Credit Access, Migration, and Climate Change Adaptation in Rural Bangladesh

Joyce J. Chen
The Ohio State University

Jon Einar Flatnes*
The Ohio State University

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Abstract
We explore the impact of flooding on migration in Bangladesh and examine whether migration responses are mitigated by access to credit. Using unique data from a household survey conducted in rural Bangladesh shortly after the 1998 flood, we estimate the effect of flooding on both permanent and temporary migration. We utilize a difference-in-differences approach that relies on randomized early access to microfinance. Flood exposure is based on village-level reports of flood intensity, which can be treated as exogenous to individual households. We find that flooding led to increased temporary migration, with no effect on permanent migration. Moreover, access to credit several years earlier fully mitigates the migration effect, suggesting that credit access allows farmers to cope with severe climate events without having to migrate. Our study thus provides an important contribution to the broader literature on climate change adaptation, by demonstrating that relieving credit constraints could enhance local livelihood strategies during environmental hazards, without deterring gradual permanent migration away from vulnerable areas.

JEL codes: O15, J61, Q54
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I. Introduction

Climate change is increasing the frequency of extreme weather events, placing already fragile areas at even greater risk of environmental hazards. Migration as adaptation is also expected to increase, as local mitigation efforts are exhausted or rendered unviable. This will create unique challenges in the provision of disaster relief, as well as having important implications for economic geography and spatial inequality. An increasing number of papers quantify the magnitude of these migration responses in a variety of contexts. Yet evidence on the institutional and socio-economic factors enabling or impeding migration remains largely descriptive, making it difficult to assess the efficacy of potential mitigation policies and, in the future, the need for large-scale resettlement programs.

In this paper, we explore the impact of flooding on migration in Bangladesh, one of the world's most environmentally vulnerable regions, and examine the extent to which these migration responses are mitigated by access to credit. We examine both permanent and temporary migration to provide a more nuanced view of resilience and adaptation. Data are drawn from a unique panel survey conducted among 2,600 households in rural Bangladesh shortly after the 1998 flood. To estimate causal effects, we utilize a combination of flooding (reported by village leaders, and proxied by rainfall[1]) and exogenous variation in eligibility and access to microfinance programs (Pitt and Khankder, 1998). The impact of credit on environmental migration can be seen as a bellwether of the viability of *in situ* adaptation options. Access to credit helps to alleviate liquidity constraints and offset costs, thereby facilitating investment in livelihood diversification strategies. Therefore, in estimating the extent to which

[1] This flooding event pre-dates the launch of NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) satellite, which can be used to estimate inundation (Xu, 2006).

households choose migration over other options (*e.g.*, crop diversification, aquaculture), we can infer that migration is more effective than the other available local adaptation strategies.

Our results indicate that people residing in villages affected by the 1998 flood were more likely to temporarily leave the village; however, consistent with prior work, we find little to no effect on permanent migration. Moreover, access to credit fully mitigates the flooding effect, suggesting that credit access allows farmers to cope with severe climate events without having to migrate. Our study thus provides an important contribution to the broader literature on climate change adaptation by demonstrating that relieving credit constraints could enhance local livelihood strategies during environmental hazards, without deterring gradual permanent migration away from vulnerable areas.

II. Background.

The current literature has largely found a weak relationship between flooding and migration in Bangladesh. In a case study of floodplain residents along the Meghna River, Brouwer et. al. (2007) find that only 2% of households identified flooding as the direct reason for migration and, overall, very few households engaged in any *ex ante* flood mitigation efforts. Similarly, Lu *et. al.* (2016) find that long-term population flows are essentially unchanged by Cyclone Mahasen in 2013. Gray and Mueller (2012) find that crop failure due to drought has a larger effect on out-migration than flooding, and Chen and Mueller (2018) find that inundation alone has a negligible effect on migration. In some cases, environmental vulnerability may even deter migration. Chen et. al. (2017) find significant negative effects of severe flooding on permanent migration, suggesting a dynamic of trapped rather than displaced populations. Call et. al. (2017) also find significant negative effects of flooding on temporary moves, though migration patterns recover fairly quickly once floodwaters recede.

However, the effect of environmental vulnerability on migration need not be uniform across weather/climate events. Despite limited effects of flooding, there is evidence that other environmental hazards do trigger out-migration in Bangladesh, namely drought (Gray and Mueller, 2012), heat stress (Call et. al., 2017), and saline intrusion (Chen and Mueller, 2018). Catastrophic flooding events have also been found to have larger impacts on migration, particularly if the scope is expanded to include temporary moves. In a survey immediately following the floods of 2005, Rayhan and Grote (2007) find that 28% of households have at least one out-migrant, temporary or permanent, though it is unclear how many of these moves occurred directly in response to flooding. And, in a case study of Sreenagar, Haque finds that over 65% of households moved family to other areas following the 1988 floods, and migration is, by far, the most prevalent *ex post* flooding coping mechanism, again including both temporary and permanent moves.

This heterogeneity in observed environment-migration relationships implies that the context in which a shock occurs will affect the ultimate response. There is, then, scope for policymakers to strengthen local resilience and adaptation by better understanding not only the relationship between environmental factors and migration, but the socio-economic factors that mitigate that relationship. For example, in northern Bangladesh's Kurigram district, Etzold *et. al.* (2013) find that migration patterns are driven primarily by seasonal fluctuations in labor demand and wages, rather than rainfall variability. Chen and Mueller (2018) show a clear wealth gradient, with environment-migration relationships being more pronounced among asset-rich households. Similarly, the qualitative evidence of Rayhan and Grote (2007) indicates that migration is often motivated by the desire to restore wealth and assets, suggesting that migration is used as a source of credit.

Our paper, therefore, seeks to explore credit as a mitigating factor in the environment-migration nexus, focusing on the 1998 flood in Bangladesh. This was one of the largest floods in the nation's recent history, in terms of both depth and breadth. Flooding began in early July and continued for roughly three months, leaving approximately two-thirds of the country underwater for roughly seven weeks and affecting around 30 million people. The Asian Development Bank places total flood losses around $3.5 billion (Shehabuddin, 2000). An estimated 15,000 km of roads, 14,000 schools, and thousands of bridges and culverts were severely damaged (Shah, 1999). Losses in the rice crop totaled 2.04 million metric tons, leading to food shortages and nutritional deficiencies (Del Ninno, 2001). In a case study of two affected districts, over 98 percent of respondents developed new or exacerbated health problems following the flood (Kunii *et. al.*, 2002). Both agricultural and non-agricultural wages were depressed in the short-run, with losses ranging from 34 to 46 percent (Mueller and Quisumbing, 2011).

Significant aid flowed into the region following the flood, with the government receiving nearly $700 million in foreign assistance within six months of flood onset. Relief was delivered to flood victims by the Bangladeshi government as well as a range of non-governmental organizations (NGOs), primarily in the form of food aid and, to a lesser extent, cash transfers. The Gratuitous Relief program distributed 51,200 metric tons of rice to flood-affected areas, and the Vulnerable Group Feeding program provided monthly rice allocations to eligible households (Del Ninno, 2001). Large microfinance institutions, including Grameen Bank, also provided indirect aid in flood-affected regions (Brown and Nagarajan, 2000). Emergency loans were given both for relief and reconstruction, and borrowers were permitted to renegotiate terms on existing loans. The efficacy of these efforts was, however, limited by clients' capacity to take on additional debt burdens, particularly where loans were needed to fund non-income generating activities and/or investments (*e.g.*, consumption shortfalls, house repairs). The comprehensive evaluation of the 1998 flood provided by del Ninno (2001) finds that poor households borrowed heavily from informal credit sources during the flood and argues that broader coverage of targeted credit programs would have been useful for disaster relief. Mueller and Quisumbing (2011) similarly note the absence of resources for asset protection and suggest that improved credit access would have helped to minimize income losses.

III. Data.

We utilize data from a panel survey of households, the Bangladesh Institute for Development Studies' Credit Programs for the Poor Impact Survey, initially carried out in 1991-92 with a follow-up in 1998-99, after the flood. The survey included 1,769 households across 87 villages, drawn from 29 randomly selected sub-districts (*thanas*) of rural Bangladesh. Of the selected *thanas*, 24 had at least one of the three major microfinance (MFI) programs (Grameen, BRAC, BRDB) in operation, hereafter referred to as "program" *thanas*. At the time of the initial survey, these three programs were the primary microfinance providers in Bangladesh, comprising the vast majority of formal lending to poor households in rural Bangladesh, and all three programs determined eligibility using a landholding requirement. Sampling followed a quasi-experimental design whereby three villages within each *thana* were randomly selected, and stratified random sampling was used to oversample program-eligible households. Additional details of the data and survey design can be found in Pitt and Khandker (1998) and Khandker (2007).

In 1998-99, roughly 93% of households were resurveyed, and new split-off households were included as well. Additional households and *thanas* were also added, for a total of 2,623 households in the 1998-99 survey. New households are also classified according to *thana* program status and household eligibility for MFI services. Roughly 60% of survey villages were affected by the 1998 flood, and special flood modules were added to the survey. Khandker (2007) provides a thorough descriptive study of flood impact and household coping mechanisms. Wages in the survey villages fell by 10-13% during the flood but rebounded quickly and even surpassed pre-flood levels. Roughly three-quarters of affected villages experienced crop damage; 27% reported damaged housing, and nearly 90% experienced livestock damages. Household consumption and non-land assets both declined significantly during the flood, increasing household vulnerability (defined as the likelihood of falling into poverty).

Consistent with Del Ninno (2001), a little over one-third of households in flood-affected survey villages report skipping meals as a coping mechanism. Other prevalent coping mechanisms include distress sales of assets (9%) and migration outside the village (3.5%). Monthly borrowing increased by about 50% relative to the year prior to the flood, but loans also shifted from formal to informal sources, primarily friends and relatives, as well as landlords, employers, and local merchants. Households with access to microfinance programs were more likely to utilize borrowing as a coping mechanism, and Khandker (2007) finds that this borrowing raised both consumption levels and asset holdings.

Descriptive statistics for our sample are presented in Table 1. Our key outcomes of interest are temporary and permanent migration. Roughly 16% of households reported having a temporary migrant who departed during or after the flood, while 4% report having a permanent migrant. Migration is identified from a sub-module of the household roster. Individuals reported as household members but staying outside the village for at least one month since flood onset are considered temporary migrants. Permanent migrants are those who are no longer considered part of the household and are reported to have left the household since flood onset.

Table 1: Descriptive Statistics

Variable	N	Mean	Std.Dev.	Min	Max
Migrated permanently. (0/1)	2,623	0.04	0.21	0	1
Migrated temporarily (0/1)	2,623	0.16	0.36	0	1
Village flooded	2,623	0.59	0.49	0	1
Household flooded	2,623	0.45	0.50	0	1
MFI present (0/1)	2,623	0.79	0.41	0	1
Eligible for credit (0/1)	2,623	0.82	0.39	0	1
MFI & eligible (0/1)	2,623	0.65	0.48	0	1
Borrowed 1991 (0/1)	2,623	0.51	0.50	0	1
Education (yrs)	2,623	5.05	3.89	0	14.00
Own business (0/1)	2,623	0.36	0.48	0	1.0
Land Value (1000 Takas)	2,623	201.78	899.10	0	35,400
Food expenditures (1000 Takas)	2,623	0.49	0.29	0	3.48
Non-food expen. (1000 Takas)	2,623	13.69	25.82	0	336.26
Total expenditures (1000 Takas)	2,623	14.18	25.96	0	337.39

The main regressors of interest are flooding and credit eligibility. Consistent with the original study design, 79% of households reside in program *thanas*, and 82% are eligible for MFI services. Although 65% of sample households could borrow from MFIs, only 51% report having borrowed in 1991. Flooding within villages is drawn from community-level surveys in which village leaders are asked to report on aggregate flood extent and damage. This is arguably a more objective measure of flooding and is clearly less closely tied to individual households' socio-economic status and any *ex ante* flood mitigation efforts. Flood impact is not uniform within villages; although 60% of villages are affected, only 45% of households report being affected. This suggests that community-level reports of flooding can also be used as an instrumental variable for household-level flood exposure.

We also present estimates using total precipitation as a proxy for flooding. These data are drawn from NASA's Tropical Rainfall Measuring Mission (TRMM), which provides measures at 0.25 x 0.25° resolution. Correlations between TRMM and rain gauge data are very high, but extrapolation from daily measures has been shown to produce biased estimates for specific regions (dry vs. wet regions) during specific seasons (pre-monsoon vs. monsoon) (Tarek *et. al.*, 2017). Following Islam and Uyeda (2007), we therefore utilize monthly precipitation values extracted from TRMM, aggregated up to annual measures, to reduce measurement error.

Rainfall-based proxies for flooding are less subject to reporting bias and measurement error than those reported by individuals. However, other studies have shown that, in Bangladesh, rainfall is a poor proxy for inundation (Guiteras *et. al.*, 2015; Chen *et. al.*, 2017). Because a large proportion of flooding in Bangladesh is due to river over-topping, as occurred in 1998 as well, localized rainfall may be less important for concurrent flooding, in many areas, than upstream water conditions. Nonetheless, proximity to rivers is a key indicator of underlying geophysical flood risk. We therefore augment our analysis with a measure of river density, based on the percentage of total land area within the sub-district that contains a river.

III. Empirical Approach.

We employ a linear probability regression model to estimate the impact of the 1998 Bangladesh flood on migration responses, which takes the following general form:

$$P(M_{vi} = 1 | F_{vi}, B_{vi}, X_{vi}) = \alpha_0 + \alpha_1 F_{vi} + \alpha_2 B_i + \alpha_3 F_i B_{vi} + \alpha_4 X_i + \epsilon_i \qquad [1]$$

Here, M_{vi} is a binary variable representing either temporary or permanent migration for household i in village v following the 1998 flood. F_{vi} is either village-level flooding or TRMM rainfall. When including rainfall in the model, we also control for river density, given that flood risk depends on river proximity. B_i indicates either whether the household had access to credit as part of the microfinance program rolled out in 1991 or whether it actually borrowed in 1991. X_i includes household-level characteristics from the 1991 survey, such as land value, business ownership, and a set of demographics variables (age, gender, education, number of household members) . We also include migration in 1991 to control for any unobserved factors affecting the propensity to migrate. Given this specification, α_1 and α_3 are the key coefficients of interest, as they represent the impact of flooding on migration and the potentially mitigating effect of credit, respectively.

This specification might suffer from one potential source of bias. In particular, credit access is likely to be endogenous to the migration decision. For example, more resourceful farmers may be more likely to receive credit and simultaneously be more mobile. In order to control for the endogeneity of credit access, we utilize the fact that a portion of our sample was targeted by three MFI programs in 1991. In particular, 24 out of the 32 *thanas* in the sample were designated as program areas. Furthermore, in the targeted *thanas*, only farmers owning less than half an acre of land were eligible for loans. While the targeting of program *thanas* was not random, the design nonetheless allows us to utilize a difference-in-differences (DiD) approach to account for self-selection into MFIs. In particular, after controlling for both *thana*-level inclusion in the program and eligibility for loans, credit access (eligible households in targeted *thanas*) can be treated as exogenous. The use of the DiD approach relies on the parallel trend assumption, which in this context implies that the difference in migration between targeted and non-targeted *thanas* must be the same in both eligible and non-eligible households. A discussion of the appropriateness of this approach in ensuring that credit access can be treated as exogenous can be found in Pitt and Khandker (1998) and Pitt (1999). Finally, in addition to including credit access directly in the model, we also use credit access as an instrument for actual borrowing in 1991.

In the analysis that follows, we separately study the effect on permanent and temporary migration. Furthermore, for each outcome, we consider four different specifications, based on the discussion above. In particular, the most basic specification [1] includes only the effect of village flooding and individual control variables, and does not control for credit access or borrowing. Next, specification [2] includes credit access in 1991 directly in the model and interacts credit access with village flooding. This allows us to study the differential effect of flooding between households who had access to credit and those who had no credit access. Third, specification [3] looks at the effect of borrowing instead of credit access. Here, credit access and credit access interacted with village flooding are used as an instruments for borrowing and borrowing interacted with village flooding. Finally, specification [4] is similar to [3], but uses rainfall as a proxy for flooding and includes a variable for river density.

IV. Results

Effect on Temporary Migration

Table 2 shows the results of estimating the four specifications of model 1 for temporary migration responses. When not controlling for credit access, we find no significant effect of village flooding on temporary migration. This is consistent with several papers that have shown no net impact of flooding on migration. As expected, having a migrant in 1992 is strongly associated with having migrants in 1999.

However, when breaking up the migration response to flooding by credit access, the data tell a different story. In particular, we find that among households who did not have access to microfinance loans in 1991, residing in a flooded village is associated with a significant increase in temporary migration of 10 percentage points. Furthermore, while credit access has an insignificant impact on temporary migration in the absence of a flood, credit access fully mitigates the response to flooding (significant at the 10% level). Put differently, among the households who were given access to microfinance loans in 1991, households affected by the 1998 flood were no more likely to temporarily migrate relative to non-affected household after controlling for the targeting of the MFI program and eligibility. This finding suggests that credit access has long-lasting effects on farmers' ability to cope with severe climate shocks without having to migrate.

When instrumenting for household-level flooding and actual borrowing in 1991 with village-level flooding and credit access, the results are similar in magnitude, and significance levels are mostly unchanged for key variables. In particular, the effect of a household being affected by the flood on temporary migration is identical. Moreover, the mitigating response of actual borrowing on the flooding effect is also slightly higher (-0.12 versus -0.084 for credit access), and this response is significant when instrumenting for actual borrowing. Finally, while rainfall has a positive and significant effect on temporary migration, the mitigating response of credit is no longer significant. This might be due to measurement error in rainfall or the fact that rainfall is a poor proxy for village-level flooding.

Table 2: Regression Results – Temporary Migration

	OLS [1]	OLS [2]	IV [3]	IV [4]
Village flooded	0.039	0.10***	0.10***	
	(0.029)	(0.036)	(0.034)	
Rainfall 1998 (1,000mm)				0.092***
				(0.033)
MFI present		-0.054	-0.053	-0.091
		(0.061)	(0.060)	(0.067)
HH eligible for MFI loan		0.012	0.012	0.014
		(0.075)	(0.078)	(0.079)
Credit Access (Elig. X MFI)		0.065		
		(0.071)		
Borrowed from MFI 1991			0.092	0.22
			(0.10)	(0.18)
Village flooded X Credit Access		-0.084*		
		(0.042)		
Village flooded X Borrowed 1991			-0.12**	
			(0.057)	
Rainfall 1998 X Borrowed 1991				-0.083
				(0.059)
Migrant 92	0.16***	0.15***	0.14***	0.15***
	(0.037)	(0.037)	(0.037)	(0.036)
River density (km/sqkm)				0.17
				(0.17)
Constant	-0.17*	-0.19**	-0.19**	-0.35***
	(0.083)	(0.086)	(0.079)	(0.11)
Observations	1668	1668	1668	1668
R^2	0.076	0.080	0.077	0.084

SEs are clustered at Thana level. *p $<$ 0.10, ** p $<$ 0.05, *** p $<$ 0.01. Dependent variable is a dummy for whether the household had at least one temporary migrant since the 1998 flood. Control variables are included but not reported.

Overall, these findings suggest that while the net migration response following the 1998 Bangladesh flood is negligible, this result is driven by the fact that a large fraction of the sample already had access to credit. When separately analyzing the migration response for households with and without credit access, households without such access are significantly more likely to engage in costly temporary migration following the flood.

Effect on Permanent Migration

Table 3: Regression Results – Permanent Migration

	[1]	[2]	[3]	[4]
Village flooded	-0.0059	0.0041	0.0064	
	(0.011)	(0.023)	(0.023)	
Rainfall 1998 (1000mm)				-0.036**
				(0.014)
MFI present		-0.060	-0.059	-0.043
		(0.087)	(0.084)	(0.082)
HH eligible for MFI loan		-0.087	-0.091	-0.090
		(0.065)	(0.067)	(0.067)
Credit Access (Elig. X MFI present)		0.080		
		(0.075)		
Borrowed from MFI 1992			0.12	0.016
			(0.11)	(0.10)
Village flooded X Credit Access		-0.014		
		(0.026)		
Village flooded X Borrowed 1991			-0.023	
			(0.036)	
Rainfall 1998 X Borrowed 1991				0.036*
				(0.020)
Migrant 92	0.0012	0.0031	-0.0043	0.0016
	(0.018)	(0.019)	(0.021)	(0.020)
River density (km/sqkm)				-0.12**
				(0.054)
_cons	0.073	0.15*	0.13*	0.22***
	(0.051)	(0.084)	(0.068)	(0.080)
Observations	1668	1668	1668	1668
R^2	0.031	0.034	0.014	0.013

SEs are clustered at Thana level. *p $<$ 0.10, ** p $<$ 0.05, *** p $<$ 0.01. Dependent variable is a dummy for whether the household had at least one permanent migrant since the 1998 flood. Control variables are included but not reported.

Next, we consider the effect of flooding and credit access on permanent migration. Table 3 shows that there are no effects of village-reported flooding or access to credit on permanent migration. However, our results suggest that there is a significant negative effect of rainfall in

1998 on the propensity to temporarily migrate and that his effect is mitigated by access to credit. These results are consistent with the idea that the decision to permanently leave vulnerable areas is a more gradual process that is not affected by a single catastrophic weather event.

V. Discussion and mechanisms

While our results suggest migration responses to the 1998 flood was fully mitigated by access to credit seven years earlier, they do not explain the mechanisms driving this results. Conceptually, credit access has the potential to increase a household's capacity to cope with adverse weather events. For example, the option to borrow from a formal lender after a shock may provide insurance, allowing people to remain in their villages rather than having to migrate in order to seek outside opportunities. Moreover, previous loans may have enabled households to diversify their portfolios, and thus helping to build resilience against flooding events. In particular, farmers who invested in fish farming may actually benefit from increased rainfall. Finally, credit access may allowed households to build up their own savings over time, which could serve as a buffer during adverse events.

In order to test some of these plausible mechanisms, we look at whether access to credit in 1991 affected the probability of owning a business, owning a fish farm, borrowing, savings, number of agricultural crops, and both agricultural and non-agricultural labor. Table 4 presents these results and shows that people who had credit access in 1991 were significantly more likely to be involved in fish farming and to borrow in 1999. These results suggest that credit access may have mitigated the migration response by allowing households to diversify their portfolios and by providing them with future credit access that could serve as insurance after an adverse shock.

Table 4: Regression Results – Effect of credit access on 1999 outcomes

	Own non-ag bus.	Own fish bus.	Borrow	Savings	No. of crops	Ag. labor	Non-ag. labor
MFI present	0.076	0.018*	-0.026	-2073.2	-0.53	-0.094	-0.054
	(0.068)	(0.0090)	(0.064)	(5026.6)	(0.53)	(0.058)	(0.054)
HH elig. for MFI loan	0.030	-0.014**	0.093	-1268.7	-1.50***	0.13	0.038
	(0.077)	(0.0066)	(0.063)	(2383.2)	(0.33)	(0.086)	(0.090)
Credit Access	-0.012	0.033**	0.46***	1859.2	0.49	-0.040	0.066
	(0.080)	(0.014)	(0.068)	(3907.3)	(0.36)	(0.092)	(0.097)
Constant	0.25***	0.066	0.17	3373.2	2.66***	0.40***	0.25**
	(0.089)	(0.070)	(0.11)	(4813.9)	(0.62)	(0.096)	(0.11)
Observations	1668	1668	1668	1668	1668	1668	1668
R^2	0.150	0.020	0.251	0.062	0.117	0.129	0.046

SEs are clustered at Thana level. *p $<$ 0.10, ** p $<$ 0.05, *** p $<$ 0.01. Control variables are included but not reported.

VI. Conclusion

Climate change presents unique challenges for smallholder farmers in developing countries and forces already fragile populations to adopt expensive coping strategies in order to deal with an increased frequency of severe weather events. In order to design policies that can help people more effectively adapt to climate change, it is therefore important to first understand existing coping strategies and assess which policies might help mitigate such strategies. In this paper, we have studied the impact of flooding on migration in Bangladesh, one of the world's most environmentally vulnerable regions, and examined whether migration responses are mitigated by access to credit. Specifically, we have focused on the 1998 flood, which was one of the largest floods in recent history, leaving approximately two-thirds of the country underwater for roughly seven weeks and affecting 30 million people. Using unique data from a survey conducted among roughly 2,600 households in rural Bangladesh shortly after the 1998 flood, we estimated the effect of flooding and credit access on both permanent and temporary migration.

Our results indicate that people residing in villages affected by the 1998 flood were more likely to temporarily leave the village; however, we find no effect on permanent migration.

Moreover, access to credit fully mitigates the migration effect, suggesting that credit access allows farmers to cope with severe climate events without having to migrate. Our results also suggest that this effect might be due to farmers diversifying their portfolios into fish farming and to households having access to credit, which can serve as a form of insurance during adverse shocks.

Our study has important implications for policies aimed at assisting farmers in vulnerable areas to more effectively cope with climate change. Most importantly, we have demonstrated that providing access to credit could have effects beyond simply increasing income in that it may also reduce the need to engage in costly temporary migration. However, future research should explore the mechanisms that are driving these results.

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