

- Ms. Ahriwar's everyday routine of fetching water from the village hand pump; she is a mother of three, living in the central Indian state of Madhya Pradesh, India:
I go out and put the jerrycans in the queue at around 5 a.m. and wait there with the children. [...] Sometimes it could take five or six hours. I have to stay there because if I leave, someone else moves ahead.
- Jyoti Abadiya, a council member in Siroha, Madhya Pradesh speaking about the problem of access to piped water:
If ration is free, house is free, child delivery is free, wedding is free, they say the water should also be free.

New York Times (Dec 21, 2021)

Urban water crisis (Link)

Rural water crisis (Link)

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- Less than 35% of households had piped water in 2018 (NITI Aayog)
- Less than 21% and 40% of households had Indoor Piped Drinking Water (IPDW) in rural and urban areas, respectively [▶ IHDS 2005-2012](#)
- Quality of water supply in urban areas is dismal, and pipe pressure is irregular (Mackenzie & Ray, 2015)

[▶ IHDS 2012](#)[▶ WRI](#)

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- The lack of IPDW is an economic, social and institutional problem [▶ Access to IPDW](#)
- Given the disproportionate burden of home production on women, the intra-household labor and health inequality could be larger in the absence of IPDW.

Literature

Study	Model	Finding
Jalan & Ravallion (2003) (Pipe Water and Child Health)	Propensity Score Matching India, NCAER 1993-94	1) Diarrhea prevalence reduces by –0.023 pp with pipe water. 2) Disease prevalence and illness duration amongst those with pipe water would be 21% & 29% lower, respectively 3) Effect is smaller with lower mother's education.
Choudhuri & Desai (2020) (Pipe Water and Child Education)	Random Effects-Village Level and entropy balanced OLS IHDS, 2012	1) IPDW does not significantly affect study (homework) time, educational expenses and math score. 2) With entropy balancing, a significant 10% increase in educational expense for girls, no other outcomes affected.
Koolwal & van deWalle (2014) (Water collection time, women's work and child schooling)	Geographic averaging with comprehensive regression controls Rural Econ. Development Survey, 1997	1) 1 hour reduction in water collection minutes increases likelihood of wage work by 9.1% for women. 2) No significant increase in child school enrollment.
Kumar & Vollmer (2013) (Improved sanitation and child illness)	Propensity Score Matching District Level Household Survey, 2008	1) Incidence of diarrhea with improved sanitation is 2.2 pp lower than those without improved sanitation.

- IPDW and Trade-offs: Becker's (1981) model of household utility maximization
 - ① Time allocation—disproportionate effect on women, social norms
 - ② Employment
 - ③ Wages
 - ④ Household division of labor
 - ⑤ Mobility
 - ⑥ Exposure to and management of risk & health hazards
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IPDW: Employment, Health and Gender Relations

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- Lack of IPDW is critical in the face of declining female labor force participation (LFP) ▶ LFP1
- The capability framework ▶ Capability
- I look at employment and health effects of IPDW at a granular level using longitudinal individual, household and village level data

- **Employment**

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Main results: Employment

- Access to IPDW increases the likelihood of work by 11.8 percentage points (pp) for the overall sample
- Approx. 2 million more people employed given the demand conditions
- In rural areas, these margins are higher for women, 19.5 pp as compared to 12.1 pp for men
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- The employment effect for women is a rural phenomenon only

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- Number of days of illness reduces by 0.31 days for the full sample, 0.46 days in rural areas, and by 0.58 days for women from poor households
- With IPDW, school absence reduces by 2.4 days for girls and by 1.34 days for boys in rural areas

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 - ① Access to Clean Cooking and Energy Survey of States Panel (Six States) (household survey, 8000 obs. each wave)
 - ② India Time Use Survey, 2019 (individual survey, 500,000 obs.)
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- Treatment variable, IPDW, is from the household level questionnaire of the IHDS

Descriptive statistics by treatment and time, 2005-2012

Variable	2005				2012			
	No IDPW		IDPW		No IDPW		IDPW	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Water								
Water in house	0.33	0.47	-	-	0.32	0.47	-	-
Water supply hours	4.23	6.14	4.92	6.38	3.88	5.35	4.18	5.78
Walk time water	10.35	10.57	-	-	10.43	12.30	-	-
Work								
Employment (>30 days)	0.40	0.49	0.36	0.48	0.47	0.50	0.44	0.50
Wage or Salary (0/1)	0.24	0.43	0.20	0.40	0.32	0.46	0.28	0.45
Annual work days	201	98	243	95	200	110	242	105
Real Annual Earnings (\$)	252	745	498	1320	228	752	383	1187
Health & Education								
Self-reported health (0-5)	2.26	0.81	2.18	0.76	2.19	0.87	2.02	0.84
Diarrhea in last month	0.03	0.17	0.01	0.12	0.02	0.15	0.02	0.13
Days ill last month	0.96	3.35	0.63	2.62	1.17	3.57	0.80	2.81
Days absent, school (30 days)	3.38	5.79	1.81	3.96	3.95	5.26	2.94	5.04
Observations	1,09,700		40,676		1,03,969		46,340	

Author's elaboration, IHDS, 2005-2012

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Variable	2005				2012			
	No IDPW		IDPW		No IDPW		IDPW	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Networks								
Doctors/Health Care	0.30	0.46	0.40	0.49	0.55	0.50	0.63	0.48
Teachers/School Workers	0.39	0.49	0.49	0.50	0.59	0.49	0.67	0.47
Politicians/Police	0.29	0.46	0.47	0.50	0.48	0.50	0.63	0.48
Government Officials	0.29	0.46	0.47	0.50	0.27	0.44	0.40	0.49
Log community income	12.00	0.44	12.30	0.38	11.63	0.47	11.98	0.42
Log household income	11.53	0.97	12.15	0.94	11.16	1.01	11.71	0.98
Electricity	0.69	0.46	0.97	0.17	0.83	0.38	0.99	0.10
Public prog. for sanitation	0.03	0.18	0.03	0.17	0.05	0.23	0.05	0.21
Male education	6.47	4.89	9.36	4.46	7.21	4.92	9.66	4.43
Female education	3.69	4.53	6.84	5.19	4.75	4.97	7.68	5.17
Age	26.71	18.90	28.70	18.76	33.69	19.28	35.54	19.05
Household size	6.56	3.12	6.32	3.11	5.82	2.72	5.66	2.61
Rain Z score	-0.36	0.64	-0.32	0.66	0.57	0.85	0.71	0.89
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 - ④ Choudhuri & Desai (2020) posit that provisioning of IPDW in India is done by local administrative units, and so is largely external to the household decisions

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- But $\text{Cov}(\bar{Z}_{jt}; \epsilon_{jt}/\bar{G}_{jt}; \bar{X}_{it}) = 0$. Hence it is conditionally exogenous

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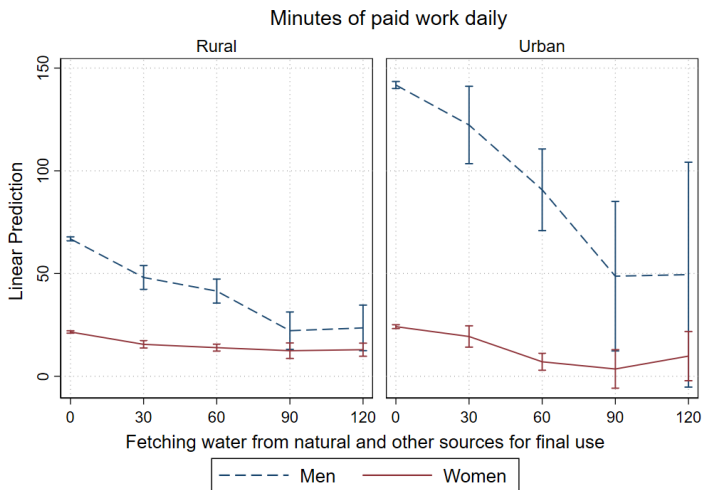
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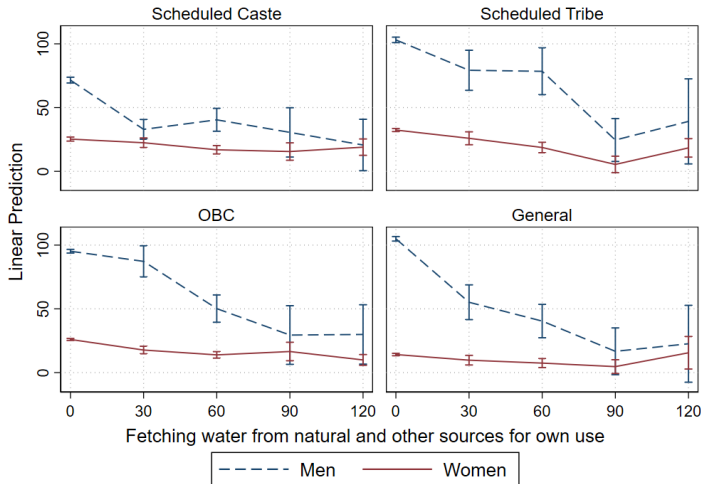
- The instrument satisfies weak identification, over identification and monotonicity as Local Average Treatment Effects ▶ IV

Employment



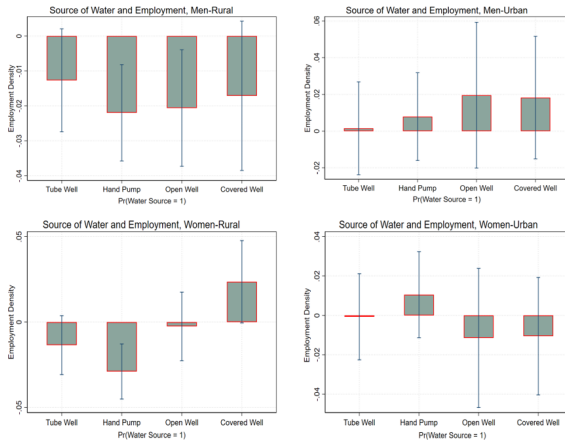
OLS, India Time Use Survey, 2019

Employment



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FE: source of water and employment by gender and location



Author's calculations, IHDS, 2005-2012; controlling for the time trend

IV-FE: IPDW and Employment by Gender and Location

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a): Individual IV-FE							
Any Employment (>30 days)							
IPDW	0.118*** (0.017)	0.119*** (0.022)	0.113*** (0.026)	0.121*** (0.026)	0.174*** (0.046)	0.195*** (0.033)	-0.029 (0.044)
F test (IV)	1,966	1,073	1,029	888	764	912	623
Two-stage q-values	0.001	0.002	0.001	0.002	0.001	0.004	0.671
Wage/Salary Employment							
IPDW	0.116*** (0.017)	0.110*** (0.024)	0.121*** (0.022)	0.088*** (0.029)	0.136*** (0.049)	0.160*** (0.029)	0.000 (0.037)
F test (IV)	1,961	1,045	1,031	891	745	906	608
Two-stage q-values	0.008	0.002	0.002	0.001	0.002	0.001	0.624
Ind. and HH. Controls	Y	Y	Y	Y	Y	Y	Y
Observations	209,860	111,061	98,799	74,901	36,160	67,534	31,265
Number of individuals	119,054	62,863	56,193	43,033	20,982	38,626	18,054

Author's calculations, IHDS, 2005-2012

IV-FE: IPDW and Earnings by Gender and Location

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a) IV-FE							
IPDW	0.138** (0.070)	0.112** (0.068)	0.175** (0.082)	0.102** (0.066)	0.132** (0.069)	0.199*** (0.076)	0.079 (0.094)
F test (IV)	1,121	832	429	554	348	393	112
Two-stage q-values	0.001	0.002	0.002	0.002	0.003	0.001	0.414
Observations	124,836	85,244	39,592	59,827	25,417	33,622	5,970
Number of individuals	80,957	52,744	28,215	37,184	16,312	23,506	4,752
Panel (b) Village FE							
IPDW	0.181** (0.072)	0.182** (0.075)	0.304** (0.124)				
Two-stage q-values	0.021	0.023	0.040				
Observations	2,486	2,486	2,431				
Number of PSUs	1,378	1,378	1,369				

Author's calculations, IHDS, 2005-2012

IV-FE: IPDW and Days of Work by Gender and Location

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a) IV-FE							
IPDW	22.755*** (2.951)	20.060*** (3.449)	27.031*** (5.388)	19.075*** (4.217)	21.667*** (6.450)	28.751*** (5.566)	10.132 (18.270)
F test (IV)	1,224	841	440	599	376	401	133
Sharpened two-stage q-values	0.311	0.762	0.002	0.172	0.563	0.001	0.516
Observations	129,410	87,415	41,995	61,795	25,620	35,877	6,118
Number of individuals	82,752	53,427	29,327	37,798	16,397	24,530	4,844
Panel (b) Village FE (Rural)							
Indoor Pipe Water	11.49*** (3.18)	13.74*** (4.06)	7.04* (3.35)				
Sharpened two-stage q-values	0.011	0.007	0.070				
Observations	2,486	2,486	2,431				
Number of PSUs	1,378	1,378	1,369				

Author's calculations, IHDS, 2005-2012

Health and Education

IV-FE: IPDW and women's self-reported health

	(1)	(2)	(3)	(4)	(5)
	All	Rural	Urban	Poor	Non-poor
<u>Good & V. Good=1, OK, Poor & V. Poor=0</u>					
FE					
IPDW	0.0294** (0.0122)	0.0316** (0.0154)	0.0352* (0.0200)	0.0686*** (0.0379)	0.0241*** (0.0128)
IV-FE					
IPDW	0.312*** (0.0432)	0.337*** (0.0518)	0.273*** (0.0827)	0.506*** (0.116)	0.274*** (0.0465)
<u>Good, V. Good & OK=1, Poor & V. Poor=0</u>					
FE					
IPDW	0.00974 (0.0066)	0.0163* (0.0084)	0.000689 (0.0110)	0.00115 (0.0198)	0.0102 (0.0070)
IV-FE					
IPDW	0.0896*** (0.0247)	0.142*** (0.0298)	-0.0191 (0.0400)	0.0951 (0.0626)	0.0878*** (0.0255)
F test (IV)	866	750	312	181	542
Observations	47,225	32,527	14,698	7,819	39,402
Number of Individuals	24,909	17,196	7,713	4,133	20,772

Author's calculations, IHDS, 2005-2012

IV-FE: IPDW and short term morbidities

	(1)	(2)	(3)	(4)	(5)
	All	Rural	Urban	Poor	Non-Poor
Panel (a) Diarrhea					
FE					
IPDW	-0.002** (0.001)	0.001 (0.001)	-0.008*** (0.002)	-0.007** (0.003)	-0.002 (0.001)
IV-FE					
IPDW	-0.015*** (0.006)	-0.012* (0.007)	-0.022*** (0.004)	-0.015** (0.005)	-0.014* (0.006)
F test (IV)	1562	1301	831	693	1414
Panel (b) Days ill last month					
FE					
IPDW	-0.007 (0.024)	0.037 (0.031)	-0.076** (0.038)	0.082 (0.063)	-0.022 (0.025)
IV-FE					
IPDW	-0.318*** (0.123)	-0.462*** (0.156)	-0.205* (0.115)	-0.580*** (0.192)	-0.399*** (0.136)
F test (IV)	1521	1227	836	668	1471
HH & Individual controls	Y	Y	Y	Y	Y

IV-FE: IPDW and school absence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Boys	Girls	Rural Boys	Urban Boys	Rural Girls	Urban Girls
FE							
IPDW	-0.437** (0.174)	-0.272 (0.243)	-0.640*** (0.246)	-0.212 (0.323)	-0.453 (0.379)	-0.882* (0.417)	-0.568** (0.312)
IV-FE							
IPDW	-1.484** (0.586)	-1.423* (0.636)	-1.559** (0.419)	-1.347** (0.362)	-0.149 (1.151)	-2.440*** (1.106)	-1.393 (1.484)
F test (IV)	732	512	487	399	118	354	87
Observations	54,446	30,305	24,141	20,738	9,567	16,358	7,783
Number of Individuals	42,421	23,732	18,690	16,471	7,424	12,883	5,956

Author's calculations, IHDS, 2005-2012

ACCESS Analysis

FE: IPDW, latent household welfare and empowerment

	(1)	(2)	(3)	(4)
Variables	Annual Savings Rs.	Non male-head decision making	Log of cooking hours	Firewood collection hours daily
Indoor Pipe Water	2,558.249* (1,383.294)	0.035* (0.021)	-0.054*** (0.017)	-0.612** (0.303)
Household Controls	Y	Y	Y	Y
Wave Dummy	Y	Y	Y	Y
Observations	16,447	16,057	17,062	4,761
Number of Households	8,562	8,548	8,563	3,794

Robust standard errors (clustered at the household level) in parentheses, p-values—*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Additional independent variables in all regressions: age, education, household size, monthly household consumption expenditure, wave dummy. The data is derived from the ACCESS panel, 2015-2018.

Author's calculations, ACCESS, 2015-2018

Robustness

FE: IPDW and employment. State and year fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Rural Men	Urban Men	Rural Women	Urban Women
Treatment: IPDW							
Any Employment (>30 days)							
Indoor Pipe Water	0.006 (0.006)	0.006 (0.007)	0.019** (0.009)	0.001 (0.010)	-0.011 (0.012)	0.036*** (0.012)	-0.006 (0.012)
Wage/Salary Employment							
Indoor Pipe Water	0.003 (0.006)	-0.013 (0.008)	0.021*** (0.008)	0.001 (0.011)	-0.017 (0.013)	0.043*** (0.010)	-0.009 (0.010)
Observations	95,966	50,909	45,057	26,153	24,756	23,452	21,605
Number of individuals	63,989	33,931	30,060	18,478	15,710	16,450	13,715

Author's calculations, IHDS, 2005-2012

- Relieving the burden of water collection:
 - ① More market-oriented activities for women
 - ② Higher earnings
 - ③ Better health outcomes for women
 - ④ Better health outcomes for families
 - ⑤ Higher economic freedom and social decision-making ability

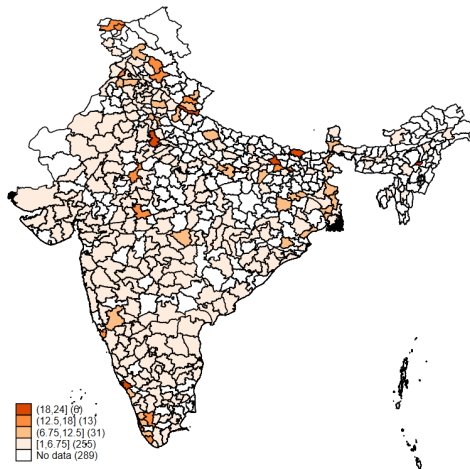
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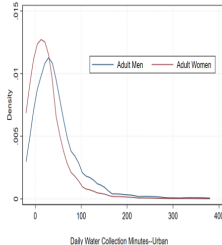
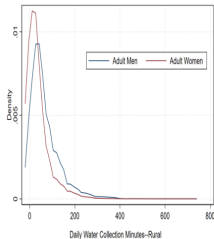
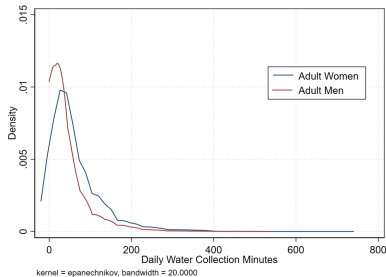
Conclusion

- Relieving the burden of water collection:
 - ① More market-oriented activities for women
 - ② Higher earnings
 - ③ Better health outcomes for women
 - ④ Better health outcomes for families
 - ⑤ Higher economic freedom and social decision-making ability
- Lesser burden of water collection and maintenance could lead to investment of time in children's nutrition, and education
- IPDW could be critical in breaking the vicious cycle of women not getting quality formal education→ limited employment opportunities→ limited or no earnings→ little human capital
- Lack of access to piped water could in fact be a crucial determinant of differences in women's socio-economic outcomes between developed and developing economies



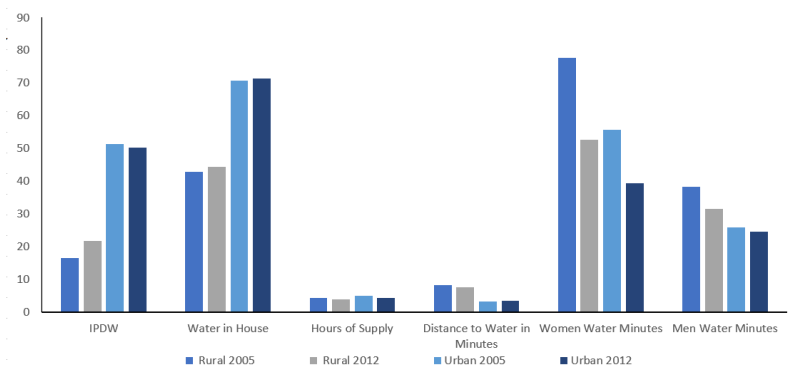
Hours of IPDW in 2012

Source: Author's elaboration, IHDS, 2005-2012.



Kernel Density Plot. Note: observations are conditional on water collection. Source: IHDS, 2005-2012

IHDS 2005-2012



IPDW and Water in House are in percentages. Water collection minutes are daily averages conditional on some water collection

► Data

Set 1

Panel Fixed Effects: Indoor Pipe Drinking Water and Women's Daily Water Collection Time in Minutes, IHDS, 2005-2012

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	All	All	Rural	Urban	Non-Poor	Poor
<u>Panel (a) Unconditional on water collection</u>						
Indoor Pipe Drinking Water	-7.416*** (2.345)	-3.954* (2.412)	-5.922** (2.777)	5.918 (5.005)	-1.277 (2.622)	-20.187*** (6.250)
HH, Ind., Com. Controls	N	Y	Y	Y	Y	Y
Observations	105,278	98,203	79,497	18,706	74,590	23,482
Number of Individuals	71,638	68,346	54,412	14,178	52,877	15,362
<u>Panel (b) Conditional on water collection</u>						
Indoor Pipe Drinking Water	-10.884*** (2.409)	-7.576** (2.533)	-10.214*** (2.913)	5.791 (5.201)	-0.927 (2.762)	-25.772*** (6.111)
HH, Ind., Com. Controls	N	Y	Y	Y	Y	Y
Observations	102,663	96,405	78,497	17,908	73,379	23,011
Number of individuals	70,481	67,570	54,066	13,735	52,322	15,233

Set 1

Individual and Village Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a): Individual FE							
Any Employment (>30 days)							
Indoor Pipe Water	0.004 (0.004)	0.003 (0.005)	0.005 (0.005)	0.013** (0.006)	-0.013 (0.008)	0.017** (0.008)	-0.010 (0.007)
Wage/Salary Employment							
Indoor Pipe Water	0.008** (0.003)	0.002 (0.005)	0.015*** (0.005)	0.008 (0.007)	-0.016 (0.008)	0.029*** (0.006)	-0.008 (0.006)
Ind. and HH. Controls	Y	Y	Y	Y	Y	Y	Y
Observations	209,860	111,061	98,799	74,901	36,160	67,534	31,265
Number of individuals	119,054	62,863	56,193	43,033	20,982	38,626	18,054
Panel (b) Village FE (Rural)							
Any Employment (>30 days)							
Indoor Pipe Water	0.045*** (0.014)	0.047*** (0.014)	0.033* (0.019)				
Wage/Salary Employment							
Indoor Pipe Water	0.025 (0.016)	0.010 (0.017)	0.039** (0.018)				
Village Fixed Effects	Y	Y	Y				
Village controls	Y	Y	Y				
Observations	2,510	2,509	2,507				
Number of PSUs	1,386	1,385	1,383				

Set 1

Panel fixed effects Log of real annual earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a) Individual FE							
Indoor Pipe Water	0.075*** (0.013)	0.066*** (0.013)	0.099*** (0.030)	0.069*** (0.018)	0.049*** (0.018)	0.118*** (0.034)	-0.036 (0.058)
Log Annual Work Hours	0.713*** (0.008)	0.740*** (0.009)	0.660*** (0.013)	0.750*** (0.010)	0.688*** (0.024)	0.659*** (0.014)	0.657*** (0.049)
Observations	124,836	85,244	39,592	59,827	25,417	33,622	5,970
Number of individuals	80,957	52,744	28,215	37,184	16,312	23,506	4,752
Panel (b) Village FE							
Indoor Pipe Water	0.197*** (0.074)	0.180** (0.078)	0.234* (0.129)				
Log Annual Work Hours	0.451*** (0.054)	0.529*** (0.063)	0.556*** (0.069)				
Observations	2,507	2,505	2,432				
Number of villages	1,386	1,385	1,364				

Set 1

Panel fixed effects: Annual work days

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a) Individual FE							
Indoor Pipe Water	1.362*** (1.131)	0.622 (1.282)	5.279*** (2.425)	2.186 (1.754)	-2.491 (1.721)	6.902*** (2.649)	-5.114 (5.966)
Observations	129,410	87,415	41,995	61,795	25,620	35,877	6,118
R-squared	0.660	0.659	0.693	0.687	0.579	0.710	0.589
Number of individuals	82,752	53,427	29,327	37,798	16,397	24,530	4,844
Panel (b) Village FE (Rural)							
Indoor Pipe Water	6.265 (6.486)	5.664 (6.696)	9.288** (4.385)				
Observations	2,510	2,508	2,450				
Number of Villages	1,386	1,385	1,367				

Set 1

Panel fixed effects: Household's access to indoor pipe drinking water and women's self-reported health, 2005-2012.

	(1)	(2)	(3)	(4)	(5)
Variables	All	Rural	Urban	Poor	Non-poor
Individual FE					
Good & V. Good=1, OK, Poor & V. Poor=0					
Indoor Pipe Water	0.0294** (0.0122)	0.0316** (0.0154)	0.0352* (0.0200)	0.0686* (0.0379)	0.0241* (0.0128)
Good, V. Good & OK=1, Poor & V. Poor=0					
Indoor Pipe Water	0.00974 (0.00662)	0.0163* (0.00840)	0.000689 (0.0110)	0.00115 (0.0198)	0.0102 (0.00704)
Observations	47,225	32,527	14,698	7,819	39,402
Number of Individuals	24,909	17,196	7,713	4,133	20,772

Set 1

Indoor Pipe Drinking Water and likelihood of Diarrhea, India, 2005-2012

	(1)	(2)	(3)	(4)	(5)
Variables	All	Rural	Urban	Poor	Non-Poor
Indoor pipe drinking water	-0.002** (0.001)	0.001 (0.001)	-0.008*** (0.002)	-0.007** (0.003)	-0.002 (0.001)
Store drinking water with lid	-0.004*** (0.001)	-0.004** (0.002)	-0.004* (0.003)	-0.007** (0.003)	-0.003* (0.002)
Wave Dummy	-0.007*** (0.002)	-0.009*** (0.002)	-0.004* (0.003)	-0.016*** (0.004)	-0.004** (0.002)
HH & Individual controls	Y	Y	Y	Y	Y
Observations	251,288	171,960	79,328	47,197	204,048
Number of individuals	139,496	96,768	44,732	26,151	113,302

Set 1

Panel fixed effects: Effect of IPDW on absence from school in the past month, India, 2005-2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Boys	Girls	Rural Boys	Urban Boys	Rural Girls	Urban Girls
Indoor Pipe Drinking Water	-0.437** (0.174)	-0.272 (0.243)	-0.640*** (0.246)	-0.212 (0.323)	-0.453 (0.379)	-0.568* (0.312)	-0.882** (0.417)
Wave Dummy	1.389*** (0.355)	0.827* (0.470)	2.061*** (0.547)	0.739 (0.575)	0.787 (0.888)	1.369** (0.632)	2.661** (1.036)
Observations	54,446	30,305	24,141	20,738	9,567	16,358	7,783
Number of Individuals	42,421	23,732	18,690	16,471	7,424	12,883	5,956

Set 1

Panel instrumental variable regression: Effect of IPDW on employment in rural India, 2005-2012

	(1)	(2)	(3)	(4)	(5)
Variables	All	Poor	Non-Poor	Men	Women
Treatment: IPDW in rural areas					
Any employment (>30 days)	0.079*** (0.020)	0.086*** (0.048)	0.069*** (0.023)	0.062*** (0.025)	0.090*** (0.033)
Wage and Salary employment	0.068*** (0.020)	0.058** (0.049)	0.062*** (0.022)	0.048*** (0.028)	0.073*** (0.029)
F test (instrument)	1,966	473	1,429	1,088	908
Observations	140,197	27,703	112,470	73,705	66,492
Number of individuals	80,373	15,826	64,523	42,336	38,037

Set 1

Panel fixed effects: Note, all regressions have state and year interaction as controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Rural Men	Urban Men	Rural Women	Urban Women
Treatment: IPDW							
Any Employment (>30 days)							
Indoor Pipe Water	0.006 (0.006)	0.006 (0.007)	0.019** (0.009)	0.001 (0.010)	-0.011 (0.012)	0.036*** (0.012)	-0.006 (0.012)
Wage/Salary Employment							
Indoor Pipe Water	0.003 (0.006)	-0.013 (0.008)	0.021*** (0.008)	0.001 (0.011)	-0.017 (0.013)	0.043*** (0.010)	-0.009 (0.010)
Observations	95,966	50,909	45,057	26,153	24,756	23,452	21,605
Number of individuals	63,989	33,931	30,060	18,478	15,710	16,450	13,715

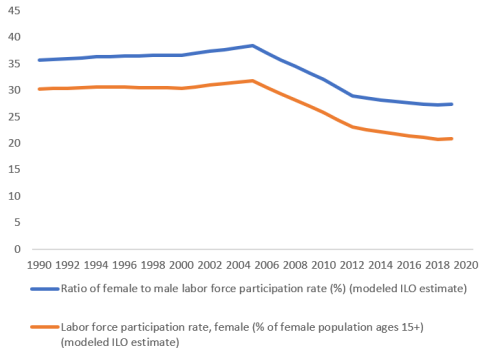
Set 1

Household fixed effects: Effect of IPDW on household savings, decision making, time spent in cooking and firewood collection, ACCESS Survey

	(1)	(2)	(3)	(4)
Variables	Annual Savings Rs.	Non male-head decision making	Log of cooking hours	Firewood collection hours daily
Indoor Pipe Water	2,558.249* (1,383.294)	0.035* (0.021)	-0.054*** (0.017)	-0.612** (0.303)
Household Controls	Y	Y	Y	Y
Wave Dummy	Y	Y	Y	Y
Observations	16,447	16,057	17,062	4,761
Number of Households	8,562	8,548	8,563	3,794

Set 2

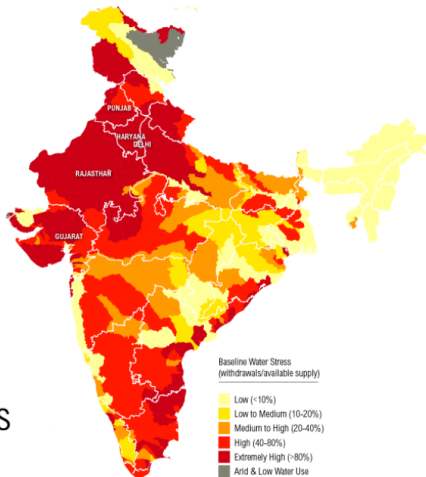
Women's Labor Force Participation, India



Source: World Bank, WDI

▶ slide 1

54%
of India
Faces
**High to
Extremely
High**
Water Stress



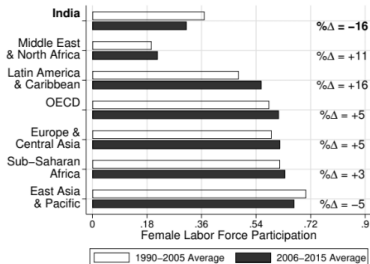
www.indiawatertool.in

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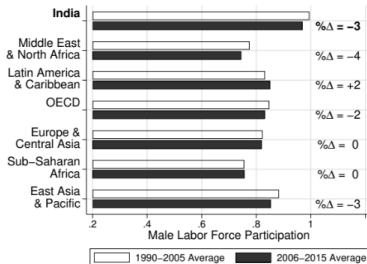
Source: World Resource Institute, 2015 ▶ slide 1

Set 2

(a) Female



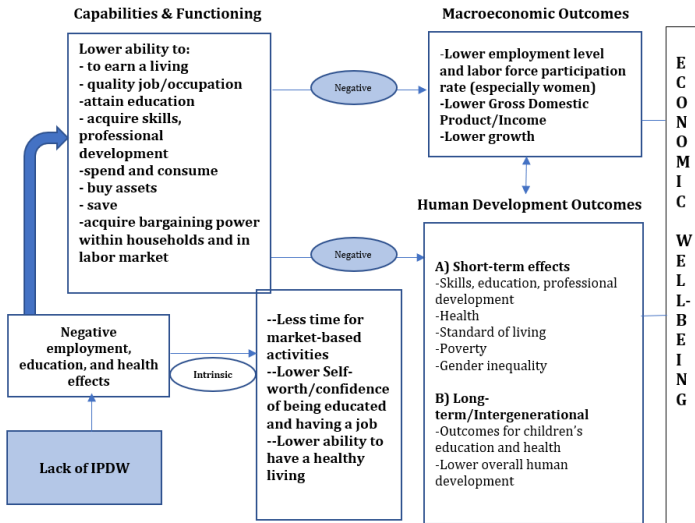
(b) Male



Note: Panel (a) displays the average fraction of women who were at least 15 years old and participated in the labor force by country or region in the period 1990-2005 (white bar) and the period 2006-2015 (black bar). Panel (b) is analogous to Panel (a) for men. %Δ is the percentage change between the black and white bars. **Source:** Author's calculations using The World Bank (2019a,b).

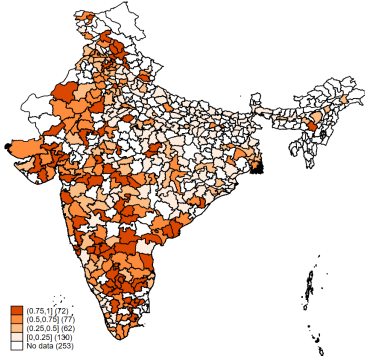
► Hypothesis

Set 2

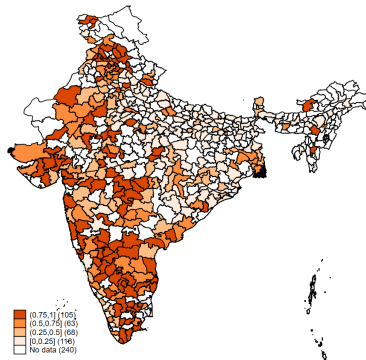


Intensity of pipe water access at the District Level

Panel A: 2005



Panel B: 2012



Notes: Author's' computations using IHDS-1 and IHDS-2. Note the map is not representative of actual boundary. The data here is derived from the administrative boundary.

Set 2

Access to piped drinking water by caste, 2005-2012.

		Forward caste	OBC	Dalit (SC)	Adivasi (ST)	Muslim
		Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)
2005	IPDW	0.41 (0.49)	0.24 (0.43)	0.20 (0.39)	0.15 (0.35)	0.24 (0.42)
2012	IPDW	0.42 (0.49)	0.28 (0.45)	0.26 (0.44)	0.18 (0.38)	0.27 (0.44)
Observations		8592	13549	8555	3443	4538

Source: Author's elaboration, IHDS, 2005-2012

► Descriptive

Set 2

Descriptive Statistics from two household surveys, India, 2005-2018

		2005		2012		T test
IHDS	Obs	Mean	SD	Mean	SD	
IPDW	40,018	0.256	0.442	0.302	0.459	***
ACCESS		2015		2018		
IPDW	8563	0.057	0.232	0.066	0.248	

Author elaboration, IHDS, 2005-2012, ACCESS survey, 2015-2018. ACCESS survey is for the rural areas in the six relatively poorer states in India namely: Madhya Pradesh, Uttar Pradesh, Odisha, Bihar, Jharkhand, West Bengal. The t-test shows mean difference in access to IPDW by the year of survey, 2015 and 2018.

IPDW: Employment, Health and Gender Relations

- Previous studies on access to water infrastructure focused mostly on health and education, with little impetus on employment

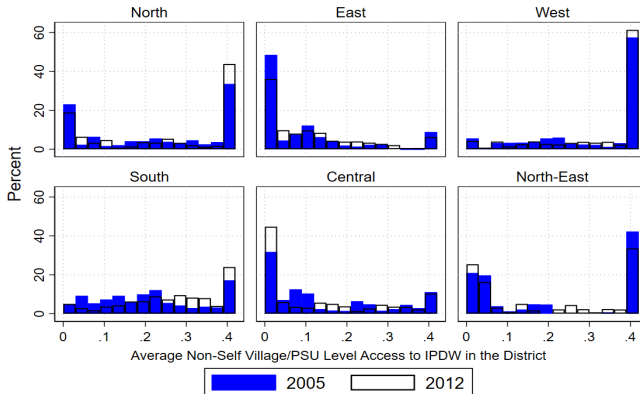
Ilahi & Grimmard (2000); Jalan & Ravallion (2003); Giliania et al. (2005); O'Reilly (2006); Mangyo (2009); Gamper et al. (2010); Lamichane & Manyo (2011); Kumar & Vollmer (2013); *Koolwal & van deWalle (2014)*; Balasubramaniam et al. (2014); Zhang & Xu (2016); *Vanaja (2020)*; Choudhari & Desai (2020); Blakeslee et al. (2020); Ashraf et al. (2021); Li et al. (2021).

Set 2

Time varying exogenous village level variables, 2005-2012

	2005		2012		t-test
	Mean	SD	Mean	SD	
Percentage of households with electricity	68.46	33.28	78.29	27.39	***
Local government body in the village	0.61	0.49	0.67	0.47	***
Agricultural cooperative in the village	0.36	0.48	0.36	0.48	
Number of private schools in the village	0.78	1.59	0.82	1.62	**
Number of government schools in the village	1.77	1.64	1.74	1.56	*
Distance to bank in kilometers from the village	2.92	4.49	2.81	4.51	*
ROSCAs in the village	0.25	0.42	0.22	0.38	***
Pucca road in the village	0.67	0.47	0.87	0.34	***
Bus frequency in the village in a day	1.84	3.24	1.84	3.43	
Distance to market from the village	6.44	6.80	6.53	6.67	*
Wage men rabi harvest	56.92	35.68	176.01	79.71	***
Wage men kharif	59.68	35.84	168.67	77.45	***
Wage women kharif	36.04	26.46	130.16	66.13	***
Wage men rabi	55.61	37.03	169.29	75.27	***
Wage women rabi	30.10	27.62	129.66	61.35	***
Wage men kharif harvest	59.80	34.07	175.85	80.09	***
Wage women kharif harvest	41.08	29.43	137.61	68.47	***
Wage women rabi harvest	38.39	30.47	137.84	67.29	***
Observations	1,378		1,378		

Average non-self community level access to IPDW by regions in India



Graphs by Administrative Region, IHDS, India

Set 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	All	Men	Women	Men Rural	Men Urban	Women Rural	Women Urban
Panel (a): Individual IV-FE							
Any Employment (>30 days)							
IPDW	0.118*** (0.017)	0.119*** (0.022)	0.113*** (0.026)	0.121*** (0.026)	0.174*** (0.046)	0.195*** (0.033)	-0.029 (0.044)
F test (IV)	1,966	1,073	1,029	888	764	912	623
Two-stage q-values	0.001	0.002	0.001	0.002	0.001	0.004	0.671
Wage/Salary Employment							
IPDW	0.116*** (0.017)	0.110*** (0.024)	0.121*** (0.022)	0.088*** (0.029)	0.136*** (0.049)	0.160*** (0.029)	0.000 (0.037)
F test (IV)	1,961	1,045	1,031	891	745	906	608
Two-stage q-values	0.008	0.002	0.002	0.001	0.002	0.001	0.624
Ind. and HH. Controls	Y	Y	Y	Y	Y	Y	Y
Observations	209,860	111,061	98,799	74,901	36,160	67,534	31,265
Number of individuals	119,054	62,863	56,193	43,033	20,982	38,626	18,054
Panel (b) Village FE (Rural)							
Any Employment (>30 days)							
IPDW	0.054*** (0.016)	0.064*** (0.017)	0.041* (0.023)				
Sharpened two-stage q-values	0.001	0.001	0.045				
Wage/Salary Employment							
IPDW	0.031* (0.016)	0.012 (0.019)	0.054*** (0.020)				
Sharpened two-stage q-values	0.063	0.212	0.002				
Village Fixed Effects	Y	Y	Y				
Village controls	Y	Y	Y				
Observations	2,488	2,488	2,488				
Number of PSUs	1,378	1,378	1,378				