Way Down in the Hole

Adaptation to Long-Term Water Loss in Rural India
Blakeslee, Fishman & Srinivasan (AER 2020)

EEE READING GROUP

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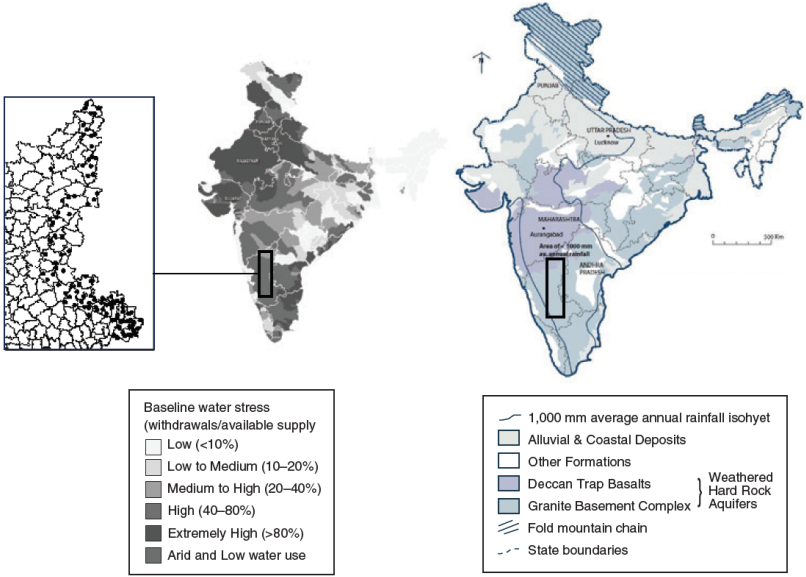
November 12, 2020

How do people adapt to *long term* changes in the environment?

- Adaption to weather may look different than adaptation to climate change
- Short term coping mechanisms might not be sustainable in the long-run
- What do these adaptive responses to long run changes reveal about the likely impacts of future climate change? Is the outlook better off or worse off?

Today: long-term evidence from water stress in India

- Utilizes quasi-experimental variation in underlying hydrogeology which induces a change in probability of facing water shortage at the *household* level
- Compares households within a village who have operational borewell vs. those whose first borewell failed
- Examines how households differ $\approx$ 10 years later


Baseline water stress
(withdrawals/available supply
Low (<10%)
Low to Medium (10–20%)
Medium to High (20–40%)
High (40–80%)
Extremely High (>80%)
Arid and Low water use
1,000 mm average annual rainfall isohyet
Alluvial & Coastal Deposits
Other Formations
Deccan Trap Basalts
Granite Basement Complex
Weathered Hard Rock Aquifers
Fold mountain chain
State boundaries
PUNJAB
UTTAR PRADESH
Lucknow
MAHARASHTRA
Aurangabad
Area of 1000 mm annual rainfall
ANDHRA PRADESH
0
500 Km

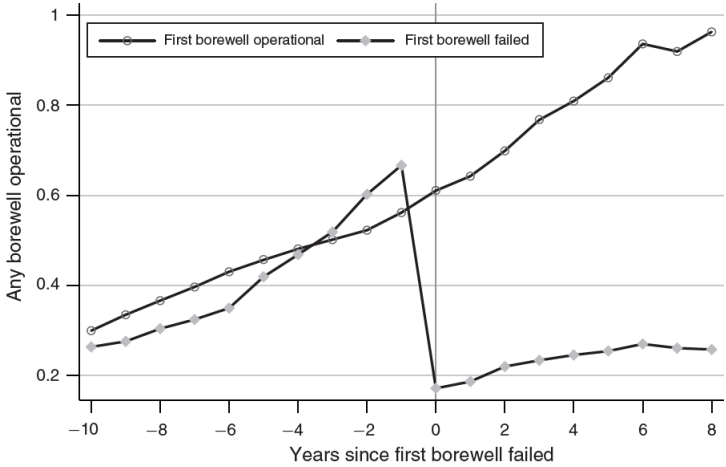


FIGURE 4. BOREWELL FAILURE AND ACCESS TO WATER OVER TIME

TABLE 3—WATER ACCESS AND AGRICULTURE

	Control mean	Impact of BW failure	
	(1)	(2)	(3)
Panel A. Water use			
Operational borewell	1.000	−0.626	−0.634
		[0.027]	[0.026]
Irrigation, rainy season (any)	0.701	−0.443	−0.458
		[0.031]	[0.029]
Irrigation, dry season (any)	0.508	−0.332	−0.336
		[0.035]	[0.034]
Irrigation, dry season (pct. land)	0.317	−0.218	−0.210
		[0.028]	[0.028]
Panel B. Rainy season			
Any cultivation	0.993	−0.020	−0.021
		[0.009]	[0.009]
Total land (acres)	4.451	−0.093	−0.124
		[0.219]	[0.266]
Field crops (acres)	3.730	0.190	0.179
		[0.209]	[0.250]
Horticulture (acres)	0.720	−0.282	−0.303
		[0.096]	[0.099]
Panel C. Dry season			
Any cultivation	0.596	−0.286	−0.303
		[0.037]	[0.038]
Total land (acres)	1.204	−0.466	−0.479
		[0.239]	[0.249]
Field crops (acres)	0.826	−0.291	−0.286
		[0.182]	[0.211]
Horticulture (acres)	0.378	−0.175	−0.193
		[0.098]	[0.089]

TABLE 4—LABOR REALLOCATION

	Control mean	Impact of BW failure	
	(1)	(2)	(3)
Panel A. Rainy season			
Occupations per member	1.380	−0.005	−0.013
		[0.047]	[0.044]
Fraction of HH members			
Working on own farm	0.527	−0.040	−0.048
		[0.024]	[0.024]
Working off-farm, agriculture	0.102	0.049	0.048
		[0.019]	[0.020]
Working off-farm, non-agriculture	0.038	0.026	0.027
		[0.011]	[0.012]
Not working	0.100	0.014	0.019
		[0.012]	[0.012]
Panel B. Dry season			
Occupations per member	1.375	−0.025	−0.026
		[0.047]	[0.044]
Fraction of HH members			
Working on own farm	0.489	−0.094	−0.104
		[0.025]	[0.025]
Working off-farm, agriculture	0.119	0.061	0.064
		[0.021]	[0.021]
Working off-farm, non-agriculture	0.045	0.040	0.042
		[0.012]	[0.014]
Not working	0.102	0.022	0.029
		[0.014]	[0.014]
Panel C. Location			
Fraction of HH members			
Semi-permanent migrant	0.010	0.013	0.014
		[0.006]	[0.007]
Non-migrant working outside village			
Rainy season	0.058	0.030	0.027
		[0.013]	[0.014]
Dry season	0.060	0.028	0.028
		[0.013]	[0.014]

TABLE 5—CHILD EMPLOYMENT AND SCHOOLING

	Control mean	Impact of BW failure	
	(1)	(2)	(3)
Children, 6–11 years old			
Fraction enrolled	0.542	0.120	0.122
		[0.058]	[0.060]
Fraction employed	0.005	−0.002	−0.004
		[0.003]	[0.005]
Children, 12–18 years old			
Fraction enrolled	0.817	−0.096	−0.110
		[0.043]	[0.042]
Fraction employed	0.130	0.052	0.073
		[0.034]	[0.037]
Village fixed effects		Yes	Yes
First-BW year-drilled fixed effects			Yes

TABLE 6—INCOME

	Control mean	Impact of BW failure	
	(1)	(2)	(3)
Any income			
On-farm	0.800	0.002	0.003
		[0.024]	[0.026]
Government transfers	0.204	0.004	0.028
		[0.031]	[0.033]
Business	0.039	−0.004	−0.010
		[0.012]	[0.012]
Remittances	0.062	0.002	0.009
		[0.019]	[0.020]
Off-farm employment	0.291	0.084	0.118
		[0.038]	[0.038]
Income (1,000 Rs.)			
On-farm	59.141	−16.684	−14.083
		[5.854]	[6.325]
Off-farm	21.850	8.623	12.182
		[5.549]	[6.017]
Total	80.991	−8.061	−1.900
		[8.773]	[9.500]
Village fixed effects		Yes	Yes
First-BW year-drilled fixed effects			Yes

TABLE 7—ASSETS AND DEBT

	Control mean	Impact of BW failure	
	(1)	(2)	(3)
Assets			
Total land (acres)	5.510	0.091	0.045
		[0.216]	[0.226]
Land value (10,000 Rs)	316.816	−18.289	10.593
		[60.519]	[64.742]
Brick house	0.412	−0.055	−0.059
		[0.036]	[0.037]
Number rooms	3.160	−0.062	−0.075
		[0.114]	[0.119]
Asset value without land (10,000 Rs)	27.758	−6.523	−6.750
		[2.363]	[2.464]
Debt			
Any	0.352	0.074	0.073
		[0.032]	[0.031]
Size of total debt (10,000 Rs)	9.270	4.599	5.572
		[2.271]	[2.294]
Village fixed effects		Yes	Yes
First-BW year-drilled fixed effects			Yes

TABLE 9—HETEROGENEOUS TREATMENT EFFECTS BY ECONOMIC DEVELOPMENT

	Impact of BW failure		
	Development		
	Low	High	Difference
	(1)	(2)	(3)
Fraction of HH members (dry season)			
Working on own farm	−0.105	−0.105	−0.000
	[0.037]	[0.035]	[0.051]
Working off-farm, agriculture	0.055	0.075	0.019
	[0.036]	[0.025]	[0.043]
Working off-farm, non-agriculture	0.034	0.062	0.028
	[0.018]	[0.019]	[0.026]
Not working	0.054	0.001	−0.053
	[0.017]	[0.023]	[0.029]
Non-migrant working outside village	0.026	0.043	0.017
	[0.018]	[0.022]	[0.029]
Semi-permanent migrant (annual)	0.026	0.008	−0.018
	[0.013]	[0.005]	[0.014]
Income (1,000 Rs)			
On-farm	−24.083	−5.502	18.582
	[8.480]	[10.903]	[13.765]
Off-farm	3.428	27.462	24.033
	[8.244]	[10.732]	[13.486]
Total	−20.655	21.960	42.615
	[12.118]	[15.926]	[19.942]
Village fixed effects	Yes	Yes	Yes
First-BW year-drilled fixed effects	Yes	Yes	Yes

Discussion

- Does this make us more or less optimistic about the likely impact of climate change on the rural poor?
- Is there a water market? How might trade change outcomes in this setting?
- Do the heterogeneous effects reveal broader concerns about *who* can adapt?