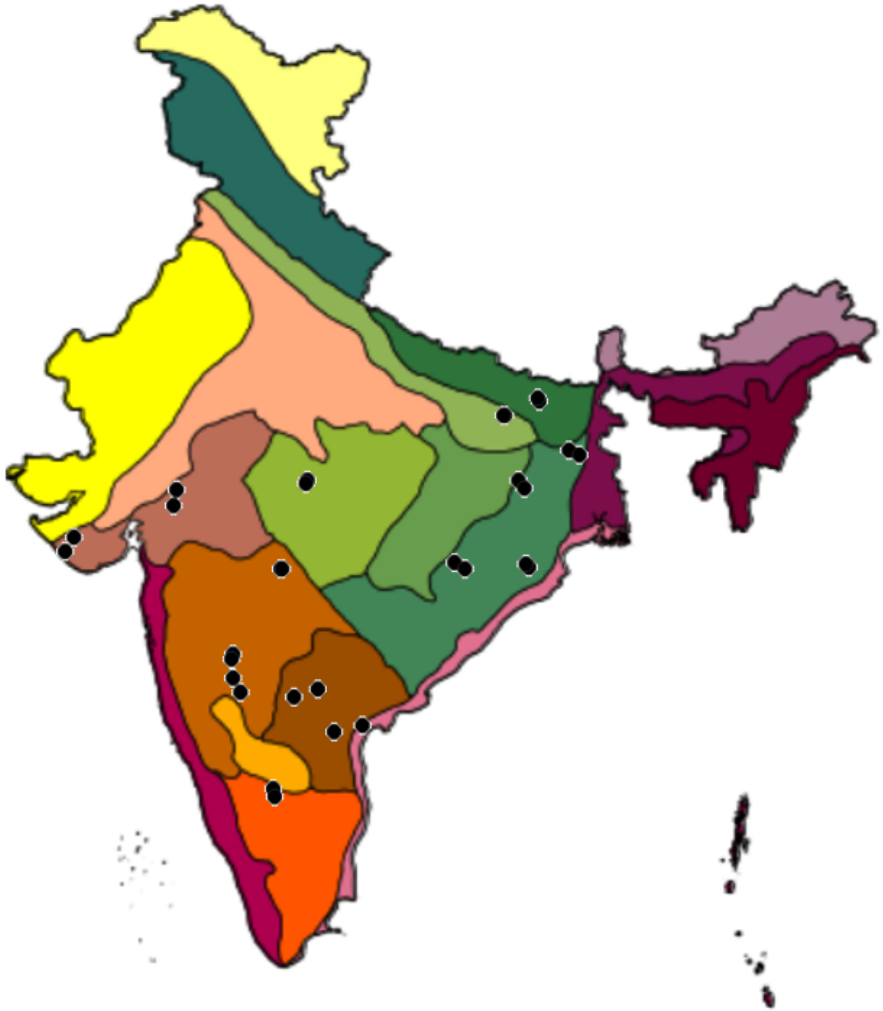

Figure: Location Map (Source: `http://vdsa.icrisat.ac.in/`)

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Alternative Mechanisms: Skills (VDSA, ICRISAT)

	Unskilled		Skilled		Business/Salaried	
	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)
Drought	0.002	0.106**	0.029	0.061	-0.038	0.039
	(0.017)	(0.047)	(0.030)	(0.044)	(0.040)	(0.036)
Difference	-0.104**		-0.032		-0.078	
	(0.044)		(0.050)		(0.048)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.448	0.585	0.558	0.644	0.654	0.711
Individual FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Other controls	✓	✓	✓	✓	✓	✓

Skill deficit doesn't explain the results

Alternative Mechanisms: Safety (NSS)

District characteristic (Z):	Crime Measure 1		Crime Measure 2	
	Female (1)	Male (2)	Female (3)	Male (4)
(A) Drought	-0.028	0.066	-0.031	0.066
	(0.026)	(0.043)	(0.026)	(0.043)
(B) Z x Drought	0.059	0.057	0.063	0.058
	(0.043)	(0.059)	(0.043)	(0.059)
Difference (A)	-0.094		-0.097	
	[0.03]		[0.02]	
Difference ((A)+(B))	-0.092		-0.092	
	[0.03]		[0.03]	
Observations	415,987	419,512	415,987	419,512
R-squared	0.078	0.149	0.078	0.149
Mean (Z=0)	0.47	2.37	0.46	2.36
Mean (Z=1)	0.58	2.42	0.59	2.42
District FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Other controls	✓	✓	✓	✓

Safety concerns don't explain the results

Table: Effect of Drought on Workdays: Robustness

	Employed		Farm				Livestock		Non-farm	
			Paid		Family		Family			
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)	Female (9)	Male (10)
Panel A: Balanced Sample										
Drought	-0.200**	-0.004	-0.015	-0.155**	-0.035	-0.029	-0.257***	-0.053	0.029	0.178***
	(0.084)	(0.047)	(0.056)	(0.070)	(0.094)	(0.072)	(0.096)	(0.085)	(0.077)	(0.061)
Difference	-0.196***		0.140*		-0.007		-0.205**		-0.149*	
	(0.066)		(0.075)		(0.080)		(0.097)		(0.078)	
Observations	97,025	109,295	97,025	109,295	97,025	109,295	97,025	109,295	97,025	109,295
R-squared	0.644	0.525	0.627	0.522	0.603	0.636	0.669	0.693	0.627	0.700
Panel B: Unconditional Sample										
Drought	-0.107	0.028	0.020	-0.141**	-0.038	-0.053	-0.170**	-0.033	0.033	0.234***
	(0.076)	(0.053)	(0.050)	(0.056)	(0.083)	(0.073)	(0.080)	(0.075)	(0.064)	(0.057)
Difference	-0.135**		0.160**		0.015		-0.137		-0.202***	
	(0.059)		(0.063)		(0.075)		(0.089)		(0.065)	
Observations	140,184	151,608	140,184	151,608	140,184	151,608	140,184	151,608	140,184	151,608
R-squared	0.652	0.592	0.615	0.520	0.601	0.627	0.662	0.670	0.607	0.683
Panel C: Village-specific annual trends										
Drought	-0.129*	0.021	-0.017	-0.067	-0.056	-0.005	-0.123*	-0.107*	0.002	0.136**
	(0.074)	(0.038)	(0.046)	(0.048)	(0.081)	(0.077)	(0.070)	(0.056)	(0.057)	(0.054)
Difference	-0.149***		0.051		-0.051		-0.015		-0.134**	
	(0.056)		(0.065)		(0.051)		(0.062)		(0.064)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.680	0.633	0.628	0.533	0.615	0.639	0.685	0.696	0.632	0.708

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Table: Effect of Drought on Workdays: Robustness (Additional Specifications)

	Lagged shocks				Temperature and its square			
	Paid Farm		Non-farm		Paid Farm		Non-farm	
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)
Drought	0.011	-0.179***	0.048	0.211***	0.006	-0.139*	-0.006	0.230***
	(0.058)	(0.066)	(0.081)	(0.073)	(0.066)	(0.076)	(0.088)	(0.071)
Lag Drought	0.100	0.011	-0.008	-0.141*				
	(0.064)	(0.066)	(0.053)	(0.079)				
$Temp$					0.002	0.006	0.005	-0.005
					(0.003)	(0.004)	(0.004)	(0.003)
$Temp^2$					-0.000	-0.000**	-0.000	0.000*
					(0.000)	(0.000)	(0.000)	(0.000)
Difference	0.190***		-0.163*		0.145*		-0.237***	
	(0.069)		(0.093)		(0.078)		(0.082)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.624	0.527	0.629	0.704	0.623	0.527	0.629	0.704

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Table: Effect of Drought on Workdays: Robustness (Alternative measures)

	Drought Measure 1				Drought Measure 2			
	Paid Farm		Non-farm		Paid Farm		Non-farm	
	Female (1)	Male (2)	Female (3)	Male (4)	Female (5)	Male (6)	Female (7)	Male (8)
Drought	0.002	0.049	-0.023	0.101**	-0.000	-0.003***	-0.000	0.003**
	(0.040)	(0.040)	(0.034)	(0.048)	(0.001)	(0.001)	(0.001)	(0.001)
Difference	-0.047		-0.124***		0.003***		-0.003**	
	(0.047)		(0.042)		(0.001)		(0.001)	
Observations	134,709	145,202	134,709	145,202	134,709	145,202	134,709	145,202
R-squared	0.623	0.526	0.629	0.704	0.623	0.527	0.629	0.704

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