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Abstract

Exposure to Climate Disasters and Individual Migration Aspirations: Evidence from Senegal and the Gambia

Daniel Meierrieks and Irene Pañeda-Fernández

How do climate disasters shape migration? The existing evidence presents conflicting and inconclusive findings. To address this question, we theorize the cognitive processes guiding migration decisions in the wake of disasters. On the one hand, the link between climate disasters and migration aspirations may be driven by sudden-onset (e.g. heavy rains, storms and landslides) rather than gradual-onset events (e.g. droughts) because the devastating effect of the former may be easier to perceive. On the other hand, gradual climate disasters may be more influential because they can be perceived as more irreversible given their protracted nature. To test our hypotheses, we analyze original survey data from a representative sample of 5,700 individuals in Senegal and the Gambia. We show that individual exposure to past climate disasters predicts higher migration aspirations, a result robust to controlling for objective past climate conditions. On closer inspection, we show that only individuals with experience with gradual-onset events report higher migration aspirations, while experience with sudden-onset events has no comparable effect. Consistent with our regression analysis, results from an embedded survey experiment show that informational cues about future climate stress only impact the migration aspirations of individuals which have experienced gradual-onset weather events in the past.

Keywords: *migration; climate disasters; climate change; gradual events; sudden events; migration aspirations*

JEL classification: F22; Q54

Zusammenfassung

Wie wirken sich Klimakatastrophen auf die Migration aus? Die bereits vorliegende Evidenz ist widersprüchlich und nicht schlüssig. Um diese Frage zu klären, stellen wir daher zunächst eine Theorie zu den kognitiven Prozessen auf, die Migrationsentscheidungen in Folge von Klimakatastrophen steuern. Einerseits könnte der Zusammenhang zwischen Klimakatastrophen und Migrationsbestrebungen eher durch plötzlich auftretende Ereignisse (z. B. schwere Regenfälle, Stürme und Erdrutsche) als durch allmählich eintretende Ereignisse (z. B. Dürren) hervorgerufen werden, da die verheerenden Auswirkungen der ersteren möglicherweise leichter wahrgenommen werden können. Andererseits könnten allmählich eintretende Klimakatastrophen einflussreicher sein, da sie aufgrund ihrer Langwierigkeit als unumkehrbar wahrgenommen werden. Um unsere Hypothesen zu überprüfen, analysieren wir eigens erhobene Daten einer repräsentativen Stichprobe von 5.700 Personen in Senegal und Gambia. Wir zeigen, dass die individuelle Exposition gegenüber vergangenen Klimakatastrophen höhere Migrationswünsche in der Gegenwart vorhersagt – ein Ergebnis, das auch bei Berücksichtigung objektiver vergangener Klimabedingungen robust ist. Bei näherer Betrachtung zeigt sich, dass nur Personen mit Erfahrungen mit allmählich eintretenden Klimaereignissen (insbesondere Dürren) höhere Migrationswünsche äußern, während Erfahrungen mit plötzlich eintretenden Klimaereignissen (z.B. Starkregen) keinen vergleichbaren Effekt haben. In Übereinstimmung mit unserer Regressionsanalyse zeigen die Ergebnisse eines Umfrageexperiments, dass Informationszeichen über zukünftigen Klimastress nur die Migrationswünsche von Personen beeinflussen, die bereits in der Vergangenheit Erfahrungen mit allmählich eintretenden Wetterereignissen gemacht haben.

Schlüsselwörter: *Migration; Klimakatastrophen; Klimawandel; allmähliche Ereignisse; plötzliche Ereignisse; Migrationsbestrebungen*

JEL Klassifikation: F22; Q54

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1. Introduction

Throughout the world, many people have the desire to migrate to another country. For instance, according to the 2016 *Gallup World Poll* conducted in over one hundred countries, about 23.5 percent of respondents said that they would permanently move to another country if they had the opportunity (Gallup, 2016). While not all migration aspirations ultimately lead to actual migration (e.g., Docquier et al., 2014; Tjaden et al., 2019), these figures nevertheless point to a large *migration potential* as an upper bound of the eventual international migration that can be expected.[1] These figures also motivate research interests in the determinants of international migration aspirations and behavior.[2]

The *role of environmental factors in migration* is increasingly receiving attention in the literature, with studies investigating whether weather-related environmental stress (e.g., in the form of droughts, heavy rains or storms) could induce a migration response, especially in light of the ongoing increase in average temperatures (climate change and global warming) and its effects on environmental hazards (e.g., floods and wildfires) as arguably one of the biggest challenges of our times. Overall, the evidence concerning the migration response to environmental stress appears to be mixed (e.g., Beine and Parsons, 2015; Cattaneo and Peri, 2016;

[1] Indeed, the stock of international migrants is substantial. According to the *International Labour Organization*, in 2019 the international migrant stock was approximately 272 million individuals, meaning that about 3.5 percent of the world's population lived outside their country of origin (ILO, 2021).

[2] This research interest is also due to the potentially substantial economic, political and security consequences of international migration for sending and destination countries, e.g., concerning the role of international migration in wages, labor markets, economic growth and development, political institutions and socio-political stability. Reviews of the related literate can be found in, e.g., Longhi et al. (2005), Okkerse (2008), Hanson (2009), Kapur (2014) and Helbling and Meierrieks (2022).

Helbling and Meierrieks, 2021; see also the reviews by Piguet et al., 2011; Berlemann and Steinhardt, 2017; Cattaneo et al., 2019; Kaczan and Orgill-Meyer, 2020). That is, while migration—both internally and internationally—is argued to be a possible strategy to adapt to environmental stress, it is unclear whether and to what extent such adaptations indeed take place (Gemenne 2011). Indeed, this ambiguity has led some scholars to claim that climate-induced migration is negligible (e.g. de Haas 2023).

The issue of *environmental migration* is especially relevant to Africa because this continent tends to be particularly vulnerable to environmental stress (e.g., Bleibaum, 2010; Afifi, 2011; Hummel, 2016) and is predicted by the *Intergovernmental Panel on Climate Change* to bear a disproportionate impact of climate breakdown (IPCC, 2022). At the same time, Africa also exhibits an especially young population that is eager to migrate. As with the overall literature on the nexus between environmental factors, climate change and migration, the evidence for Africa tends to be mixed (e.g., Findley, 1994; Romankiewicz and Doevenspeck, 2015; Helbling et al., 2021; see also the literature reviews by Morrisey, 2014; Boderon et al., 2019; Balgah and Kimengsi, 2022).

In this paper, we contribute to the literature on the nexus between environmental factors and migration in Africa in several ways. First, we explicitly theorize at the individual level how individual exposure to different types of climate disasters (such as droughts, heavy rains and storms) shapes *international migration aspirations*.[3] Second, we empirically test our hypotheses with a unique original survey that is nationally representative of the population aged 15-36 for the Gambia and representative of the two most populated regions in Senegal—Casamance and Dakar—for the same age group. Third, we study how various climate disasters (e.g.,

[3] Following Carlin and Schewel (2018: 946), in this paper the term *migration aspirations* refers to the "conviction that migration is preferable to non-migration".

droughts, storms, landslides and heavy rainfall) shape individual migration aspirations, in contrast to existing research on the migration response to environmental stress in Africa which focus only on specific types of events when studying their roles in environmental migration in sub-Saharan African.

Concerning our theoretical contribution, we argue that individual exposure to climate disasters rather than objective climate conditions affect the formation of individual migration aspirations. Drawing on theoretical arguments related to bounded rationality and incomplete information, we hypothesize that past exposure to (and remembrance of) environmental stress leads to higher migration aspirations. We argue that this is because such individual exposure induces a cognitive response – related to information updating and the formation of stress-specific habits and emotions – which, in turn, facilitates the emergence of migration aspirations. Furthermore, we study whether *different types of climate disasters*—gradual- versus sudden-onset—shape aspirations to migrate internationally differently. Again, differences in response may be driven by individual exposure to such disasters and the potentially diverse cognitive effects they induce. On the one hand, the link between climate disasters and migration may be driven by *sudden climate disasters* (e.g. floods or landslides) because the devastating effect of these may be easier to perceive. On the other hand, the link may be driven by *gradual climate disasters* (e.g. droughts and increased salinity) because these can be perceived as more irreversible given their slow-unfolding nature.

For our empirical analysis, we combine correlational evidence with an embedded survey experiment. First, in a regression framework, we show that individual exposure to past climate disasters indeed predicts higher migration aspirations. This result is robust to us controlling for objective past climate conditions. On closer inspection, we also show that only individuals with experience with gradual-onset events, especially droughts, report higher migration aspirations, while experience with sudden-onset events (such as heavy rains, storms and landslides) has no comparable effect. Second, we run a survey experiment to bolster causal claims

about the effect of individual experiences with climate disasters and migration aspirations. Consistent with our regression findings, we show that informational cues about future weather stress only impact the migration aspirations of individuals which have experienced gradual-onset weather events in the past. Consequently, our empirical findings speak to our main theoretical ideas that emphasize how individual perceptions of weather-related environmental stress (over and above objective climate measure) shape individual migration intentions, where a key characteristic of climate disasters—whether they are sudden or gradual—also impacts the extent to which they spark the desire to migrate internationally. These findings and underlying theoretical arguments have important implications for the study of how climate change might impact international migration that go beyond the African context studied in this paper.

2. Theoretical Considerations and Hypotheses

2.1 Migration as a Process

The *migration process* commonly starts with the formation of migration aspirations and includes the planning and preparation of the migration journey, culminating with the migration journey itself (e.g., Kley, 2011; Carling and Schewel, 2018). In this contribution, we are interested in how individual exposure to weather-related environmental events matters to the first stage of the migration process, the emergence of migration aspirations.[4] Importantly, while not all migration aspirations lead to actual migration, there is a strong positive relationship between them (e.g., Docquier et al., 2014; Tjaden et al., 2019). For instance, Tjaden

[4] Note that in this paper, we analyze the relationship between the formation of *voluntary* international migration aspirations in response to weather-related environmental events. We do not consider an involuntary migration response to such events, e.g., in the form of a *flight* from locations affected by weather-related disasters. Clearly, for such involuntary migration the migration process could take a different form.

et al. (2018) study the relationship between migration aspirations and official migration flow data for more than 160 countries, finding a positive association between aspirations and aggregated international migration. Understanding how exposure to weather-related environmental events shapes migration aspirations is thus also eminently important to assess the relationship between weather events and the (observed) patterns of migration.

By approaching migration as process and investigating how environmental stress shapes the formation of (im)mobiliy aspirations, we seek to avoid the mobility bias that abounds migration research in general (Schewel 2019) and climate mobility research in particular (Zickgraf 2021b) and open the black box of how perceptions shape the process (Koubi et al., 2016).

2.2 Economic Models of Climate Migration

When studying the impact of environmental stress on migration, scholars have tended to use models that invoke economic motivations in the context of, e.g., cost-benefit analyses or push-pull models (e.g., Sjaastad, 1962; de Jong et al., 1983; Dorigo and Tobler, 1983; Borjas, 1989; Massey et al., 1993; Van Hear et al., 2020). This *homo economicus* framework contends that migration aspirations form when the expected utility of migration (expressed in terms of earning higher wages abroad) surpasses the expected utility of staying in one's home country (i.e., earnings at home). For instance, the stress associated with climate change may reduce economic activity (e.g., Kallis, 2008; Dell et al., 2014; Henseler and Schumacher, 2019), adversely impact human health (e.g., Haines et al., 2006; McMichael et al., 2006; Meierrieks, 2021) and contribute to political and institutional instability (e.g., Berrebi and Ostwald, 2011; Mach et al., 2019). This stress is expected to lower the earnings potential in countries affected by climate change (e.g., by contributing to unemployment). Consequently, economic models of migration contend that the unfavorable consequences of climate change make it less attractive to

stay in one's home country and increase the benefits of migrating abroad where socio-economic and political conditions are comparatively preferable.

However, while economic theory provides a clear theoretical prediction—climate stress leads to more migration—the empirical evidence remains mixed (see the overviews by Piguet et al., 2011; Berlemann and Steinhardt, 2017; Cattaneo et al., 2019; Kaczan and Orgill-Meyer, 2020). That is, despite the obvious and widespread negative consequences of climate disasters, the evidence suggests that not as many individuals end up migrating in their wake as economic migration models would predict (e.g., Adger et al., 2015; Hunter et al., 2015; Schewel et al., 2022). Relatedly, most prior work focuses on realized migration decisions, an approach that does not leave room for delving into the cognitive processes involved in migration decision-making.

2.3 Cognition and Migration Aspirations

In this paper, we argue that an alternative perspective is needed to adapt previous frameworks and theorize at the individual level how individuals perceive climate disasters and how these perceptions shape migration aspirations. This leads to more nuanced predictions about the impact of climate events on migration intentions, highlighting heterogeneities rooted in cognitive processes as well as individual experiences with a broad range of climate disasters.

Social scientists have long alerted us that models of human decision-making that assume full knowledge and rationality are implausible because humans are boundedly rational, i.e., they are limited in the amount of information they can process and thus in the choices they can make (Martin 2010; Miller 1956). Due to such limitations, people generally rely on habit and schemas (Cerulo 2010, 2014; DiMaggio 1997; Lizardo and Strand 2010; Martin 2010; Vaisey 2009; Zerubavel 2015), which are "mental structures related to memory and pattern recognition" and "provide a framework for organizing information" (Cerulo, Leschziner, and Shepherd 2021:66). Decision-making scholars have also shown that individuals

tend to use only a small fraction of the available information (Brandstätter, Gigerenzer, and Hertwig 2006; Galotti 2007; Payne, Bettman, and Johnson 1993) and restrict their focus to only some of the relevant information (Cooksey 1996; Zsambok and Klein 2014). Empirically, these bounded rationality models rest on solid ground as scholars have provided extensive evidence of how schemas and mental shortcuts are acquired and activated – e.g. work on positive asymmetry (Cerulo 2006; Fligstein, Stuart Brundage, and Schultz 2017; Reynolds and Baird 2010) or in the context of implicit bias (Greenwald and Krieger 2006; Levinson 2007; Melamed et al. 2019; Valian 2005).

In line with this thinking, some migration scholars argue that decision-making pertaining to migration does not resemble a computer making mathematical calculations about costs and expected earnings (Carling and Schewel 2018; de Haas 2021). Rather, emerging theoretical perspectives suggest that people's desires, experiences and subjective worries shape the information they take in and the courses of action they consider possible in the first place (Galotti 2007 as cited in Koikkalainen and Kyle 2016 and Triandafyllidou 2019). Indeed, Incipient empirical evidence supports this view of how migration decisions operate (Hernández-Carretero 2016; Koikkalainen and Kyle 2016; Townsend and Oomen 2015).

In consonance with the latter strand of the literature, we argue that individual exposure to (and recollection of) weather-related stressors induces a cognitive response in affected individuals. For instance, such exposure allows individuals to update their information on the unfavorable consequences of climate disasters, i.e., to become more informed (but not fully informed) about them. It could also induce subjective worries concerning the inevitability, irreversibility or dangerousness of climate disasters. Similarly, exposure makes it more likely that individuals form habits and schemas to deal with such disasters. All these individual cognitive reactions to personal experiences with climate disasters makes, in turn, a behavioral response to them more probable. Indeed, this argument is different

from the economic model of climate migration discussed in the previous sub-section, where individuals are thought to be fully informed about the ill effects of environmental stress even in the absence of personal experience. In sum, we thus expect to find support for the following hypothesis:

H1: *Exposure to unfavorable weather–related environmental events is associated with stronger migration aspirations.*

2.4 Sudden versus Gradual Climate Disasters and Migration Aspirations

Further qualifying how the individual exposure to climate disasters matters to migration aspirations, in this sub-section we argue that, even though sudden and gradual disasters have been shown to be just as damaging and threatening to the survival of entire communities (Dell et al., 2014), these different disaster types are not *perceived* equally. Thus, we contend the distinction between sudden and gradual climate disaster is key (cf. Koubi et al., 2016). Our argument rests on the idea that individuals' experiences with sudden or gradual disasters may lead to the emerge of different types of schemas to understand them in terms of their damage and irreversibility. These differing schemas or mental structures that people resort to when confronted with climate disasters, in turn, further explain whether the disaster sparks migration aspirations or not.

We set up two contrasting hypotheses on the relationship between exposure to sudden versus gradual climate disasters and migration aspirations. On the one hand, we may hypothesize that the migration consequences of sudden-onset events are stronger than their gradual-onset counterparts. First, *sudden* disasters (such as floods or heavy storms) may create and be linked to schemas and mental structures that classify these disasters as *more damaging* because they happen abruptly and are easily recognizable as extreme events inflicting potentially heavy material and human costs, irrespective of objective assessments of damage relative to other sudden disasters. Second, adapting to disasters that happen abruptly might be harder than adapting to slow-unfolding disasters. For instance,

farmers affected by droughts may adapt by economizing on water consumption but those affected by floods may not have concrete strategies. Crucially, these skewed perceptions of the damage and dangers of sudden disasters vis-à-vis gradual ones shape how individuals respond to prospects of climate change. Following the argumentation above, we contend that when confronted with a future where climate disasters, both sudden and gradual, will be more common, those with prior experience of sudden disasters will be more likely to respond with migration aspirations than those with exposure to (only) gradual events.

In sum, the immediacy of the adverse socio-economic effects of sudden disasters and the lack of adaptation strategies may generate especially heightened perceptions of damage, fear and pessimism. Following this theorization, we thus hypothesize as follows:

H2a: *Exposure to unfavorable sudden–onset weather–related environmental events is associated with stronger migration aspirations compared to exposure to gradual–onset events.*

On the other hand, however, we may also argue that gradual-onset events are more impactful in shaping personal migration aspirations than sudden-onset events. *Gradual* disasters (such as droughts) that unfold slowly over long periods of time may create and be linked to mental schemas that these disasters are *more irreversible* than sudden disasters that have a clear beginning and end. The persistence of gradual events may thus be particularly influential in shaping mental schemas and narratives of helplessness, which may mean that the psychological consequences of exposure to gradual disasters might be more severe than exposure to quicker sudden events. This argumentation also implies that when confronted with the prospect that climate disasters will become more common in the future, those with prior exposure to gradual events will be more likely to respond with aspirations to migrate than those with exposure to sudden events.

In sum, our alternative theoretical argument is that gradual climate disasters lead to heightened perceptions of irreversibility that do not develop in the case of sudden disasters. Following this theorization, we hypothesize thusly:

H2b: *Exposure to unfavorable gradual–onset weather–related environmental events is associated with stronger migration aspirations compared to exposure to sudden–onset events.*

3. Data and Patterns of Migration Aspirations and Exposure to Weather Events

Above, we have developed several hypotheses (*H1* as well as *H2a* and *H2b*) concerning the nexus between individual migration aspirations and the individual experience with weather-related stressors. Before testing these hypotheses in regression and survey experiment frameworks, in this section we discuss our data and main variables of interest.

3.1 Original Survey Dataset

For our empirical analysis, we rely on original survey data from Senegal (data collected between November 2021 and January 2022) and the Gambia (data collected in November 2021). As this survey was intended to target the potential migrant population, respondents were randomly drawn from the population of 15- to 35-year-olds.[5]

In the Gambia, we interviewed 1,807 respondents, using a nation-wide random stratified sampling approach by dividing the country into 4,098 districts from which 164 districts were randomly drawn. Thus, our survey is representative for the whole of Gambia (approximately 600,000 inhabitants for the given respondent age bracket).

[5] Data collection was approved by the WZB Berlin Social Science Center´s Research Ethics Committee.

For Senegal, our survey is representative for the Senegalese regions of Dakar and Casamance (i.e., for approximately 1.4 million Senegalese out of a population of approximately five million for the given age bracket). Here, we interviewed 4,037 respondents from the same number of households in the Dakar (*N*=997) and Casamance regions (total *N*=3,040, with the sub-regions Ziguinchor *N*=1,629, Sédhiou *N*=614 and Kolda *N*=797).

In the survey, inter alia, respondents were asked about their migration aspirations and plans, their experience with past climate disasters, socio-economic and demographic characteristics (e.g., age, gender and relationship status) as well as their thoughts on life in Senegal or the Gambia (e.g., with respect to their economic prospects compared to the prospects of others). The surveys were conducted either in French (Senegal) or English (the Gambia) or, if the respondent did not speak these languages, in a local language (e.g., Wolof, Pulaar or Mandinka) as computer-assisted personal interviews by local interviewers in cooperation with the *National Agency of Statistics and Demography* of Senegal and the *Gambia Bureau of Statistics*.

3.2 Migration Aspirations

To consider individual migration aspirations, we asked respondents the following survey question: "How much are you considering moving to another country to live there ("live" meaning staying for more than 3 months)?" Answers were on a scale from 0 ("I don't want to move at all") to 100 ("I really want to move").

Figure 1 provides a first look at our survey data concerning individual migration aspirations. To visualize the data more clearly, we create five bins that each correspond to a twenty-unit interval on the answer scale, thus corresponding to individual respondents having no migration aspirations (0-19 on the initial scale), low migration aspirations (20-39), some migration aspirations (40-59), considerable migration aspirations (60-79) and very strong migration aspirations (≥80).

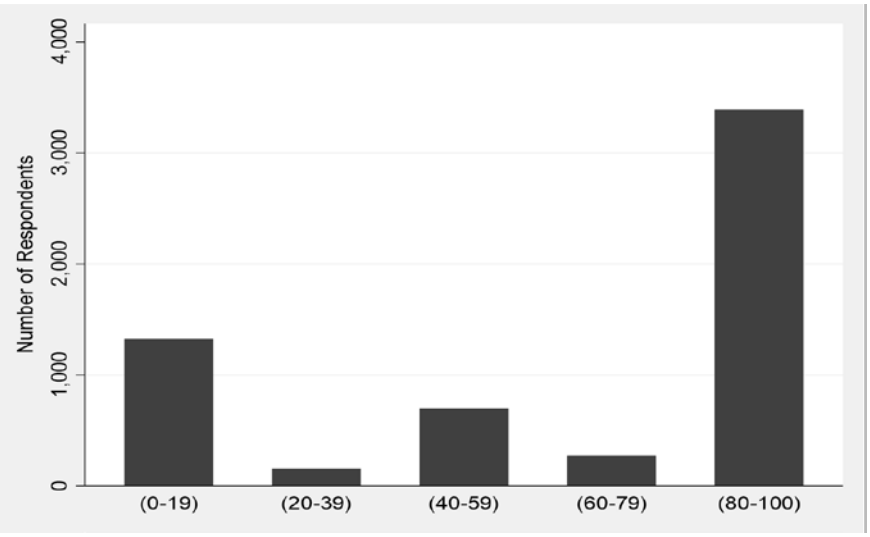


Figure 1: International Migration Aspirations Among Survey Respondents

The individual desire to migrate to another country is widespread in both Senegal and the Gambia. While approximately 25 percent of respondents in Senegal and 17 percent of respondents in the Gambia have no to little aspiration to migrate, about 53 percent (Senegal) and 69 percent (the Gambia) have very strong aspirations to do so. Also speaking to the representativeness of our survey sample, these figures are comparable to those by the seventh wave (2016–2018) of the *Afrobarometer*, where respondents from Senegal and the Gambia were asked for their thoughts about migration to another country, with approximately 40 (56) percent of respondents in Senegal (the Gambia) stating that they have considered moving to another country to live there at least to some extent.[6] In the Gambia, we also asked for the respondents' preferred migration destination: About 79 percent of respondents opted for either France, Germany, Italy, Spain, the United Kingdom or the United States (which alone was selected by approximately 35 percent of the respondents).

[6] The data can be found at https://www.afrobarometer.org/online-data-analysis/. We arrive at somewhat higher average migration aspirations because we restrict our sample to individuals between the ages of 15 and 35, while the *Afrobarometer* also interviews older respondents whose migration aspirations tend to be lower.

3.3 Exposure to Weather-Related Environmental Events

We measure individual experience with weather-related environmental stress by considering the respondents' answers to the following survey item: "From your perspective, can you describe the main weather events that have happened here during the past five years?" Respondents were able to select one or more of the following options: (1) heavy rain and floods, (2) storms, cyclones or typhons, (3) landslides, mudslides or avalanches, (4) droughts, (5) salinity or erosion and (6) other. Alternatively, they could respond that they did not experience any of these events or that they do not know.

Figure 2 gives an overview of the individual experience with weather-related events among the survey respondents. Approximately 81 percent of respondents report that they have experienced at least one unfavorable weather event during the past five years at their place of residence. Here, exposure to heavy rain and associated flooding events is by far the most common, with about 71 percent of respondents mentioning this weather event. This is not surprising, as the climate in both Senegal and the Gambia is characterized by a wet season (mostly between June and October). Experience with other weather events is less common: About 12 percent of respondents report exposure to heavy storms and droughts, respectively, while less than 5 percent of respondents report that they have experienced landslides, mudslides, avalanches, salinity or erosion during the past five years.

As argued above, we hypothesize that the role of these various weather-related environmental stressors in shaping migration aspirations could also depend on the suddenness of the environmental event considered. Following Koubi et al. (2016), we therefore differentiate between gradual-onset and sudden-onset weather events. For our sample, gradual-onset weather-related environmental events include droughts, salinity and erosion, while sudden-onset events include heavy rains/flooding, landslides, mudslides, avalanches and heavy storms. Using

this differentiation, approximately 76 percent of respondents were exposed to sudden-onset events, while approximately 15 percent of respondents experienced gradual-onset events. About 71 percent of respondents experienced both types of weather-related environmental stressors in the five years before 2021/2022.

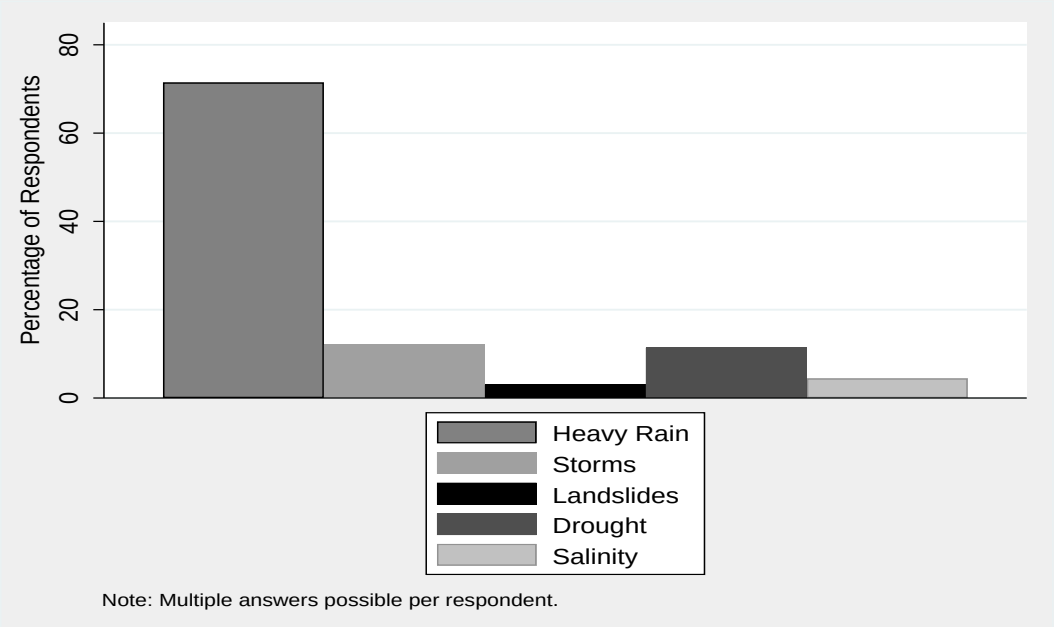


Figure 2: Exposure to Environmental Events Among Survey Respondents

3.4 Climate Perceptions and Observed Climate Conditions

Our survey item relates to individual perceptions about past environmental events which are, in turn, shaped by individual memory and cognitive abilities. In this sub-section, we assess to what extent individual perceptions of heavy rainfall and droughts (as the most important sudden-onset and gradual environmental events, respectively) correlate with observed climate conditions. This is to link objective climate measurements and subjective climate perceptions.

To do so, we draw data on the *Standardized Precipitation Evapotranspiration Index* (SPEI) developed by Vicente-Serrano et al. (2010) and further described in Beguería et al. (2010) from the *Global SPEI Database*.[7] The SPEI not only considers precipitation but also temperature and evapotranspiration, allowing for a more

[7] The data can be found at https://spei.csic.es/database.html

complete approach to explore the effects of climate change on wetness or dryness (Beguería et al., 2010). In detail, the SPEI is calculated using a water balance methodology, where the SPEI is derived by subtracting potential evapotranspiration from precipitation and standardized in reference to past climate conditions (Beguería et al., 2010; Vicente-Serrano et al., 2010). It ranges from +2.5 to -2.5, where SPEI values >+1 would indicate noticeable wet spells (i.e., high levels of rainfall in comparison to long-run expected precipitation levels), whereas SPEI values <-1 would indicate dry spells. As the SPEI data is also geo-coded at a 0.5 degrees spatial resolution, we can relate individual-level climate perceptions (from our survey) to climate conditions objectively measured at the local level.[8] Here, the SPEI is averaged for each 0.5 degree grid over the 2017-2021 period, corresponding to the survey questions that asked for individual experiences with climate change over the last five years (the survey took place between November 2021 and January 2022).

We report our findings on the correlation between individual climate disaster experiences and objective climate conditions in Table 1. We find that lower (higher) levels of the SPEI mean that is more likely for survey respondents to say that they have experienced droughts (heavy rainfalls) at their place of residence. Thus, individual climate perceptions correlate with objective climate conditions in intuitive ways. This finding speaks to the notion that subjective climate perceptions are indeed rooted in actual experience of past climate disasters.

[8] This implies that individuals who live in the same 0.5-degree grid experience the same objective climate conditions. In other words, the available climate data does not allow us to create objective climate measures that are unique to each survey respondents.

Table 1: Climate Perceptions and the SPEI

	(1)	(2)	(3)	(4)
Dependent Variable →	Experienced Rainfall	Experienced Rainfall	Experienced Drought	Experienced Drought
SPEI	0.149***	0.110**	-0.260***	-0.185***
	(0.040)	(0.044)	(0.028)	(0.029)
Age		0.002*		0.001*
		(0.001)		(0.001)
Female		0.012		-0.034***
		(0.012)		(0.008)
At Least Secondary Education		0.062***		-0.044***
		(0.013)		(0.008)
Observations	5,845	5,783	5,845	5,783

Notes: OLS estimates reported. Constant not reported. For a discussion of the demographic controls, see the main text. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4. Migration Aspirations and Weather-Related Environmental Stress

When introducing our original dataset, we showed that most respondents in Senegal and the Gambia have considerable aspirations to migrate to another country. At the same time, many respondents have also experienced one or more stressful (gradual- and/or sudden-onset) weather-related events (i.e., climate disasters). In this section, we ask whether individual migration aspirations systemically correlate with individual exposure to unfavorable weather events, as suggested by our hypotheses *H1*, *H2a* and *H2b*. The summary statistics of all variables we use in this empirical analysis are reported in the Supplementary Material (Appendix A).

4.1 Empirical Model

To estimate the association between individual migration aspirations and experience with environmental stress (conditional on further factors), we estimate the following regression model:

$$migration_{ij} = \beta_1 * environment_{ik} + \beta_, * X_i' + \varepsilon_i \qquad (1)$$

Our dependent variable, *migration*, refers to the *j*-th measure of the migration aspirations of individual *i*. Usually, we consider the respondent's answer to the question on how much they have considered moving to another country, with the answer being on a scale from zero to 100 (with higher values meaning stronger migration aspirations). For the sake of robustness, we also create two alternative migration aspiration variables. First, we create five bins that each correspond to a twenty-unit interval on the initial answer scale. The five bins thus correspond to no migration aspirations (0–19 on the initial scale), low migration aspirations (20–39), some migration aspirations (40–59), considerable migration aspirations (60–79) and very strong migration aspirations (≥80). Second, we create a binary variable that is equal to unity when a respondent has at least considerable migration aspirations (meaning a value of ≥60 on the initial answer scale) and zero otherwise. Finally, we also use the respondents' answer to the following question as an alternative dependent variable: "Have you made concrete plans to move to another country within the next 12 months?" The answer is a binary variable, with unity indicating that the respondent has made concrete plans, while zero indicates that they have not. This variable more strongly reflects a respondent's desire to act on their migration aspirations (e.g., Tjaden et al., 2018).[9]

[9] Our survey data suggests that while about 3,000 individuals report at least considerable migration aspirations, only approximately eight hundred respondents say that have made concrete plans to migrate within the coming 12 months. This is in line with the idea of conceptualizing migration as a process involving several steps (e.g., consisting of the formation of migration aspirations, the planning of migration and its eventual realization).

Our main variable of interest, *environment*, is the *k*-th measure of exposure to weather-related environmental events. For one, to test *H1*, we employ a binary variable that is equal to unity if a respondent has experienced any type of stressful event (i.e., droughts, salinity/erosion, rain/flooding, heavy storms or landslide/mudslides). For another, we differentiate between slow-onset and sudden-onset weather events, using two binary variables that are equal to unity if a respondent has experienced any slow-onset event (droughts, salinity or erosion) or sudden-onset event (heavy rainfall, heavy storms or landslides/mudslides), respectively. This allows us to test *H2a* and *H2b*.

Finally, our empirical model includes a vector of controls, *X*. The choice of these variables follows from a review on the determinants of migration aspirations by Aslany et al. (2021). We control for respondent's *age*, *gender* and *relationship status*, where we expect migration aspirations to correlate negatively with age, female gender and the respondents being in a long-term relationship or marriage (Aslany et al., 2021). We also control for *education* with a dummy variable that is equal to unity when a respondent has secondary education or higher. We expect higher education levels to correlate with stronger migration aspirations (Aslany et al., 2021). An additional control is for personal *income satisfaction*, where we anticipate dissatisfaction to increase one's aspiration to move to another country where economic conditions are potentially more favorable (Aslany et al., 2021).[10] Finally, we include a dummy variable that is equal to unity when a respondent is from *Senegal*. As shown in the previous section when we presented our data, migration aspirations tend to be higher in the Gambia compared to Senegal on average, so we expect the Senegal dummy variable to negatively predict migration aspirations.

[10] This variable uses the respondents' answer to the question "Overall, how satisfied are you with your current income situation?", where answers could range from "very dissatisfied" to "very satisfied", with higher value of the associated variable corresponding to higher levels of income satisfaction.

4.2 Main Regression Results

We report our regression results in Table 2. There are two main findings. First, if we measure experience with weather-related environmental stress as a binary variable, this exposure variable correlates with higher migration aspirations. Second, once we differentiate between experience with gradual- and sudden-onset weather events, we find that only exposure to gradual-onset but not sudden-onset weather events positively predict migration aspirations in a statistically significant way. Here, in terms of effect size the estimated relationship implies that experiencing a slow-onset weather-related event is associated with a four-point increase in migration aspirations on a scale from zero to 100.

Table 2: Main Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable →	Intentions (0–100)	Intentions (0–100)	Intentions (0–100)	Intentions (0–4)	Intentions (0–4)	Intentions (0–1)	Intentions (0–1)	Intentions (0–1)	Plans (0–1)	Plans (0–1)
Weather Event Binary	3.599***			0.163**		0.211***			0.034	
	(1.270)			(0.065)		(0.071)			(0.101)	
Gradual-Onset Events		4.044***	4.152***		0.239***		0.296***	0.303***		0.273***
		(1.482)	(1.479)		(0.079)		(0.085)	(0.085)		(0.105)
Sudden-Onset Events		0.589	0.481		-0.000		-0.008	-0.010		-0.042
		(1.174)	(1.181)		(0.062)		(0.067)	(0.068)		(0.092)
Age	-0.825***	-0.811***	-0.793***	-0.042***	-0.042***	-0.041***	-0.040***	-0.039***	0.010	0.011
	(0.102)	(0.102)	(0.102)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)
Female	-9.472***	-9.443***	-9.629***	-0.503***	-0.502***	-0.495***	-0.492***	-0.506***	-0.617***	-0.613***
	(1.062)	(1.062)	(1.062)	(0.057)	(0.057)	(0.062)	(0.062)	(0.062)	(0.090)	(0.090)
At Least Secondary	8.989***	9.184***	8.523***	0.421***	0.435***	0.449***	0.465***	0.428***	0.444***	0.456***
Education	(1.099)	(1.101)	(1.117)	(0.057)	(0.057)	(0.061)	(0.062)	(0.062)	(0.090)	(0.090)
Married/In	-12.280***	-12.427***	-12.112***	-0.618***	-0.627***	-0.670***	-0.681***	-0.665	-0.669***	-0.686***
Relationship	(1.304)	(1.310)	(1.311)	(0.067)	(0.067)	(0.070)	(0.070)	(0.071)	(0.108)	(0.108)
Satisfaction with	-0.604	-0.639	-0.720	-0.029	-0.034	-0.016	-0.020	-0.025	0.025	0.028
Income	(0.538)	(0.538)	(0.538)	(0.029)	(0.029)	(0.030)	(0.030)	(0.030)	(0.041)	(0.041)
Senegal	-9.754***	-10.480***	-7.713***	-0.516***	-0.558***	-0.568***	-0.621***	-0.456***	0.756***	0.709***
	(1.111)	(1.129)	(1.355)	(0.065)	(0.066)	(0.070)	(0.071)	(0.081)	(0.108)	(0.109)
Estimation Method	OLS	OLS	OLS	Ord. Logit	Ord. Logit	Logit	Logit	Logit	Logit	Logit
Control for SPEI	No	No	Yes	No	No	No	No	Yes	No	No
Observations	5,783	5,783	5,783	5,783	5,783	5,783	5,783	5,783	5,783	5,783

Notes: Constant not reported. SPEI is the sstandardized precipitation evapotranspiration index as a measure of objective local climate conditions; see main text for further discussion. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Briefly discussing the controls, the estimated associations are as expected and in line with the literature summarized by Aslany et al. (2021). We find that older individuals, female individuals, respondents in a long-term relationship and respondents from Senegal have lower migration aspirations, while more educated individuals are more likely to report higher migration aspirations. There is no statistically meaningful relationship between migration aspirations and personal income satisfaction.

Table 2 also shows that our main finding—that especially exposure to slow-onset weather events predicts stronger migration aspirations—is robust to the inclusion of a control for objective local climate conditions (i.e., the local SPEI). Effectively, this means that subjective perceptions of climate disasters impact migration aspirations over and above objective climate conditions. This highlights the importance of our theoretical framework that links individual exposure to macro-climatic conditions to the individual migration response.

In Table 2 we also show that our findings are robust to alternative operationalizations of the dependent variable and estimation approaches. Running both ordered logit models (for the binned version of the dependent variable) and logit models (for the dichotomous version of the dependent variable), we find that only experience with gradual-onset weather events positively correlates with individual migration aspirations.[11] In terms of effect size, e.g., the logit results imply that experience with a gradual-onset weather event increases the odds of having at least considerable migration aspirations by about 34 percent.

Finally, we consider how exposure to weather-related environmental stressors affects migration planning. Planning can be considered the next step (after forming aspirations) in one's migration process, which, in turn, could be followed by the actual migration journey (e.g., Kley, 2011). We find that individuals that have

[11] Estimating Models (3) to (6) with OLS yields the same empirical conclusion (results available upon request).

been exposed to a gradual-onset weather-related event during the last five years are also more likely to have made concrete plans to move to another country within the next 12 months.[12] This latter finding thus suggest that our main finding also pertains to the next step of the migration process.

In sum, our findings are in line with *H1* in that individual experience with unfavorable environmental events increases migration aspirations. On closer inspection, we find that this relationship is driven by the individual exposure to gradual-onset but not sudden-onset events. For instance, this may be because gradual-onset disasters (such as droughts) lead to a heightened perception of irreversibility of climate change compared to sudden-onset disasters. Thus, our findings also support *H2b* but not *H2a*.

4.3 Robustness Checks

In the Supplementary Material (Appendix B) we demonstrate that our findings are robust to the inclusion of additional control variables. In detail, these controls account for household size, life satisfaction, employment status, geographical location as well as ethnic and religious affiliation; details on the operationalization of these additional controls are discussed in Appendix B. Furthermore, in Appendix C we show that our main result—that especially exposure to slow-onset weather events is a statistically meaningful and positive predictor of personal migration aspirations—also holds when we restrict our analysis to only the Gambia or Senegal, respectively.

4.4 Role of Specific Weather-Related Environmental Stressors

To further explore the nexus between migration aspirations and the exposure to unfavorable weather events, we study whether and how specific events matter. Here, we once again make use of our original survey data, where respondents

[12] Estimating Models (7) and (8) with OLS provides the same result (results available upon request).

stated their experience with various gradual-onset and sudden-onset weather events.

We report our findings in Table 3. They can be summarized as follows. First, investigating separately the association between slow- and sudden-onset weather-related events and migration aspirations (Models 1 and 2 of Table 3), we find that only exposure to gradual-onset events is linked to stronger aspirations. Second, considering respondents that have experienced *only* gradual-onset but no sudden-onset events during the past five years as well as respondents that have been exposed *only* to sudden-onset but no gradual-onset events (Models 3 and 4), we find that only the former respondent group reports substantially stronger migration aspirations. In terms of effect sizes, this latter association appears to be especially pronounced: Experiencing only slow-onset weather-related events is associated with a ten-point increase in migration aspirations on a scale from zero to 100. Third, differentiating between the role of droughts and salinity/erosion as different types of gradual-onset events (Models 5 and 6), only experience with droughts results in a statistically significant and positive association with individual migration aspirations. Finally, considering separately the various types of sudden-onset weather-related stressors (Models 7 to 9), we find that neither stressor (heavy rains, floods, landslides, heavy storms etc.) correlates with migration aspirations in a statistically meaningful way.

Table 3: Role of Specific Weather-Related Environmental Stressor

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Weather Variable →	Gradual	Sudden	Gradual, No Sudden	Sudden, No Gradual	Drought	Salinity/ Erosion	Heavy Rain	Landslide	Storm
Weather Event	3.986***	0.322	10.434***	0.349	4.281***	2.493	1.242	-0.514	-2.276
	(1.472)	(1.170)	(2.138)	(1.089)	(1.645)	(2.465)	(1.122)	(3.036)	(1.646)
Age	-0.809***	-0.821***	-0.800***	-0.821***	-0.812***	-0.814***	-0.825***	-0.821***	-0.821***
	(0.102)	(0.102)	(0.102)	(0.102)	(0.102)	(0.102)	(0.102)	(0.102)	(0.102)
Female	-9.443***	-9.512***	-9.380***	-9.514***	-9.399***	-9.525***	-9.525***	-9.507***	-9.557***
	(1.062)	(1.063)	(1.062)	(1.063)	(1.062)	(1.063)	(1.063)	(1.064)	(1.065)
At Least Secondary Education	9.206***	9.081***	9.211***	9.074***	9.262***	9.071***	9.017***	9.094***	8.978***
	(1.101)	(1.100)	(1.099)	(1.101)	(1.102)	(1.099)	(1.101)	(1.099)	(1.104)
Married/In Relationship	-12.435***	-12.249***	-12.505***	-12.241***	-12.481***	-12.240***	-12.204***	-12.260***	-12.142***
	(1.309)	(1.306)	(1.308)	(1.307)	(1.312)	(1.306)	(1.306)	(1.306)	(1.307)
Satisfaction with Income	-0.653	-0.687	-0.668	-0.689	-0.668	-0.685	-0.671	-0.695	-0.713
	(0.536)	(0.538)	(0.536)	(0.538)	(0.536)	(0.537)	(0.538)	(0.537)	(0.538)
Senegal	-10.524***	-9.924***	-10.318***	-9.883***	-10.401***	-10.100***	-9.878***	-9.928***	-10.087***
	(1.125)	(1.114)	(1.112)	(1.126)	(1.120)	(1.116)	(1.111)	(1.117)	(1.113)
Observations	5,783	5,783	5,783	5,783	5,783	5,783	5,783	5,783	5,783

Notes: Constant not reported. Gradual=Experience with droughts and/or salinity/erosion. Sudden=Experience with heavy rainfall, landslides/mudslides/ avalanches and/or storms/cyclones/ typhoons. Gradual, No Sudden=Experience with droughts and/or salinity/erosion but not with heavy rainfall; landslides/mudslides/avalanches and/or storms/cyclones/typhoons. Sudden, No Gradual=Experience with heavy rainfall, landslides/mudslides/avalanches and/or storms/cyclones/ typhoons but not with droughts and/or salinity/erosion. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In sum, the results reported in Table 3 strengthen our main empirical conclusions reported above that only experience with slow-onset events matters to personal migration aspirations. Here, we can show exposure to droughts is more relevant than exposure to salinity or erosion. By contrast, we again find that sudden-onset weather-related events do not play a role in shaping individual migration aspirations. Thus, our findings lend further support to *H2b* but not *H2a*.

5. Survey Experiment

The empirical results reported in the previous section point to a positive correlation between the experience with slow-onset unfavorable weather events and individual migration aspirations. A causal interpretation of this finding is, however, non-trivial. On the one hand, respondents were asked about their present-day migration aspirations and past exposure to weather-related environmental stressors (i.e., events that have occurred during the past five years), making a cause-effect relationship between both variables plausible. On the other hand, however, there are many factors complicating such a causal interpretation, including, e.g., the role of unobserved confounders (i.e., factors that could determine both the occurrence of specific unfavorable weather events and individual migration aspirations). To strengthen our empirical findings and make a better case for a causal relationship between environmental stress and migration aspirations, in this section we therefore present findings from a survey experiment conducted in the context of our original data gathering efforts in Senegal and the Gambia.

5.1 Experimental Approach

For our survey experiment, respondents received the following cue: "Some people say that the probability of floods or droughts happening here in the next few years [treatment]." Here, the *treatment* could take three forms: (1) "will increase", (2) "will decrease" or (3) "will stay the same". Survey respondents were randomly assigned one of the three treatment options. For the subsequent analysis, we are primarily interested in the interviewee's response to this cue with respect to their

migration aspirations. This response is established via this question that immediately follows the treatment information: "Hearing this information, does this make you [outcome]?" Here, the *outcome* could take on two forms: (1) "More likely to want to migrate" or (2) "Not more likely to want to migrate" (i.e., individual migration aspirations were reported to stay the same or decrease). Importantly, to avoid post-treatment bias, we ran the survey experiment only after having learned the respondents' migration aspirations (which was our dependent variable in the previous section) and after having gathered data on all controls.

The survey experiment allows us to examine how individual migration aspirations change in response to information about future exposure to slow-onset (droughts) and sudden-onset (floods) weather-related environmental stressors. We test whether respondents report stronger migration aspirations after having received the information that weather conditions will become more unfavorable in the future via the following model:

$$outcome_i = \beta_1 * treatment_i + \beta_, * X_i' + \varepsilon_i \qquad (2a)$$

Here, *outcome* is a binary variable that is equal to unity when respondents report an increase in migration aspirations and zero when they do not. Furthermore, *treatment* is a binary variable that is equal to unity when the treatment refers to a future increase in unfavorable weather conditions (i.e., more droughts or floods); it is equal to zero when the cue refers to unchanged or improved future weather conditions. In some specification, we also consider our baseline controls (X) for age, gender, education, relationship status, income satisfaction and country of origin. Additionally, this vector also controls for pre-treatment migration aspiration levels. Given the dichotomous nature of the dependent variable, we estimate a series of logit models.[13]

[13] However, estimating OLS models produces empirical results that are very similar to the logit estimates (results available upon request).

Estimating Equation (2a) implicitly assumes that climate disasters uniformly increase migration aspirations. However, the results of the previous section indicate that a heterogeneous perspective could be more appropriate. Thus, we move beyond the unconditional model (where the treatment matters to migration aspirations regardless of moderating factors), by also estimating a conditional variant of the model that takes the following form:

$$outcome_i = \beta_1 * treatment_i + \beta_2 * environment_{ik} +$$

$$\beta_3 * (treatment * environment_{ik}) + \beta, * X_i' + \varepsilon_i \qquad (2b)$$

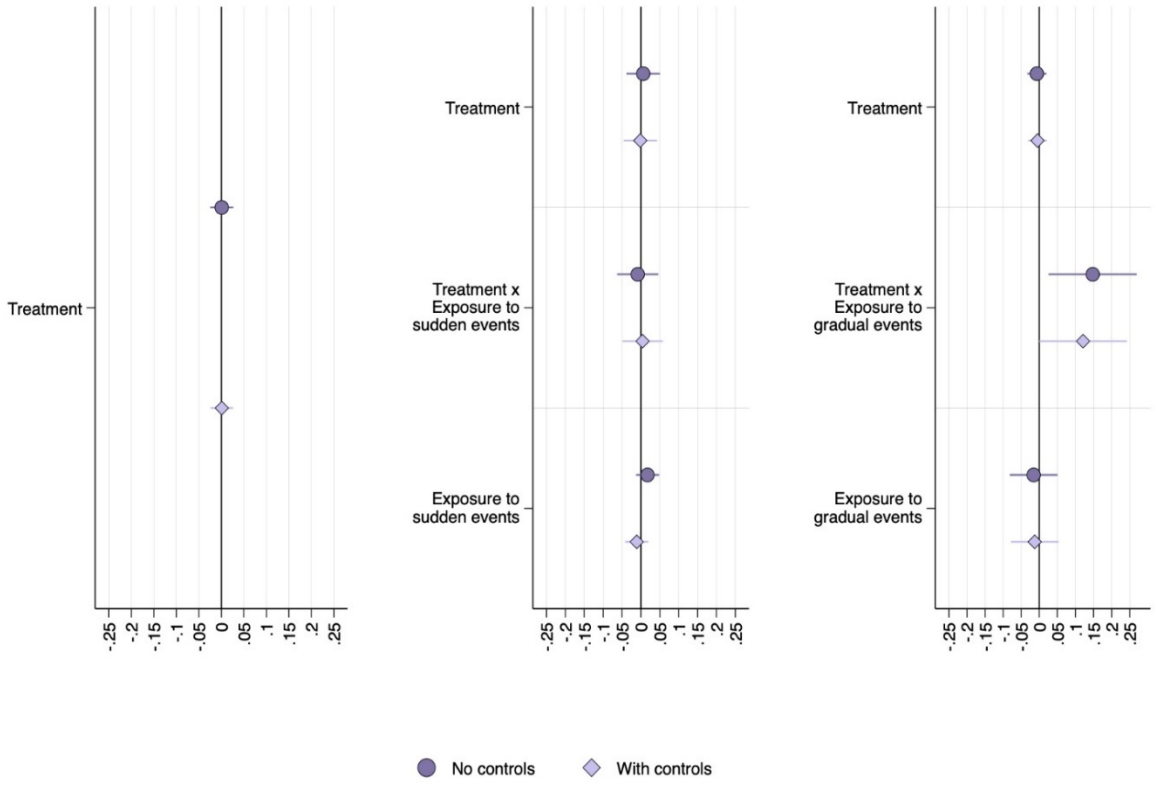
Here, we interact the treatment variable with another variable, *environment*, which is equal to unity when a respondent has only experienced gradual-onset weather events or only sudden-onset weather events, respectively. In line with the arguments we developed in the theory section, the idea is that past individual exposure to unfavorable environmental events has cognitive consequences and thus affect the individual migration response to these events. At the same time, this idea also directly follows from our empirical results reported in the previous section, where we showed that respondents with past exposure to gradual-onset (but not sudden-onset) weather-related stressors have stronger migration aspirations. Consequently, in the experimental setting we expect individuals with experience with slow-onset climate disasters to be especially responsive to informational cues that project even worse climate conditions in the future.

5.2 Empirical Results

Our empirical results are reported in Figure 3; the associated regression results are reported in Appendix D. Figure 3 indicates that there is no unconditional effect of the treatment on the outcome. That is, individuals who received an informational cue that weather conditions are expected to become more adverse do not report an increase in their migration aspirations compared to individuals who received cues that communicated neutral or favorable expectations about future

conditions. By contrast, there is evidence for a conditional treatment effect. Individuals that have past experience with gradual-onset climate events (such as droughts) respond to the treatment with an increase in their migration aspirations. The same is not true for individuals that have only been exposed to sudden-onset weather events (such as heavy rains, floods or storms). These results do not change when we include the various demographic, economic and geographic control variables.

Figure 3: Survey Experiment Results



Notes: Dependent variable=binary outcome (1=stronger migration intentions; 0=no change or weaker migration intentions). Treatment="Some people say that the probability of floods or droughts happening here in the next few years will increase". Reference group for Treatment=" Some people say that the probability of floods or droughts happening here in the next few years will stay the same/will decrease".

As a robustness check, we run a series of models where the treatment can take on three values corresponding to the three possible treatment cues of worsening, unchanging and improving climate conditions. As further discussed in the Supplementary Material (Appendix E), using this alternative definition of the treatment yields empirical conclusions that are very similar to those discussed above. That is, we again find no evidence of an unconditional treatment effect but show that individuals with experience with slow-onset climate disasters respond to information about a future worsening of weather conditions with higher migration aspirations.

In sum, the findings from the survey experiment indicate that the expectation of more unfavorable weather-related events leads to stronger migration aspirations especially among respondents that have experienced slow-onset weather events during the last five years. This further speaks to *H1* (in that individual experience of climate disasters matters to individual migration aspirations) and *H2b* (in that slow-onset events are more impactful) but not to *H2a*. At the same time, our experimental findings also mirror the regression analysis results reported in the previous section, where stronger migration aspirations correlated with exposure to gradual-onset (but not sudden-onset) weather events. That is, they make a causal interpretation of these regression results more plausible.

6. Conclusion

While there is an increasing research interest—sparked by concerns about global climate change—in the migration consequences of environmental stress, the empirical evidence on the nexus between environmental factors and migration remains mixed. In this paper, we contribute to the empirical research on this nexus, focusing on the role of climate disasters in international migration aspirations in Senegal and the Gambia. Using an original survey dataset that covers over 5,700 respondents, we add to the literature by considering individual experience with

various types of disasters, differentiating between the roles of gradual-onset events (such as droughts) and sudden-onset events (such as heavy rains and floods) in shaping migration aspirations as well as by running a survey experiment that allows us to strengthen causal claims related to the nexus between individual experience with environmental factors and migration.

While individual aspirations to migrate to another country as well as personal experiences with various unfavorable weather-related environmental events are widespread in both Senegal and the Gambia, we show that migration aspirations are only meaningfully stronger for individuals with past exposure to gradual-onset events, especially droughts, while experience with sudden-onset events (such as heavy rains, storms and landslides) has no comparable effect. Corroborating this result, in a survey experiment we find that only those individuals that have been exposed to gradual-onset weather-related events in the past respond to the prospect of more unfavorable weather conditions in the future with an increase in their migration aspirations. Indeed, gradual-onset environmental stress especially in the form of droughts is expected to increase in Africa in the coming decades because of climate change (e.g., IPCC, 2022). Our findings imply that a (heterogeneous) response to this increase in environmental stress can be expected.

Our empirical results imply that accounting for potentially heterogeneous effects of environmental stress on migration aspirations and migration behavior may be a promising avenue for future research. Our results also highlight the importance of focusing on gradual-onset climate disasters, which receive much less attention (Zickgraf 2021a). Exploring such effect heterogeneity (e.g., in terms of what types of environmental stressors are considered) may also contribute to explaining why the evidence on the nexus between non-geological environmental stress and migration aspirations is mixed. Furthermore, we show that through the use of survey experiments, we can corroborate causal claims about this nexus. Such experiments may thus constitute another fruitful tool of future research.

More broadly, our results imply that a uniform migration response to climate change (as it would follow from naïve economic models of climate migration) cannot be assumed (Boas et al. 2019). At the same time, the assessment that climate-induced migration is negligible (as argued by, e.g., de Haas 2023) also appears to be premature. Rather, our findings point to a nuanced perspective on the nexus between environmental stress and migration, where a heterogenous migration response to climate disasters is driven by dissimilar individual experiences with unfavorable climate events and the cognitive processes (e.g., concerning perceptions of irreversibility and inevitability due to climate disasters) associated with these experiences. Thus, our analysis also speaks to the importance of individual theorization of the link between climate disasters and migration aspirations.

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Supplementary Material

Appendix A. Summary Statistics

Supplementary Table 1: Summary Statistics

	N*T	Mean	SD	Min	Max
Migration Aspirations [0-100]	5,783	66.70	40.70	0	100
Migration Aspirations [0-4]	5,783	2.72	1.67	0	4
Migration Aspirations [0-1]	5,783	0.63	0.48	0	1
Migration Plans [0-1]	5,783	0.13	0.34	0	1
Age	5,783	27.11	6.47	15	35
Female	5,783	0.42	0.49	0	1
At Least Secondary Education	5,783	0.50	0.50	0	1
In Relationship	5,783	0.52	0.50	0	1
Satisfaction with Income	5,783	1.53	0.98	0	4
Senegal	5,783	0.70	0.46	0	1
Weather Event Binary	5,783	0.81	0.39	0	1
Gradual-Onset Weather Event	5,783	0.15	0.35	0	1
Sudden-Onset Weather Event	5,783	0.76	0.43	0	1
Drought	5,783	0.11	0.32	0	1
Salinity/Erosion	5,783	0.04	0.21	0	1
Heavy Rain/Flood	5,783	0.71	0.45	0	1
Landslide/Mudslide/Avalanche	5,783	0.03	0.17	0	1
Storms/Cyclones/Typhoons	5,783	0.12	0.33	0	1

Appendix B. Additional Control Variables

In the following, we investigate whether our main empirical finding of a positive association between the individual exposure to weather-related environmental stressors and migration aspirations is robust to the inclusion of further control variables. We consider the following controls, where all variables are constructed from our survey (quantitative) dataset:

- Household Size=Answer to question "Including you, how many people live in this household?" (variable is a count).
- Life Satisfaction=Answer to question "How satisfied are you currently with your life in general?" (higher values correspond to higher satisfaction).

- Unemployed=Answer to question "Are you currently employed, self-employed or a civil servant?" (variable is a binary variable, 1=respondent is neither employed, self-employed or a civil servant).
- Latitude/longitude=Uses information provided by the interviewer on his/her geolocation (variable is in degrees latitude/longitude). Note: Reduced number of observations because geocoded information was not always provided by interviewers.
- Religion- and Ethnicity-Fixed Effects=Answer to the question "What is your religion?" (mutually exclusive options are Muslim, Christian, traditional or other) as well as answer to the question "To which ethnicity or cultural group do you belong? (mutually exclusive options are Wolof, Mandinka, Fula, Jola, Serere, Sarahule, Manjango, Bambara, Creole/Aku Marabout or other)

We report our empirical results below. For the sake of brevity, we only report the main regression coefficients of interest associated with the weather variables and the respective added control, while we do not report the results for the baseline controls (age, gender, education, relationship status, satisfaction with personal income and a dummy variable for Senegal). We also do not report the results for the set of religion- and ethnicity-fixed effects for the sake of clarity. As shown in Supplementary Table 2, our results are robust to the inclusion of the additional controls. This suggests that our empirical findings reported in the main text are not due to the choice of the control variables.

Supplementary Table 2: Additional Regression Estimates with Further Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Weather Event Binary	3.684***		3.620***		3.590***		2.723**		3.630***	
	(1.272)		(1.271)		(1.270)		(1.384)		(1.273)	
Gradual-Onset Events		4.159***		4.091***		4.029***		8.490***		4.777***
		(1.487)		(1.483)		(1.483)		(1.944)		(1.485)
Sudden-Onset Events		0.640		0.617		0.583		0.142		0.516
		(1.175)		(1.175)		(1.174)		(1.350)		(1.177)
Household Size	-0.074	-0.076								
	(0.065)	(0.065)								
Life Satisfaction			-0.867	-0.944						
			(1.195)	(1.198)						
Unemployment					-0.321	-0.241				
					(1.113)	(1.114)				
Latitude							0.839	0.343		
							(1.037)	(1.049)		
Longitude							-4.404***	-5.114***		
							(0.745)	(0.763)		
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,783	5,783	5,783	5,783	5,783	5,783	4,146	4,146	5,783	5,783

Notes: Dependent variable is the respondent's answer to the question "How much are you considering moving to another country to live?", with response values ranging from 0 to 100. OLS estimates reported. Constant not reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix C. Sub-Samples

In the following, we study whether our main results are driven by either Senegal or the Gambia. As shown in Supplementary Table 3, we find that for both countries, especially exposure to gradual weather-related events is associated with higher migration intentions. These results thus suggest that our findings are not driven by a specific country, even though the association is somewhat more precisely estimated for the case of Senegal (which is most likely due to the larger sample size).

Supplementary Table 3: Regression Estimates for Individual Countries

	(1)	(2)	(3)	(4)
Country →	The Gambia		Senegal	
Weather Event Binary	-1.739		5.556***	
	(2.381)		(1.491)	
Gradual-Onset Events		6.844*		3.541**
		(4.018)		(1.593)
Sudden-Onset Events		-1.822		1.551
		(2.297)		(1.367)
Age	-0.619***	-0.619***	-0.936***	-0.923***
	(0.196)	(0.196)	(0.121)	(0.122)
Female	-15.936***	-15.931***	-7.077***	-7.075***
	(1.805)	(1.805)	(1.324)	(1.325)
At Least Secondary Education	11.665***	11.758***	7.482***	7.777***
	(1.880)	(1.882)	(1.363)	(1.368)
Married/In Relationship	-9.528***	-9.663***	-12.686***	-12.710***
	(2.373)	(2.382)	(1.582)	(1.591)
Satisfaction with Income	1.534*	1.565*	-1.544**	-1.608**
	(0.913)	(0.912)	(0.660)	(0.660)
Observations	1,745	1,745	4,038	4,038

Notes: Dependent variable is the respondent's answer to the question "How much are you considering moving to another country to live?", with response values ranging from 0 to 100. OLS estimates reported. Constant not reported. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix D. Main Experimental Regression Results

Supplementary Table 4: Main Survey Experiment Results

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.001	-0.007	0.006	0.001	-0.005	-0.002
	(0.013)	(0.013)	(0.023)	(0.013)	(0.013)	(0.023)
Gradual-Onset Event		-0.015			-0.013	
		(0.034)			(0.034)	
Treatment * Gradual-Onset Event		0.148**			0.121**	
		(0.062)			(0.062)	
Sudden-Onset Event			0.018			-0.011
			(0.016)			(0.016)
Treatment * Sudden-Onset Event			-0.008			0.004
			(0.028)			(0.027)
Age				-0.005***	-0.005***	-0.005***
				(0.001)	(0.001)	(0.001)
Female				-0.067***	-0.067***	-0.067***
				(0.013)	(0.013)	(0.013)
At Least Secondary Education				0.016	0.017	0.017
				(0.013)	(0.013)	(0.013)
Married/In Relationship				-0.034**	-0.034**	-0.034**
				(0.015)	(0.015)	(0.015)
Satisfaction with Income				-0.026***	-0.026***	-0.026***
				(0.006)	(0.006)	(0.006)
Senegal				-0.064***	-0.065***	-0.066***
				(0.014)	(0.014)	(0.015)
Migration Aspirations				0.002***	0.002***	0.002***
				(0.000)	(0.000)	(0.000)
Observations	5,845	5,845	5,845	5,845	5,783	5,783

Notes: Constant not reported. Dependent variable=binary outcome (1=stronger migration intentions; 0=no change or weaker migration intentions). Treatment="Some people say that the probability of floods or droughts happening here in the next few years will increase". Reference group for Treatment=" Some people say that the probability of floods or droughts happening here in the next few years will stay the same/will decrease". Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix E. Alternative Form of Treatment

Finally, we examine whether our survey experiment results are affected by the definition of the treatment. Recall that in the main text, our treatment is the informational cue concerning worsening weather conditions, meaning that respondents were shown the vignette "Some people say that the probability of floods or droughts happening here in the next few years will increase". Respondents that did not get the treatment instead got the cue that weather conditions

are not expected to change ("Some people say that the probability of floods or droughts happening here in the next few years will stay the same") or improve ("Some people say that the probability of floods or droughts happening here in the next few years will decrease"). For this robustness check, we now explicitly consider the neutral informational cue. That is, in comparison to the favorable cue ("Some people say that the probability of floods or droughts happening here in the next few years will decrease"), one treatment now refers to the neutral cue ("Some people say that the probability of floods or droughts happening here in the next few years will stay the same"), while the second treatment refers to worsening weather conditions (meaning that respondents received the cue "Some people say that the probability of floods or droughts happening here in the next few years will increase").

As shown in Supplementary Table 4, we find that there is no uniform effect of the two forms of the treatment on changes in migration aspirations. This is consistent with our main survey experiment results. We also find that receiving the neutral cue does not affect migration aspirations, regardless of whether we consider respondents that experienced only gradual or sudden weather-related environmental events. By contrast, we show that receiving the unfavorable prompt results in increased migration aspirations among respondents that experienced only gradual weather-related environmental events but not among respondents that only faced sudden events instead. This latter finding speaks to our experimental finding reported in the main text that especially unfavorable cues lead to higher migration aspirations particularly among respondents that encountered gradual weather-related environmental events in the past.

Supplementary Table 5: Alternative Definition of Treatment

	(1)	(2)	(3)
Treatment1	0.041	0.041	
	(0.071)	(0.073)	
Treatment2	0.028	-0.001	
	(0.071)	(0.073)	
Gradual-Onset Event		-0.040	
		(0.218)	
Treatment1 * Gradual-Onset Event		-0.017	
		(0.329)	
Treatment2 * Gradual-Onset Event		0.522*	
		(0.069)	
Sudden-Onset Event			0.015
			(0.106)
Treatment1 * Sudden-Onset Event			-0.151
			(0.151)
Treatment2 * Sudden-Onset Event			-0.045
			(0.152)
Age	-0.024***	-0.024***	-0.024***
	(0.006)	(0.006)	(0.006)
Female	-0.317***	-0.317***	-0.316***
	(0.063)	(0.063)	(0.063)
At Least Secondary Education	0.083	0.087	0.085
	(0.063)	(0.063)	(0.063)
Married/In Relationship	-0.142*	-0.145*	-0.144*
	(0.075)	(0.075)	(0.075)
Satisfaction with Income	-0.128***	-0.129***	-0.129***
	(0.031)	(0.031)	(0.031)
Senegal	-0.287***	-0.290***	-0.297***
	(0.066)	(0.066)	(0.067)
Migration Aspirations	0.010***	0.010***	0.010***
	(0.001)	(0.001)	(0.001)
Observations	5,783	5,783	5,783

Notes: Constant not reported. Dependent variable=binary outcome (1=stronger migration intentions; 0=no change or weaker migration intentions). Treatment1="Some people say that the probability of floods or droughts happening here in the next few years will stay the same". Treatment2="Some people say that the probability of floods or droughts happening here in the next few years will increase". Reference group for Treatments=" Some people say that the probability of floods or droughts happening here in the next few years will stay the will decrease". Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.