

SFS

GEORGETOWN UNIVERSITY

Walsh School of Foreign Service

Institute for the Study of International Migration

Environmental Change and Human Migration in Bangladesh: Transdisciplinary Research Collaboration

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MARCH 18 2024

Relationship between Physical and Human Landscapes

How is climate and environmental change affecting patterns and processes of demographic outcomes in Bangladesh?

- Emphasis on migration
- Other outcomes in origins and destinations (employment, health, marriage, etc)
- Effects on sending households and communities

Current Team



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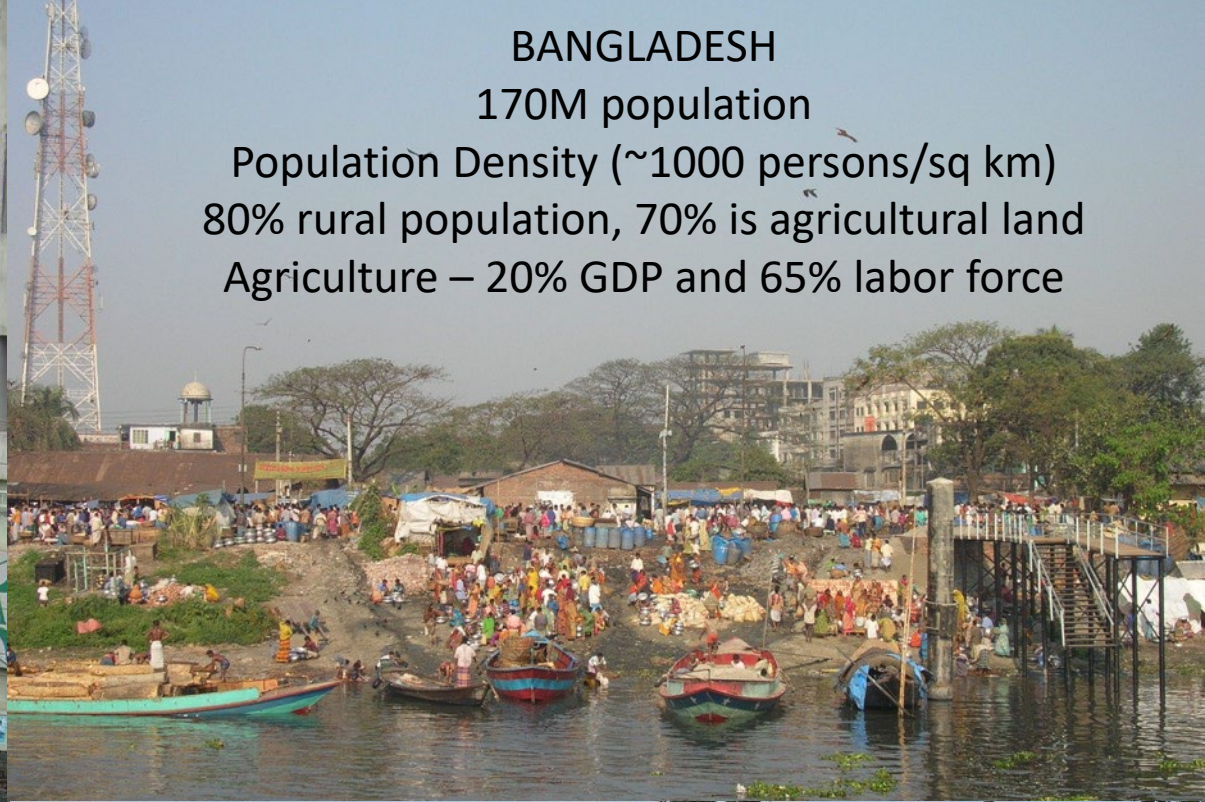
Helen Wilson
PhD Student



Samina Islam
MS Student







BANGLADESH

170M population

Population Density (~1000 persons/sq km)
80% rural population, 70% is agricultural land
Agriculture – 20% GDP and 65% labor force

World's Largest Delta (Bangladesh and West Bengal, India): Fertile, dynamic, low-lying coastal sedimentary landform



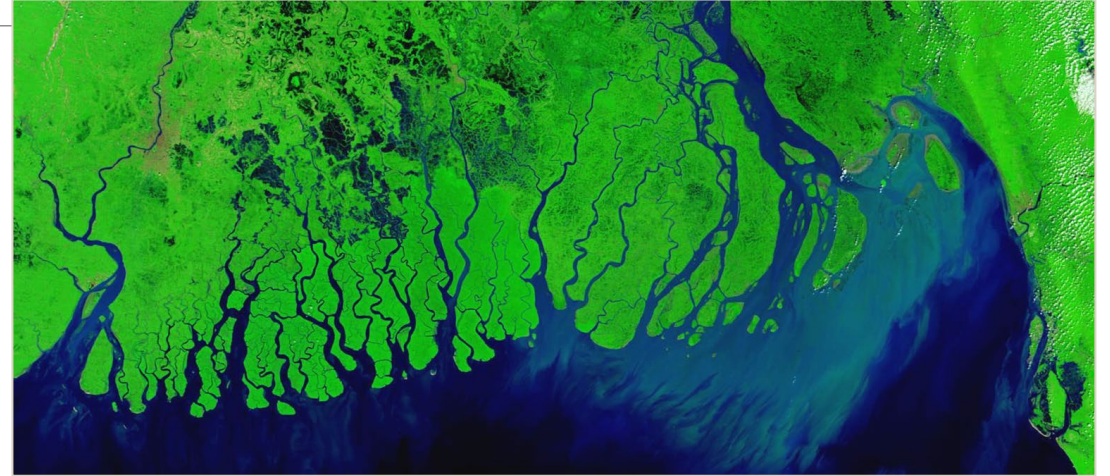
“...deltaic communities will face severe disruption by 2100, and as early as 2050 in many cases ”
- IPCC AR 6

Global climate and anthropogenic changes are affecting regular sediment and freshwater delivery from upstream river basins, threatening to sediment and freshwater delivery to deltas



Dynamic physical system

- Dynamic delta with ~ 1 billion tons of sediment deposited every year
- Coastal and riverbank erosion and accretion
- Seasonal monsoons
- Flooding and waterlogging
- Cyclones
- Salinity encroachment

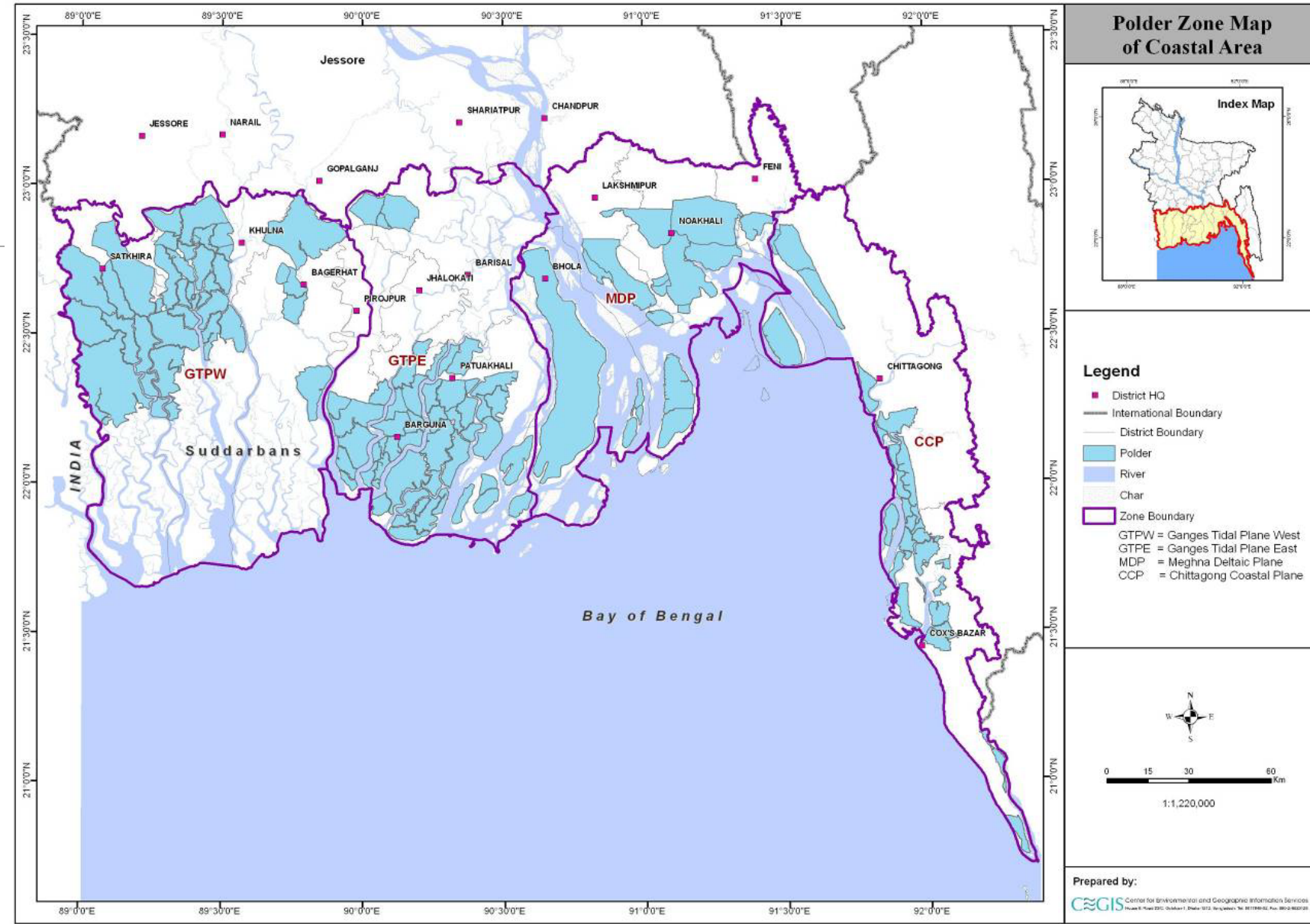


Long history: Soft & hard infrastructure to control river dynamics and protect from saline tidal intrusion:

Mud berms to protect rice paddies, torn down after each monsoon, rebuilt next year (allowing water to drain from cropland & protecting vulnerable flooding areas)

In 1950s, Bangladesh (then East Pakistan) govt, with USAID funding, constructed 139 earthen embankments reinforced with concrete blocks

Embankments (polders) constructed by Dutch from 1960s into 1980s, but little maintenance since then



~ 6,000 km of embankments; 2900 sluice gates

Migration in Bangladesh

Active migration for 1,000 years

- Economic opportunity & social/cultural connections
- Environmental stresses interact with existing patterns

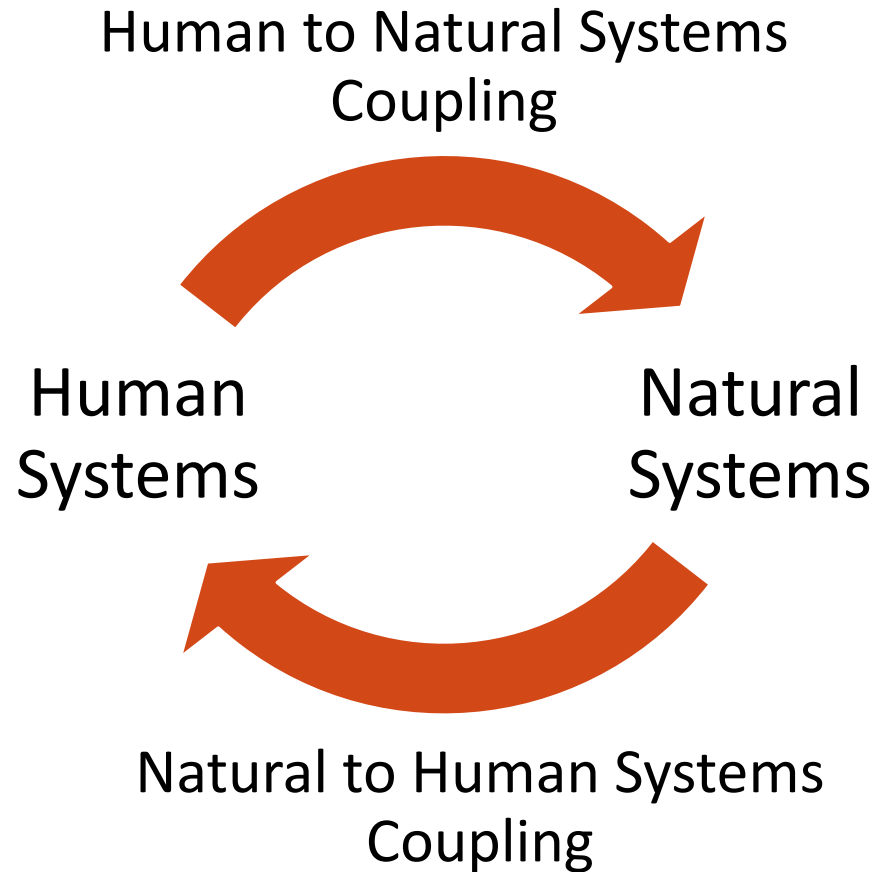
Migration can be both a sign of

- **System failure** (desperation → leave)
- **Resilience** (remittances strengthen home community)



Photo by J. Gilligan

Connecting Physical and Social Landscapes



National Science Foundation Dynamics of Coupled Natural-Human Systems (now called DISES)



- Initiated in 2001
- Cross-directorate
- Highly competitive

“Supports interdisciplinary research that examines human and natural system processes and the complex interactions among human and natural systems at diverse scales”

NSF Award #1716909

CNH-L: Socioecological System Dynamics Related to Livelihood, Human Migration, and Landscape Evolution



Type of Human Migration/Mobility

Displacement	Involuntary, forced due to natural disasters, war, violence, etc.
Migration	Planned movement with intent to remain permanently or semi-permanently (years to decades)
Circular Migration	Planned movement with intent to return (temporary or seasonal work)
Commuting	Daily or near-daily movement between residence and place of work

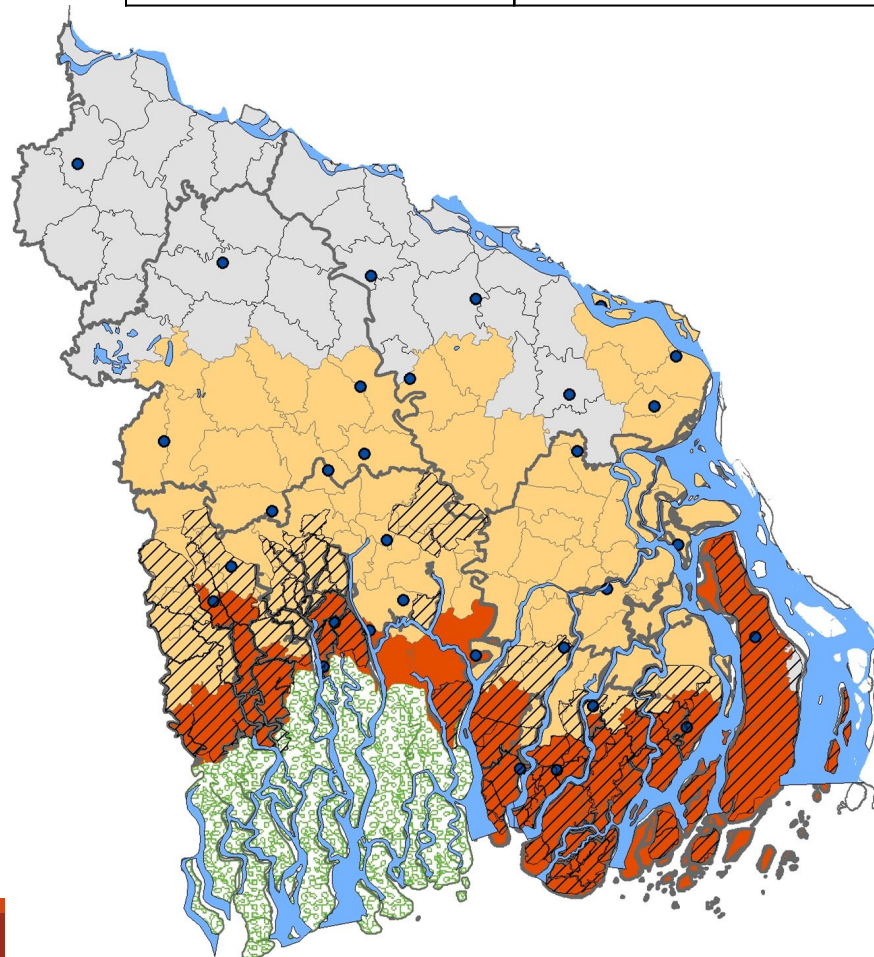
How to Measure Migration?

How to measure migration/other outcomes such that statistical modeling can include data about physical and social landscapes?

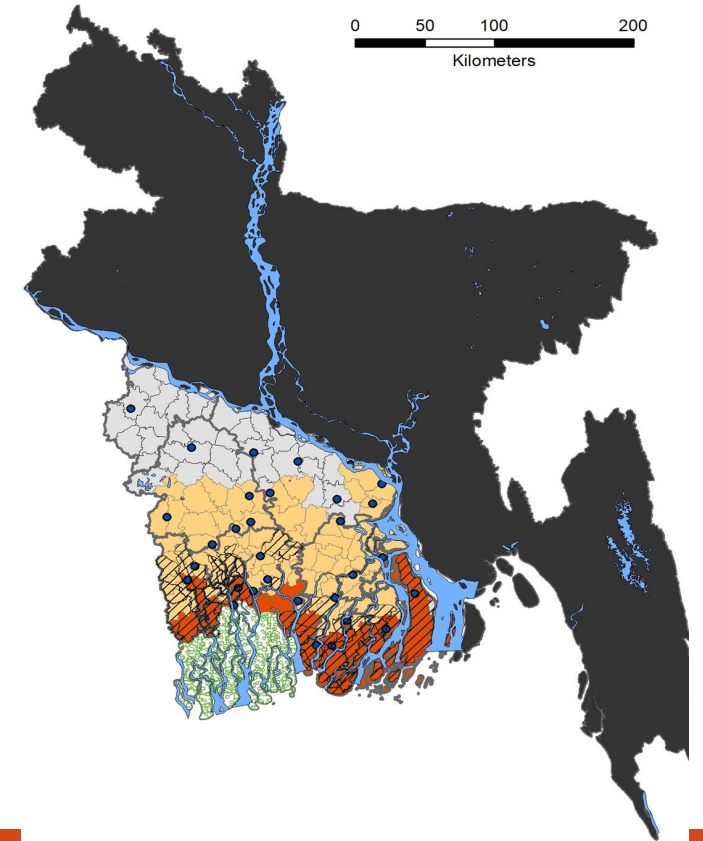
- Migration data must vary **temporally and spatially** to permit integration of physical data
- Household data must offer **detail** to analyze demographic outcomes

Bangladesh Environment & Migration Survey (BEMS)

Version	Dates	Sample
BEMS-1	2013 – 2014	1800 households, 9 research sites
BEMS-2	2019 – 2020	4000 households, 20 research sites



- Exposed Coast
- Interior Coast
- Inland
- Poldered Areas (2009)
- BEMS Sites



BEMS Methodology

- Research sites reflect range of socioeconomic and environmental conditions
- Implemented household census in each research site, then randomly selected 200 households in each
- Survey data collected from household heads and spouses
- Emphasis on retrospective (life history) approach
 - Demographics (e.g. births, deaths, marriages)
 - Migrant trips
 - Livelihoods
 - Land Access/use
 - Environmental impacts

Retrospective (Life History) Approach

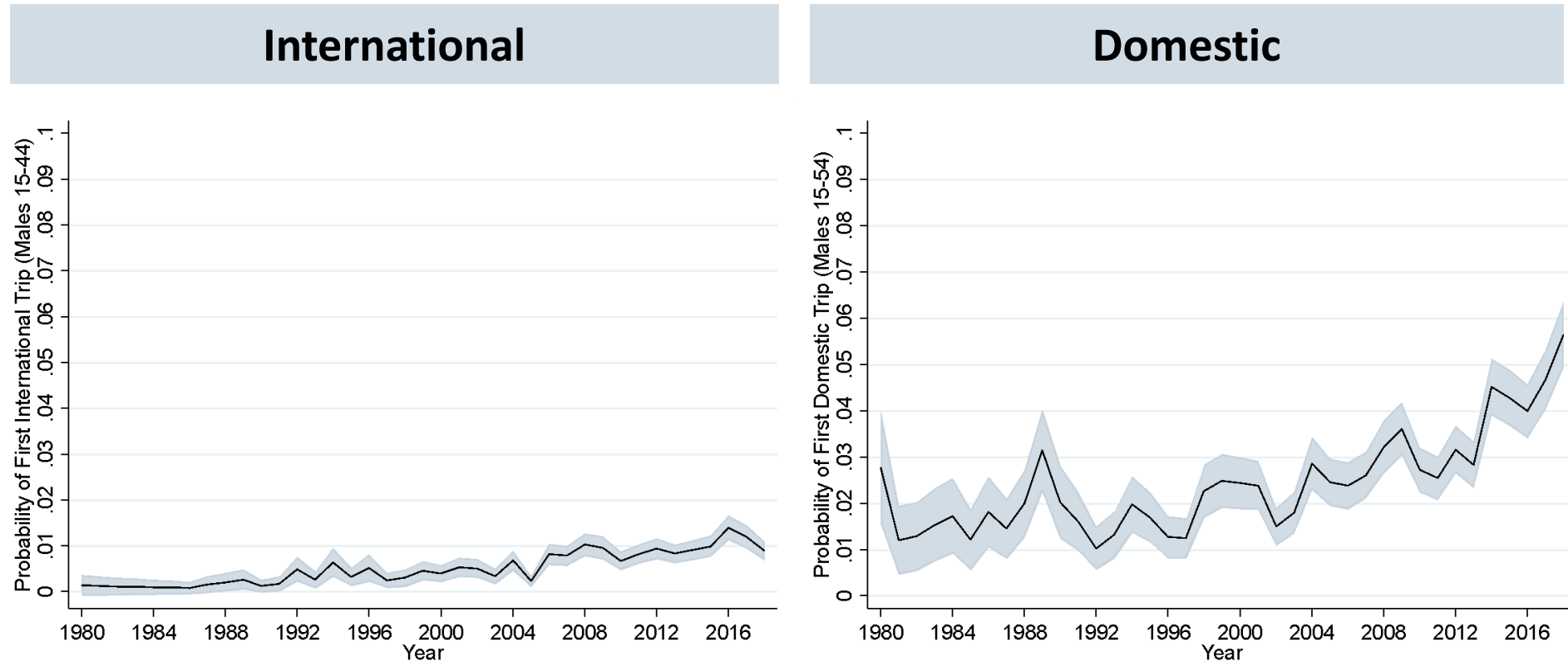
Table D1c: Information about other people in TABLE A with migratory experience within Bangladesh
Collect from migrant. If migrant is not present, collect from another knowledgeable household member if possible.

Line # "A" D1c.1	Name D1c.2	Relation to HH head (Use codes from table A) d1c.3	Total # trips d1c.4	Trip serial d1c.5	Place of destination (village, union, upazila, district) d1c.6	Month and Year of arrival d1c.7	Duration of stay (yyyy.mm) d1c.8	Primary purpose of trip (use the codes of below, choose only 1) d1c.9	Main livelihood occupation (Use occupation codes from table A) d1c.10	Wage (with other compensation) (Indicate compensation amount in taka if applicable. If paid in other than taka, include description of payment form and amount received) d1c.11		
										Taka	Wage Unit ^(b) (use the codes of below)	Other (material)
D1c.0 Do one or more people in Table A have migration experience within Bangladesh? Yes.....1 No.....2 (Skip to Table D2)												
				1 st		Month: Year:						Yes..... 1 No 2
				2 nd Last		Month: Year:						Yes..... 1 No 2
				Last		Month: Year:						Yes..... 1 No 2
				1 st		Month: Year:						Yes..... 1 No 2
				2 nd Last		Month: Year:						Yes..... 1 No 2
				Last		Month: Year:						Yes..... 1 No 2
				1 st		Month: Year:						Yes..... 1 No 2
				2 nd Last		Month: Year:						Yes..... 1 No 2
				Last		Month: Year:						Yes..... 1 No 2

Data Structure: Households, People and Person-Years

ID #	Year	Education	Age	Married	Child	Trip	Destination	Occupation	Heat Wave	Cyclone
11_164_1456_1	1993	2. below primary	0	0		0		0	0	0
11_164_1456_1	1994	2. below primary	1	0		0		0	0	0
11_164_1456_1	1995	2. below primary	2	0		0		0	8	0
11_164_1456_1	1996	2. below primary	3	0		0		0	3	0
11_164_1456_1	1997	2. below primary	4	0		0		0	0	0
11_164_1456_1	1998	2. below primary	5	0		0		0	9	0
11_164_1456_1	1999	2. below primary	6	0		0		0	3	0
11_164_1456_1	2000	2. below primary	7	0		0		0	2	0
11_164_1456_1	2001	2. below primary	8	0		0		0	0	0
11_164_1456_1	2002	2. below primary	9	0		0		0	2	0
11_164_1456_1	2003	2. below primary	10	0		0		0	3	0
11_164_1456_1	2004	2. below primary	11	0		0		0	0	0
11_164_1456_1	2005	2. below primary	12	0		0		0	3	0
11_164_1456_1	2006	2. below primary	13	0		0		4. Fisherman	7	0
11_164_1456_1	2007	2. below primary	14	0		0		4. Fisherman	0	0
11_164_1456_1	2008	2. below primary	15	0		0		4. Fisherman	7	0
11_164_1456_1	2009	2. below primary	16	0		1	Dhaka	6. Rickshaw puller	10	0
11_164_1456_1	2010	2. below primary	17	0		0	Dhaka	6. Rickshaw puller	0	0
11_164_1456_1	2011	2. below primary	18	0		0	Dhaka	6. Rickshaw puller	13	0
11_164_1456_1	2012	2. below primary	19	0		0	Dhaka	6. Rickshaw puller	9	0
11_164_1456_1	2013	2. below primary	20	0		0	Dhaka	6. Rickshaw puller	0	1
11_164_1456_1	2014	2. below primary	21	1		0		4. Fisherman	30	0
11_164_1456_1	2015	2. below primary	22	1		0		4. Fisherman	9	0
11_164_1456_1	2016	2. below primary	23	1	1	0		4. Fisherman	21	0
11_164_1456_1	2017	2. below primary	24	1	1	0		4. Fisherman	14	0

1st Migrant trips over time, Men aged 15 - 44



Selected Findings

1. Is erosion associated with rates of out-migration?

Analysis

Discrete time event history models: how geomorphological change (erosion/land loss) relates to risks of household heads making a 1st trip in a given year

- Controlled for time and community fixed effects
- Clustered standard errors (person)
- Created erosion variables from remotely sensed data (annual Landsat images from 1998 to 2017), merged to BEMS household data
 - Net area of land eroded (km²) **last year**

Generated cumulative probabilities of making 1st trip by age 43

Covariates

Time-varying characteristics

Age (under 20, 20-34, 35-49, over 50)

Marital status

Livelihood activity (lagged one year)

- Agricultural landowner
- Agricultural worker (non land owner)
- Non-agricultural worker

Social ties (lagged one year)

Weather conditions

- Dry spell intensity (CDD)
- Wet spell intensity (CWD)

Time-invariant characteristics

Education (< primary, completed primary, completed secondary, > secondary)

Gender (1=female, 0=male)

Religion (1=Muslim, 0=other)

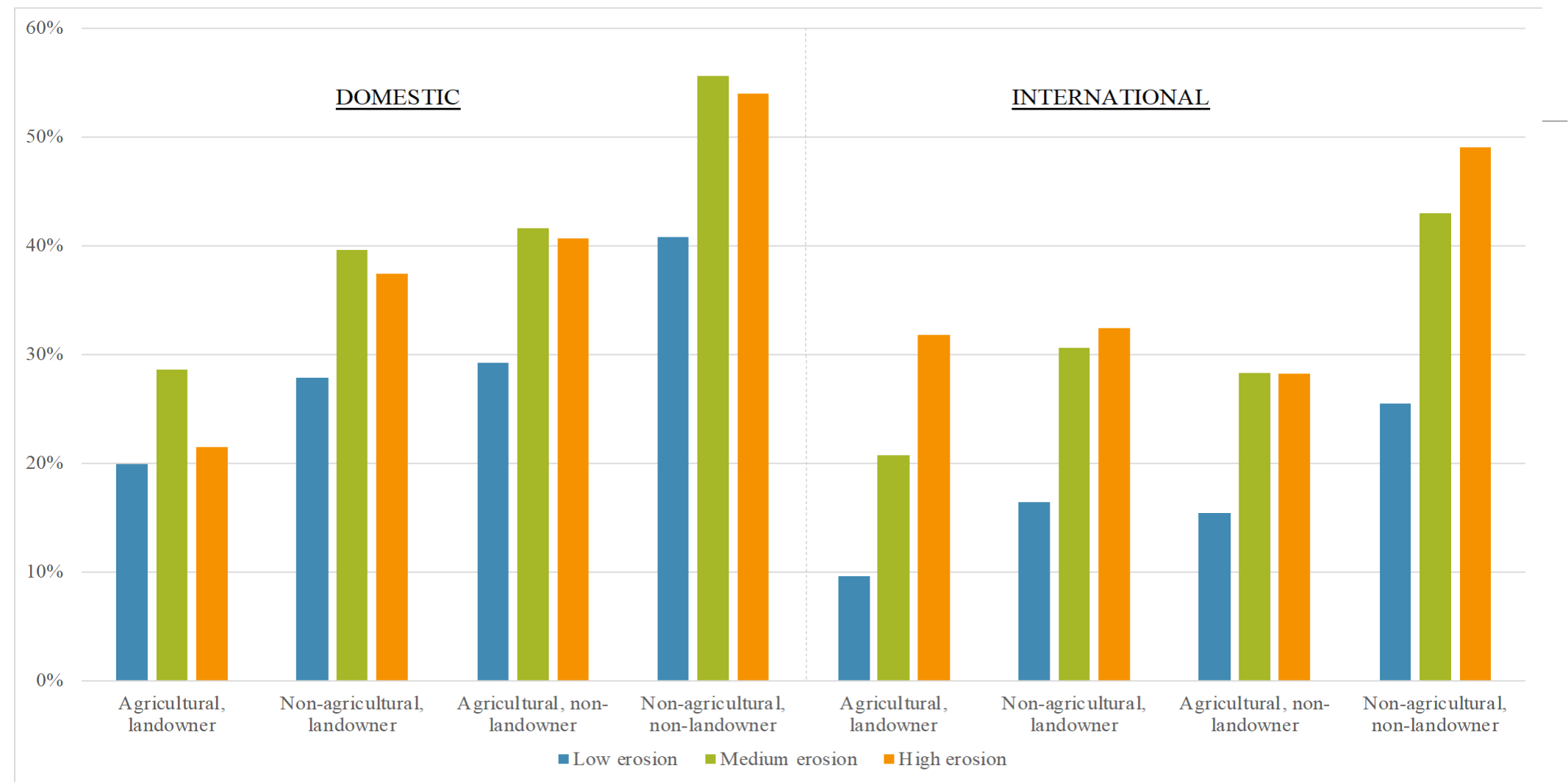
Is Erosion Associated with Outmigration?

- Erosion predicts increase in first domestic trips (5%/km²)
- Weak effect for international trips

Table 2: Logistic Regressions with Research Site and Year Fixed Effects

	Domestic		International	
	Odds ratio	AME	Odds ratio	AME
Absolute land loss (km ²) o	1.051*** (0.0192)	0.000942*** (0.000349)	1.067 (0.0500)	0.000414 (0.000301)
Social Ties - Internal	1.121 (0.0776)	0.00218 (0.00132)		
Social Ties - International			1.750*** (0.363)	0.00359*** (0.00133)
Age 20-34	0.884* (0.0581)	-0.00235* (0.00125)	3.503*** (1.347)	0.00805*** (0.00246)
Age 35-49	0.251*** (0.0311)	-0.0264*** (0.00236)	1.617 (0.776)	0.00309 (0.00308)
Age over 50	0.132*** (0.0260)	-0.0388*** (0.00375)	0.547 (0.351)	-0.00388 (0.00412)
Completed primary	1.128 (0.1000)	0.00231 (0.00169)	1.910*** (0.464)	0.00416*** (0.00155)
Completed secondary	1.249** (0.131)	0.00425** (0.00201)	2.398*** (0.678)	0.00562*** (0.00182)
Higher than secondary	1.671*** (0.240)	0.00981*** (0.00274)	1.790** (0.476)	0.00374** (0.00171)
Female	0.503*** (0.0676)	-0.0131*** (0.00256)	0.187*** (0.0790)	-0.0108*** (0.00270)
Muslim	1.205 (0.208)	0.00357 (0.00330)	9.739** (9.711)	0.0146** (0.00641)
Married	0.980 (0.0979)	-0.000378 (0.00191)	0.950 (0.217)	-0.000328 (0.00147)
Agricultural landowner	0.482*** (0.0810)	-0.0115*** (0.00204)	0.357*** (0.0716)	-0.00555*** (0.000781)
Agricultural worker, non-landowner	0.669*** (0.0759)	-0.00729*** (0.00180)	0.470*** (0.0739)	-0.00455*** (0.000733)
Dry spells (CDD)	0.999 (0.00380)	-2.80e-05 (7.27e-05)	1.012** (0.00517)	7.83e-05** (3.28e-05)
Wet spells (CWD)	1.010 (0.00917)	0.000190 (0.000174)	0.957 (0.0305)	-0.000284 (0.000205)
Constant	0.0199*** (0.00855)		5.20e-05*** (5.61e-05)	
Year Fixed Effects	Yes	Yes	Yes	Yes
Site Fixed Effects	Yes	Yes	Yes	Yes
Observations	38,671	38,671	33,053	33,053
R-squared	0.0771		0.156	

Cumulative Probabilities: Making 1st Domestic/International Trip by Age 43 by Erosion, Livelihood and Landownership



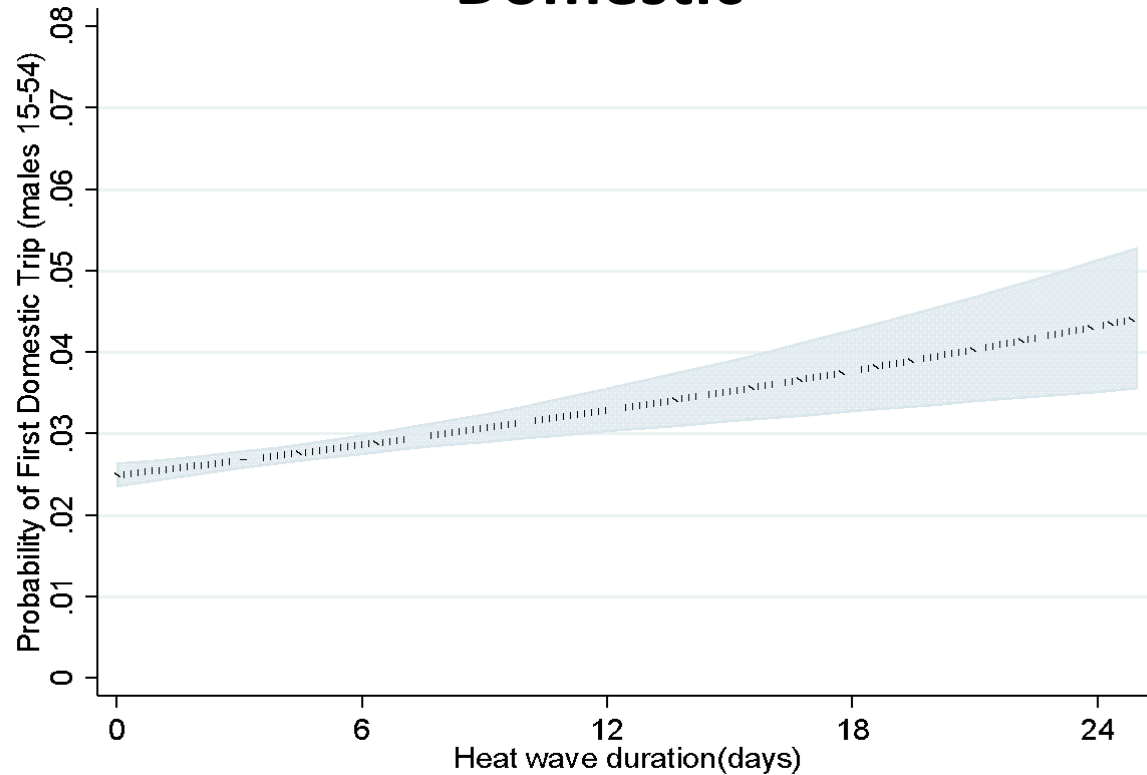
Note: Lifetime probabilities are for single Muslim men, born in 1974 who have completed primary school and no family with migration experience.

Selected Findings

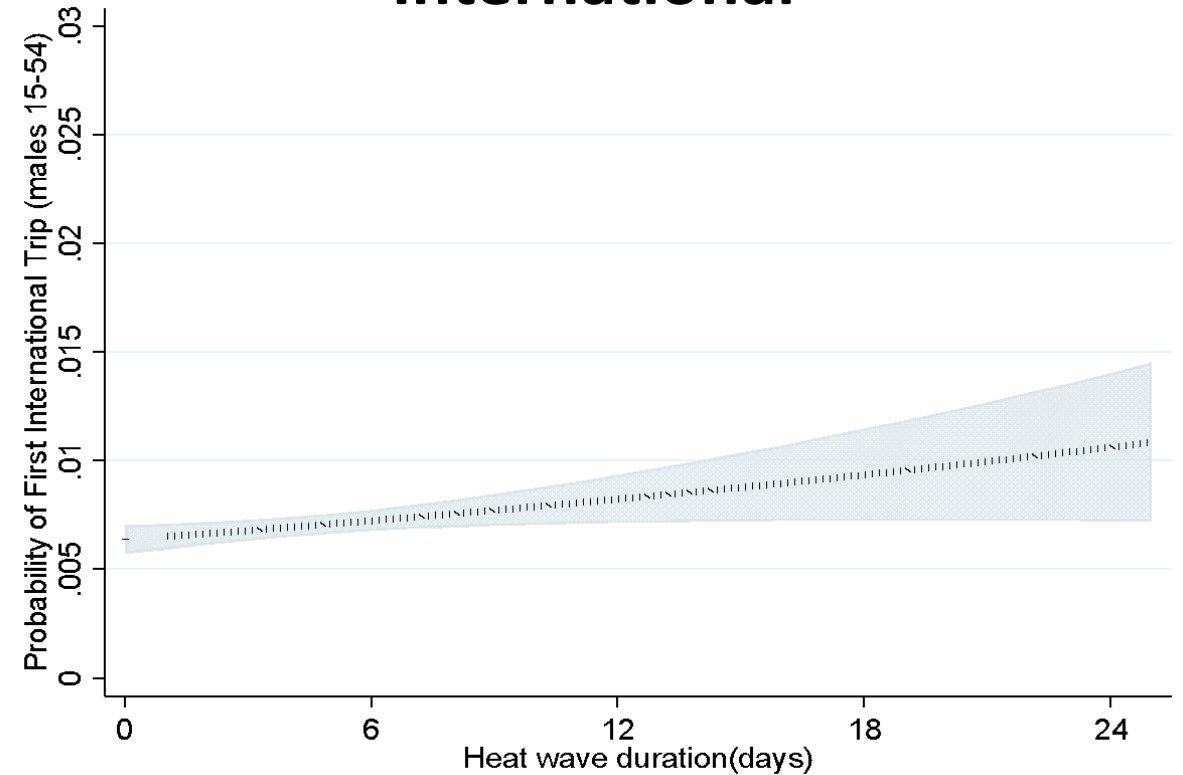
1. Is erosion associated with rates of out-migration?
2. Are heat waves associated with making 1st migrant trip?
3. Could extreme weather exacerbate early marriage?

Are Heat Waves Associated with 1st Migrant Trips?

Domestic

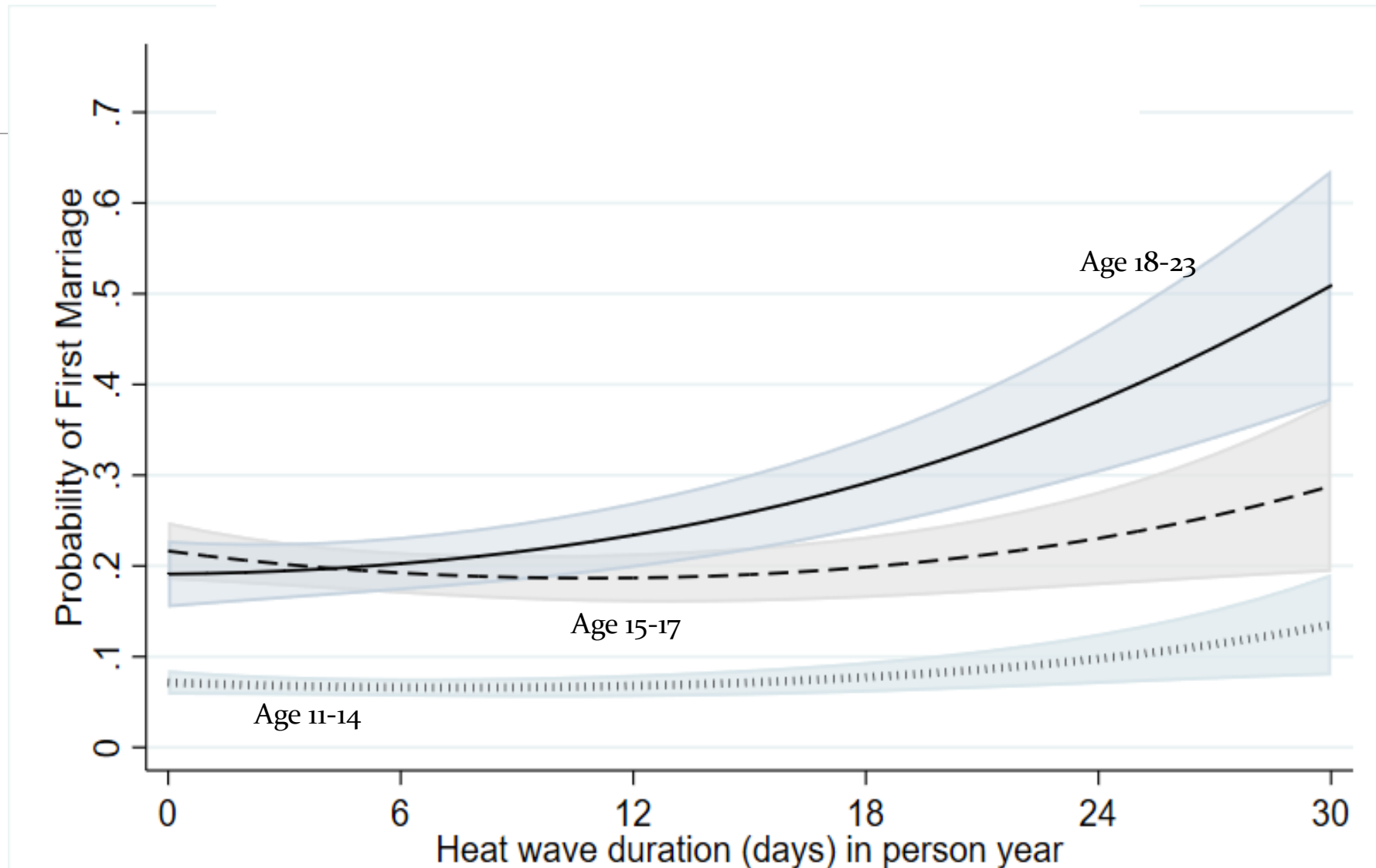


International



Carrico, A. R., & Donato, K. (2019). Extreme weather and migration: evidence from Bangladesh. *Population and Environment*, 41, 1-31.

Could Extreme Weather Exacerbate Early Marriage?



Selected Findings

1. Is erosion associated with rates of out-migration?
2. Are heat waves related to making 1st migrant trip?
3. Could extreme weather exacerbate early marriage?
4. Who are the environmental migrants?

Who Are the Environmental Migrants?

	Unaffected Years (5,910)		Heat Affected Years (579)		
	Mean	95% CI	Mean	95% CI	sig
(A) Migrant Demographics					
Male	0.72	0.70 – 0.73	0.74	0.69 – 0.78	
Age	29.26	28.83 – 29.70	31.52	30.06 – 32.97	***
Married	0.65	0.64 – 0.66	0.75	0.71 – 0.80	***
# of children <14 in household	1.27	1.22 – 1.31	1.73	1.56 – 1.90	***
(B) Migrant Socio-economic Characteristics					
Literate	0.78	0.76 – 0.79	0.77	0.73 – 0.82	
Education – Above primary	0.67	0.65 – 0.68	0.66	0.61 – 0.71	
Education – Above secondary	0.35	0.33 – 0.37	0.32	0.27 – 0.38	
Head in agriculture ¹	0.14	0.12 – 0.15	0.20	0.15 – 0.26	**
Head in unskilled work ¹	0.13	0.12 – 0.14	0.15	0.10 – 0.19	
Head in business/prof ¹	0.27	0.26 – 0.29	0.34	0.28 – 0.41	*
(D) Trip characteristics					
Destination is foreign	0.17	0.16 – 0.18	0.17	0.13 – 0.21	
Destination is Dhaka	0.41	0.39 – 0.42	0.36	0.30 – 0.40	*
Has migrant relatives	0.62	0.60 – 0.64	0.66	0.60 – 0.71	
First trip	0.58	0.57 – 0.60	0.56	0.50 – 0.62	
Duration > 1 year	0.71	0.71 – 0.72	0.70	0.65 – 0.74	
Duration > 5 years	0.48	0.46 – 0.50	0.52	0.47 – 0.58	
Livelihood sector					
Agriculture	0.01	0.01 – 0.01	0.02	0.00 – 0.05	
Unskilled labor	0.06	0.05 – 0.07	0.07	0.05 – 0.10	
Professional/Business	0.23	0.22 – 0.24	0.23	0.18 – 0.28	

Study Period: 2000 – 2019

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Study Period: 2000 - 2019

Next Stage: Migration, Rural Land Use, and Resilience in Coastal Bangladesh, Human-Environment and Geographical Sciences (HEGS/NSF) Funding

Version	Dates	Sample
BEMS-1	2013 – 2014	N = 1800 hhs; 9 sites
BEMS-2	2017 - 2022	N = 4000 hhs; 20 sites
BEMS-F1	2022 – 2025	Longitudinal followup with N=1500

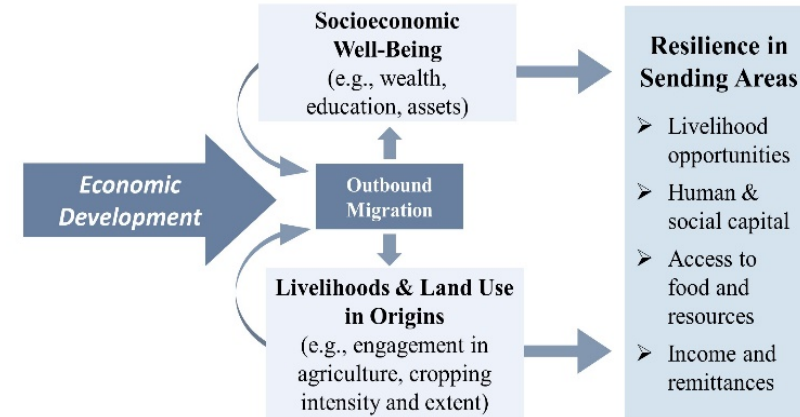


Focus to Migration Impacts on Origins

Two research questions:

1. What are the effects of migration on agricultural resilience in sending communities?
2. What are impacts of large-scale return-migration (COVID) on land use and well-being?

(A) Migration and Development Nexus



(B) Abrupt Return-Migration

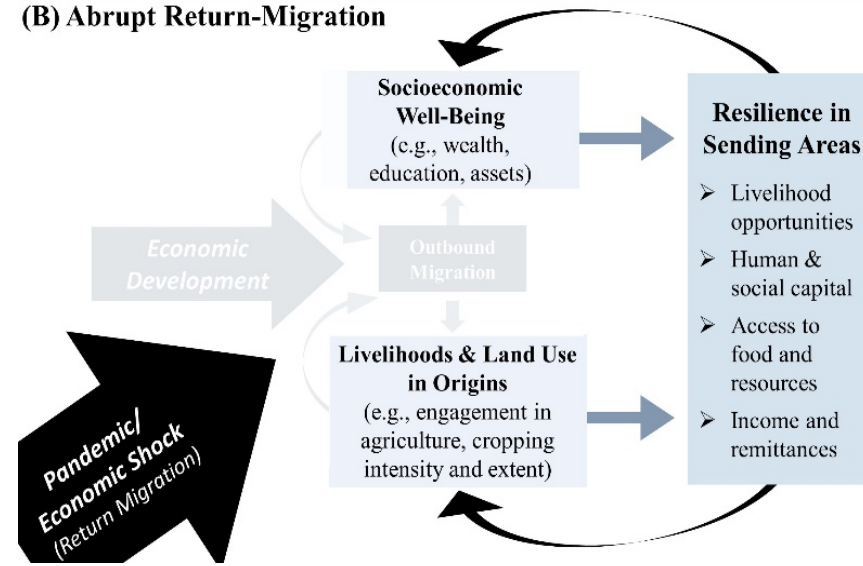


Figure 1- Linkages between migration and resilience in rural sending regions vis-a-vis socioeconomic conditions, agricultural activity, and land use.

HEGS Project (2022-25)

In 2022, returned to approximately 1400 households (part of 4000 2019 BEMS households)

- Collected/updated household and individual BEMS data
- Collected GIS markers for all land owned by households
- Analyze land use shifts using remotely sensed data
- Examine how COVID and return migration affect land use and well-being

Thank you

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CU Population Center

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