Weather shocks and migration intentions in Western Africa: Insights from a multilevel analysis

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Climate migration on the rise

Changes in weather conditions induce economic, health and welfare effects within a given spatial unit (Dell et al., 2014)

In particular, natural disasters and variations in temperature/rainfall have substantive impacts on the level and volatility of income in agriculture-dependent economies, thereby increasing incentives (and sometimes forcing) individuals and families to seek more viable and less vulnerable places to live (IPCC, 2014; Rigaud, et al. 2018)

Forecasts vary from 25 million to 1 billion environmental migrants by 2050, moving either internally or internationally (UNU-IEHS, 2015)

Need to better understand climate migration patterns

The World Bank Group report stresses "the **need to improve our understanding of climate migration trends and trajectories** at the country level, such that policymakers can anticipate the scale of climate migration, the places people will go to or stay in, and the development implications of these movements"

Stance of the literature

A burgeoning body of literature has looked into the relationship between climate factors and migration

But there is a **significant diversity in terms of outcomes** (see Piguet, 2010; Millock, 2015; Berlemann and Steinhardt, 2017; Beine and Jeusette, 2018; Cattaneo et al., 2018)

Important gaps remain in the understanding of the complex climate-migration nexus, mainly due to:

- the difficulty of connecting weather realizations to the exposed populations
- the difficulty of accounting for the individual and regional contexts that govern mobility decisions

Our approach

We bridge the gap between micro and macro approaches using **a multilevel approach**

- This allows us to better identify individuals hit by climate shocks, and to gain understanding of the mechanics of migration responses (both internal and international)

We combine for **six Western African countries**:

- measures on climate shocks collected from ground weather stations at a relatively detailed level of time and spatial granularity
- with individual survey data documenting migration intentions at specific dates in specific spatial units

Focus on six Western African countries

We focus on six countries (Burkina Faso, Ivory Coast, Mali, Mauritania, Niger, Senegal) in Western Africa

- usually seen as one of the most at risk regions of the world in terms of environmental balance and associated mobility patterns (European Commission, 2015)
- heavily depending on agriculture
- already experienced rising temperatures, shifting precipitation patterns, and increasing extreme events (Jalloh et al., 2013)

Data

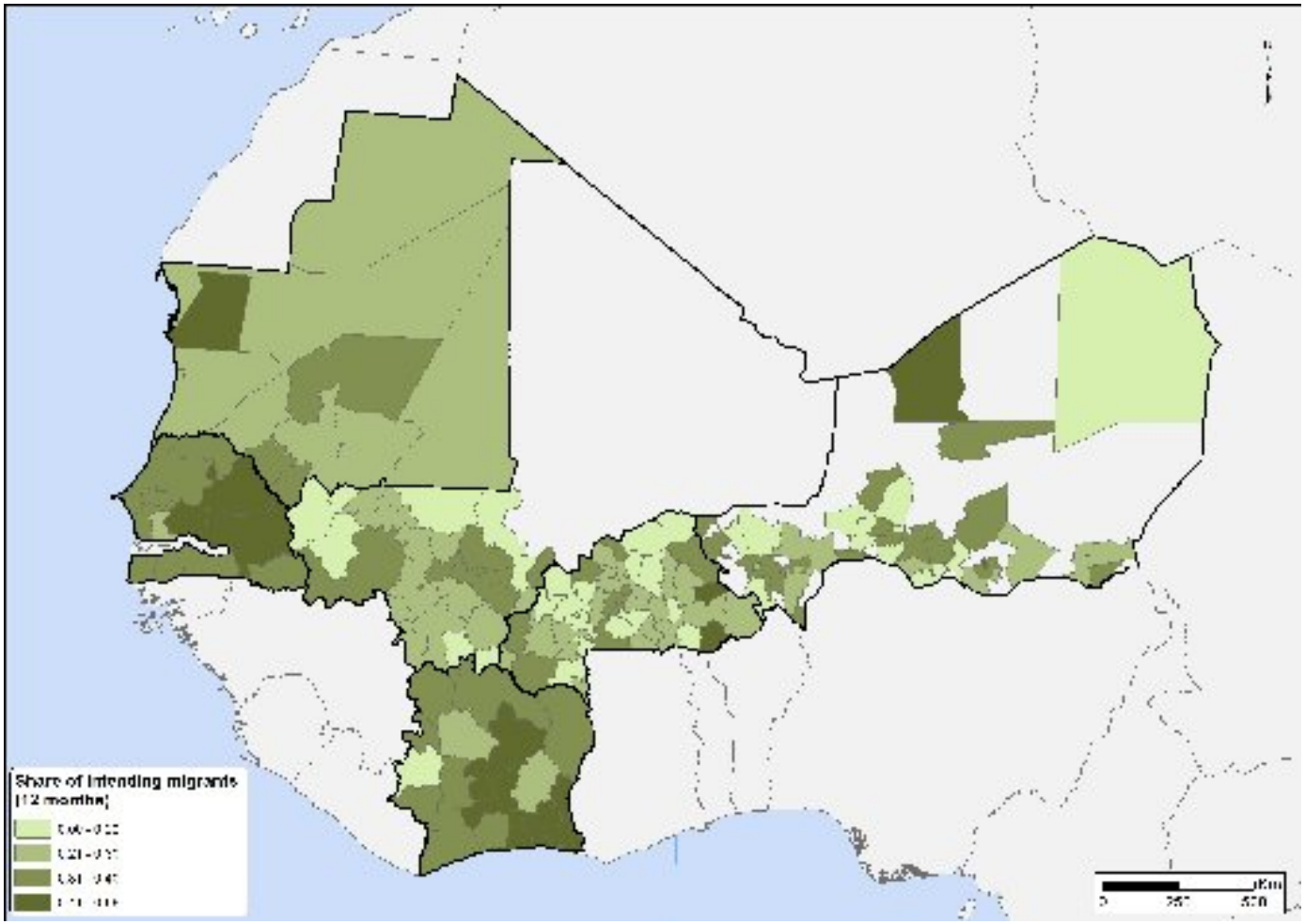
Gallup World Polls

- Our database covers micro data on **migration intentions** and **individual characteristics** of respondents in six Western African countries over a period of 9 years (2008-2016)

Georeferenced climate data

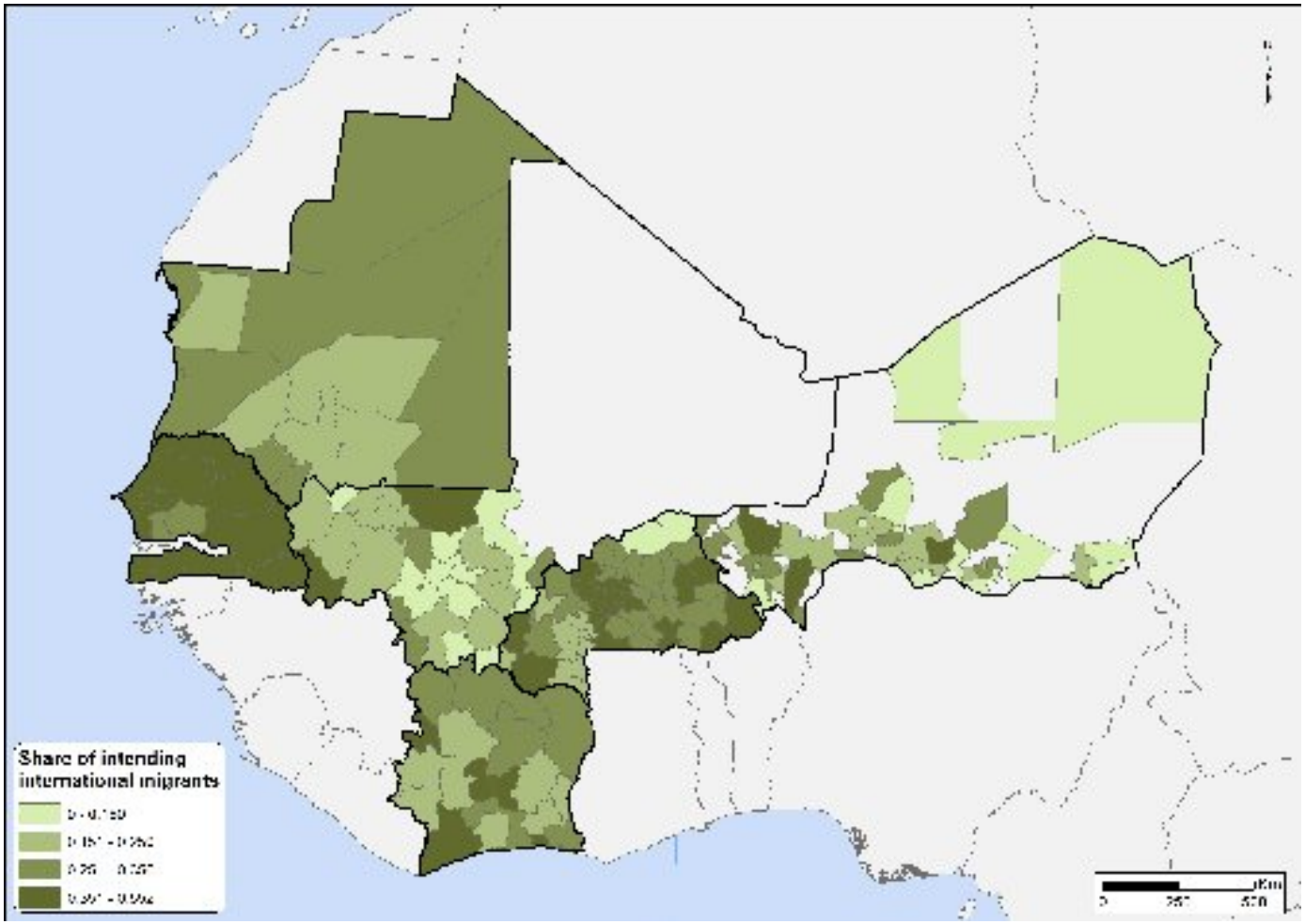
- Monthly data on **rainfall and temperature** for each GADM region of the countries included in the analysis from the high-resolution gridded dataset CRU TS v.4.01 built by the Climatic Research Unit of the University of East Anglia (see Harris et al., 2014)
- Monthly data on the Standardized Precipitation-Evapotranspiration Index (**SPEI**) (Begueria et al., 2014)

Share of individuals intending to move within 12 months (fine regions)



Source: Authors' elaboration on Gallup World Polls and GADM.

Share of individuals intending to move abroad (fine regions)



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Weather anomalies

The data on meteorological conditions at the monthly level (rainfall and temperature) are provided at a resolution of 0.5 degrees and they come from the aggregation of observations collected from **ground weather stations**

The weather conditions prevailing in each GADM region have been computed by aggregating the values corresponding to the **grids that belong (entirely or partly) to the GADM region**, where grids are weighted proportionally to the part of their surface that belongs to the GADM region

For each region and month, we compute deviations from the long-term region and month-specific average rainfall and temperature (calculated over Jan 1900-Dec 1999)

Weather anomalies

We also use information on the **Standardized Precipitation-Evapotranspiration Index or "SPEI"** (Begueria et al., 2014)

= a multiscalar **drought index** determining the onset, duration and magnitude of drought conditions with respect to normal conditions in a variety of natural and managed systems such as crops, ecosystems, rivers, water resources

It depends both on the supply of water to the ground through rainfall and the demand (or use) of water by the atmosphere through evapotranspiration (a function of a.o. temperature, latitude, monthly number of sun hours)

A drought is characterized by $SPEI_{rt} < 0$

Local crop-growing seasons

Studies show that the economic effects of weather shocks mostly operate through their influence on crop yields. In particular, **adverse weather shocks occurring during the crop-planting and crop-growing seasons are more likely to affect crop production** (Iizumi and Ramankutty, 2015)

For each GADM region

1. we identify the main crop (using EARTHSTAT data) for each region e.g. groundnut, millet, rice and sorghum for the various regions in Senegal
2. then rely on information on the (local) planting and harvesting season for this crop to identify periods of the year in which weather conditions are expected to exert a stronger influence on agricultural yields, and thus possibly on stated migration intentions

RUM model of migration

Our goal is to analyze the determinants of migration intentions, and to test whether these intentions are affected by adverse weather shocks in the six Western African countries under consideration

2 steps:

1. develop the microfoundations underlying our empirical model
2. conduct a meta-analysis to avoid arbitrary choices for our benchmark specification

The choice set

The choice set D of individual i includes 3 alternatives:

- **Staying** in the home region
- **Moving domestically** to another region in the country
- **Migrating to an international destination**

Our variable of interest concerns past weather conditions in region r of country j, for which the estimated coefficient is denoted by β

Individual and household characteristics

We account also for personal characteristics which might influence migration behavior:

- age dummies (20-29, 30-39, 40-49)
- dummy for being high skilled
- dummy for being male
- dummy for living in a large city or suburb of large city
- household size (number of adults and children)
- dummy for having a friend or relative abroad

and dummies for the

- month-of-the-year (possible seasonal effects)
- year in which individual *i* was interviewed (time-varying country-level determinants)
- region (time-invariant spatial heterogeneity in the intentions to move)

Meta-analysis

We have a large degree of freedom to define the specification of the response functions in general, and the definition of the weather shock variable (WS_{rt}) in particular

To better understand the link between weather shocks and migration intentions, we consider a **large number of specifications** and **conduct a meta-analysis of the regression results** to assess the impact of methodological choices related to our variable of interest and different sub-samples of respondents on the significance, sign and size of β and the predictive power of the model

Our meta-analysis distinguishes between

- 7 weather variables: temperature and precipitation anomalies and 5 variants of the SPEI shocks
- 3 types of weather shocks: adverse shocks, beneficial shocks, or both (symmetrically)
- 3 measures of the intensity of the shock: at least 1, 2 or 3 standard deviations from the long-term average
- deviations from the long-term average computed from 1 up to 36 months back
- 2 specifications: identifying weather anomalies in all months, or in months falling in the crop-growing season
- 2 sets of regional identifiers: fine or coarse
- 7 samples: full sample, or subsamples covering only rural areas, urban areas, low-educated respondents, high-educated respondents, respondents with or without a family member or friend abroad

Main take-aways

Overall, our meta-analysis reveals that the predictive power of the model is maximized when

- using negative SPEI shocks (i.e., droughts)
- measuring shocks as the share of months with at least 2 standard deviations below the relevant long-term average value over the last 12 months
- focusing on weather anomalies during the crop-growing season
- focusing on individuals living in rural areas

Benchmark specification

The results of our meta-analysis are used to guide the choice of the proxy used to measure past weather shocks for region r at time t, WS_{rt}

Benchmark: proxy WS_{rt} with the share of months belonging to the local (region-specific) crop-growing season in the 12 months before the interview in which the SPEI (measured over one month) was at least 2 standard deviations below its long-term average value

$\Rightarrow$ We focus on the effect of droughts on moving intentions

- if β is positive, droughts make the origin location relatively less attractive than other destinations

Logit estimations on intentions to move in 12m

	Intentions to move within 12 months					
	CIV	SEN	MLI	NER	BFA	MRT
Adv. SPEI	6.326**	4.881**	0.988	6.962***	0.217	0.784
	(2.15)	(2.52)	(1.00)	(6.43)	(0.11)	(0.24)
Age 25-34	-0.046	-0.061	-0.548***	-0.063	-0.223***	0.040
	(-0.40)	(-0.62)	(-7.16)	(-0.93)	(-3.15)	(0.31)
Age 35+	-0.643***	-0.629***	-1.117***	-0.625***	-0.757***	-0.536***
	(-4.32)	(-4.73)	(-10.32)	(-6.31)	(-5.78)	(-7.83)
Male	0.072	0.681***	0.732***	1.177***	0.508***	0.486***
	(1.05)	(9.30)	(5.70)	(9.78)	(5.84)	(4.60)
College	0.102	-0.236	0.137	-0.174	0.251	0.229
	(0.22)	(-1.29)	(0.46)	(-0.57)	(0.82)	(0.80)
HH size	0.014	0.029	-0.022**	0.048**	-0.035*	0.085***
	(0.78)	(1.54)	(-1.97)	(2.34)	(-1.85)	(5.33)
N. children	-0.013	-0.001	0.002	0.004	-0.023*	0.002
	(-0.75)	(-0.14)	(0.16)	(0.30)	(-1.66)	(0.16)
Network	0.167**	0.212***	0.381***	0.380***	0.187**	0.083
	(2.19)	(3.43)	(7.83)	(4.42)	(2.23)	(0.70)
Const	-0.578**	-0.661**	-0.801***	-2.674***	-1.610***	-0.894**
	(-2.57)	(-2.55)	(-3.79)	(-14.69)	(-10.86)	(-2.12)
Pseudo R^2	0.054	0.054	0.067	0.088	0.059	0.035
Corr Pred	66.476	66.667	75.627	81.083	78.281	72.614
N. of obs.	3329	6483	6380	6428	5654	3122

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Logit estimations on internat migration intentions

	Intentions to move internationally					
	CIV	SEN	MLI	NER	BFA	MRT
Adv. SPEI	-0.613	-0.550	1.189	8.486***	-0.590	1.215
	(-0.17)	(-0.47)	(0.41)	(10.48)	(-0.20)	(0.56)
Age 25-34	-0.396***	-0.414***	-0.590***	-0.334***	-0.480***	-0.335**
	(-6.08)	(-8.91)	(-6.12)	(-3.82)	(-6.12)	(-2.05)
Age 35+	-0.968***	-1.115***	-1.293***	-0.957***	-1.127***	-1.163***
	(-8.05)	(-8.75)	(-9.58)	(-10.45)	(-10.88)	(-11.24)
Male	0.384***	0.723***	0.838***	1.477***	0.686***	0.548***
	(4.76)	(6.32)	(6.78)	(10.88)	(7.92)	(4.95)
College	0.485***	-0.423***	0.186	-0.083	-0.465	0.041
	(2.76)	(-2.62)	(0.66)	(-0.28)	(-1.29)	(0.20)
HH size	0.060	0.057***	0.013	0.033**	0.009	0.026
	(1.64)	(4.13)	(1.13)	(2.23)	(0.59)	(1.26)
N. children	-0.018	-0.021*	-0.004	0.020**	-0.036**	0.015
	(-0.99)	(-1.78)	(-0.36)	(2.02)	(-2.27)	(0.47)
Network	0.106	0.422***	0.310***	0.487***	0.384***	0.439***
	(1.17)	(6.64)	(3.29)	(5.83)	(5.63)	(3.13)
Const	-1.327***	0.095	-0.776***	-2.483***	-0.653***	-1.225***
	(-4.84)	(0.34)	(-3.64)	(-20.32)	(-6.68)	(-2.97)
Pseudo R^2	0.084	0.095	0.088	0.125	0.082	0.075
Corr Pred	70.032	66.181	77.747	83.241	70.150	76.006
N. of obs.	3417	6594	6480	6468	5789	3255

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Logit estimations on intentions to move in 12m (low-skilled individuals from rural areas)

Intentions to move within 12 months

	CIV	SEN	MLI	NER	BFA	MRT
Adv. SPEI	10.096***	3.680*	2.825	7.378***	0.137	0.000
	(2.66)	(1.92)	(1.28)	(4.28)	(0.06)	(.)
Age 25-34	-0.184	-0.121	-0.614***	-0.068	-0.211**	0.036
	(-1.32)	(-1.08)	(-6.78)	(-0.31)	(-2.37)	(.)
Age 35+	-0.863***	-0.622***	-1.259***	-0.416***	-0.862***	-0.381
	(-5.83)	(-7.05)	(-10.88)	(-3.51)	(-6.51)	(.)
Male	0.078	0.727***	0.935***	1.007***	0.585***	0.316
	(0.80)	(10.62)	(6.45)	(8.31)	(5.63)	(.)
HH size	0.034	0.023	-0.007	0.096***	-0.036*	0.143
	(1.12)	(0.89)	(-0.40)	(3.51)	(-1.69)	(.)
N. children	-0.012	0.002	0.007	-0.022	-0.025*	-0.028
	(-0.58)	(0.20)	(0.55)	(-0.86)	(-1.66)	(.)
Network	0.251**	0.117	0.348***	0.503***	0.148*	-0.001
	(2.04)	(0.99)	(7.67)	(2.84)	(1.69)	(.)
Constant	-1.126***	-0.473	-1.162***	-1.892***	-1.599***	-0.040
	(-3.90)	(-1.31)	(-7.91)	(-5.66)	(-9.93)	(.)
Pseudo R^2	0.068	0.072	0.087	0.083	0.069	0.099
Corr Pred	70.058	69.045	76.607	77.638	78.615	69.310
N. of obs.	2418	3392	4433	957	4807	290

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Logit estimations on internat migration intentions (low-skilled individuals from rural areas)

	Intentions to move internationally					
	CIV	SEN	MLI	NER	BFA	MRT
Adv. SPEI	8.136*	-0.818	-5.561	13.166***	-0.829	-16.157
	(1.93)	(-0.60)	(-1.11)	(7.89)	(-0.29)	(.)
Age 25-34	-0.398***	-0.486***	-0.662***	-0.137	-0.485***	0.053
	(-4.06)	(-7.09)	(-6.30)	(-0.59)	(-5.97)	(.)
Age 35 +	-1.041***	-1.139***	-1.414***	-0.980***	-1.160***	-0.994
	(-7.18)	(-7.74)	(-7.52)	(-5.27)	(-11.74)	(.)
Male	0.400***	0.863***	0.946***	1.406***	0.716***	0.704
	(5.27)	(9.48)	(6.26)	(11.33)	(8.01)	(.)
HH size	0.067	0.037	0.017	0.018	0.002	0.201
	(1.55)	(1.44)	(1.23)	(0.74)	(0.14)	(.)
N. children	-0.024	-0.034**	-0.001	0.064**	-0.034**	-0.003
	(-1.01)	(-2.50)	(-0.05)	(2.44)	(-2.23)	(.)
Network	0.129	0.320***	0.229	0.747***	0.417***	0.153
	(0.70)	(3.45)	(1.56)	(13.11)	(5.37)	(.)
Constant	-2.293***	0.061	-0.992***	-2.471***	-0.634***	-0.178
	(-7.13)	(0.14)	(-4.69)	(-14.41)	(-6.31)	(.)
Pseudo R^2	0.083	0.102	0.106	0.138	0.088	0.244
Corr Pred	72.950	67.053	79.012	81.771	70.343	80.838
N. of obs.	2488	3454	4512	971	4923	334

Caveats and sensitivity

Weather conditions in a local region are likely correlated with those in neighboring regions making these less attractive $\rightarrow$ estimated effect possibly biased towards zero and statistical significance possibly reduced (less of a problem for international migration intentions)

Individuals might have moved between the occurrence of an extreme weather event and the date in which they are interviewed by Gallup

- Moved abroad: out of the sample
- Moved internally: still in the sample, but incorrectly matched to the weather conditions prevailing in the region which they moved to rather than in their origin

Our conjecture: potential migrants remain in the pool of respondents in the first weeks and months following a shock

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Conclusion

In this paper, we use a multilevel approach to characterize the relationship between weather shocks and (internal and international) migration intentions in six Western African countries over the period 2008-2016

Our results are in line with other cross-country studies or studies focusing on long-term climate changes. Still, they also reveal that migration responses vary across countries at the extensive and intensive margins, which can be due to differences in culture or adaptation capabilities

Thank you!

Questions? Comments? Suggestions?

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Stance of the literature: cross-country studies

Cross-country studies strongly suggest that internal and international migration responses to environmental shocks are context-specific, depending on

- the type of economic activity
- the level of development of the country

Yet, it remains unclear to what extent such conditional effects are due to

- financial constraints
- the skill composition of the population
- heterogeneity in the capacity of "on-farm" adaptation
- past migrations
- cultural characteristics governing the perceptions of environmental hazard

Stance of the literature: case studies

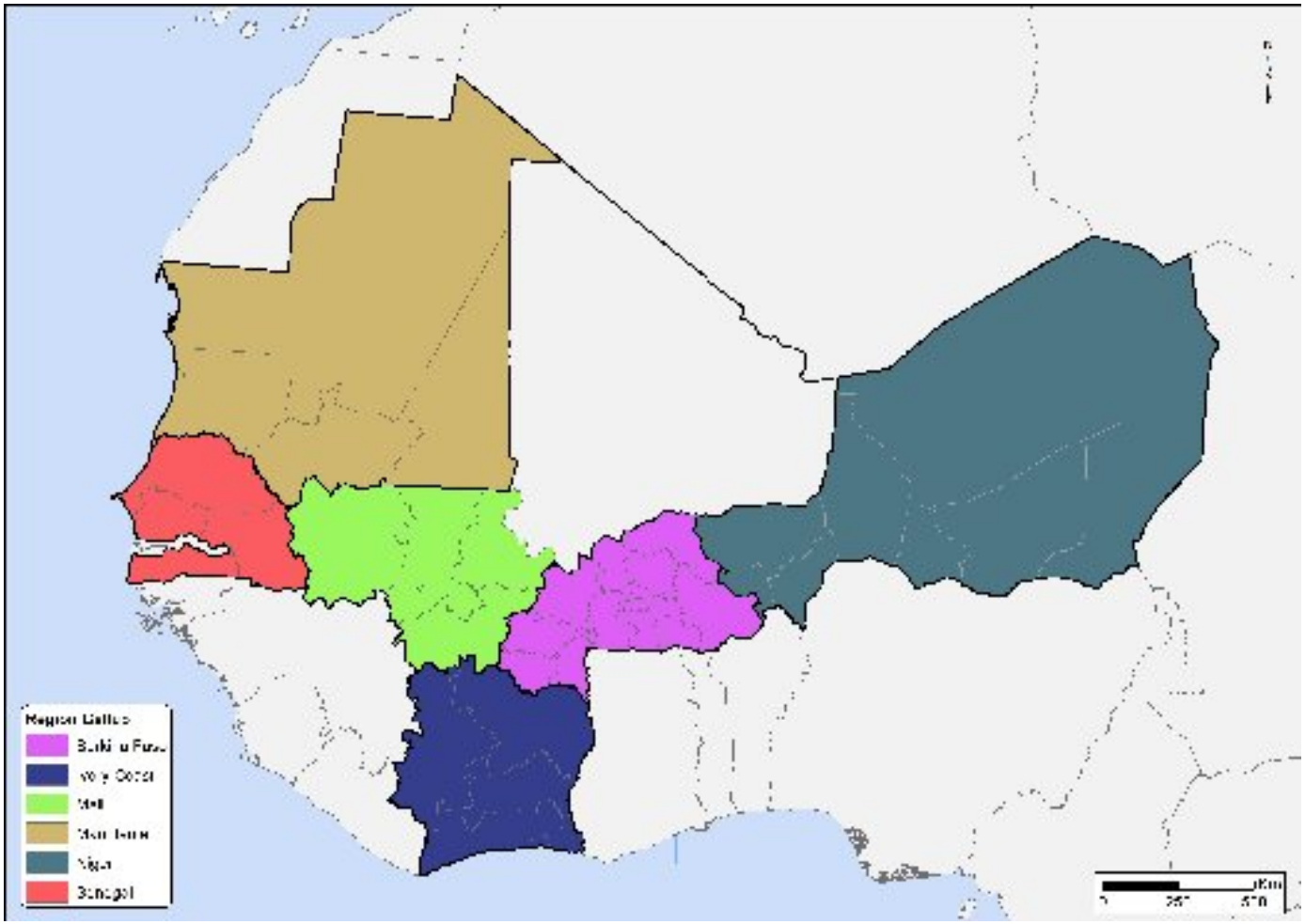
Case studies conducted at the microeconomic level tend to confirm that migration responses are conditional and sometimes contradictory (Piguet, 2010; Gray and Bilsborrow, 2013)

Due to data constraints case studies typically focus on the impact of a single type of shock and on rural-to-urban migration in specific countries

Migration responses are shown to be different depending on

- household wealth (role of poverty constraints)
- skill levels (evidence found in both directions)
- gender (mostly evidence for higher impact for men)

Regions (coarse identifiers) for the six countries



Source: Authors' elaboration on Gallup World Polls.

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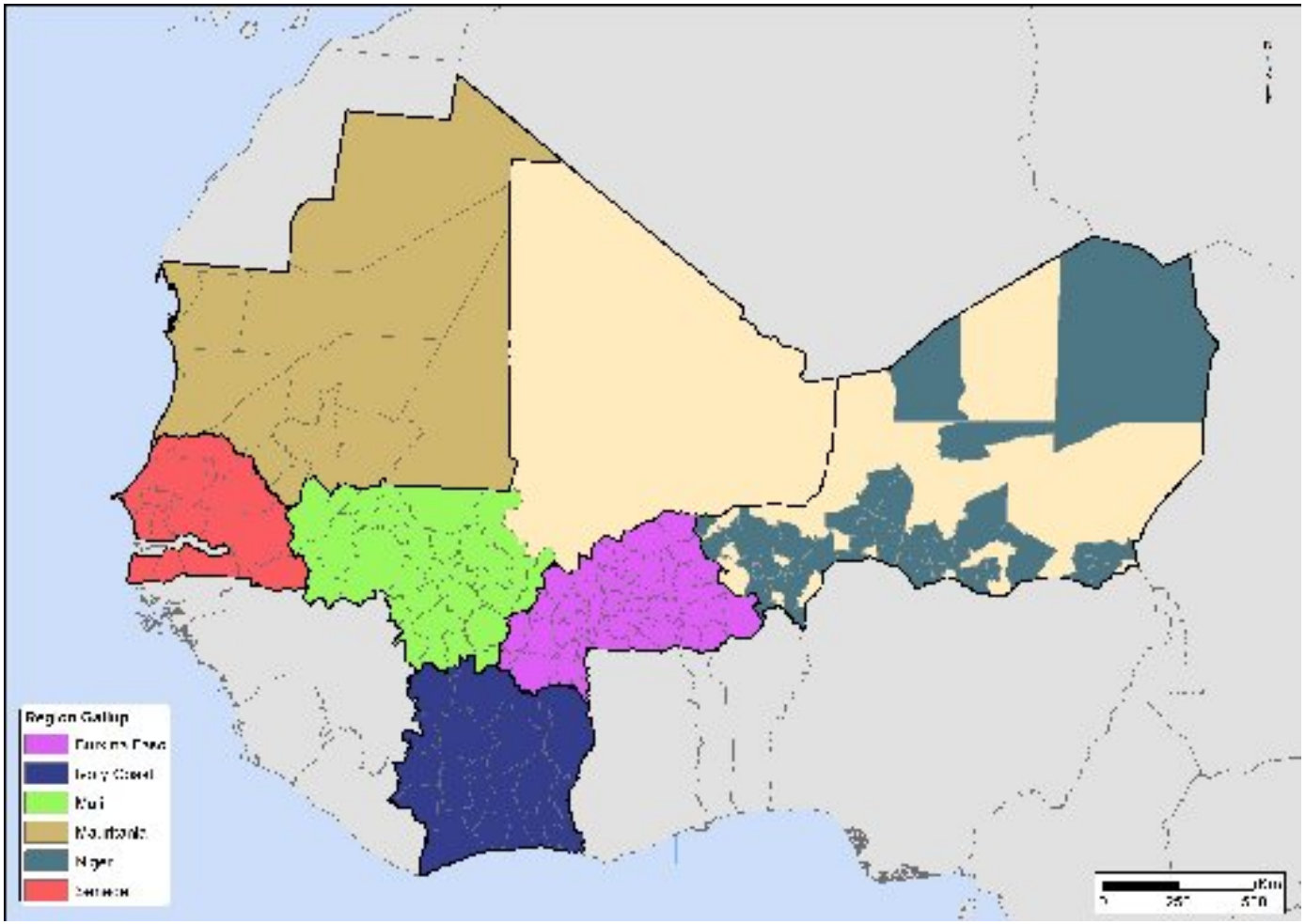
Regions (fine identifiers) for the six countries



Source: Authors' elaboration on Gallup World Polls.

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Availability of coarse and fine regional identifiers

	Year (coarse)								
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
Burkina Faso	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ivory Coast		No				No	Yes	Yes	Yes
Mali	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mauritania		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Niger	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Senegal	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	Year (fine)								
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
Burkina Faso	No		No	No	No	Yes	Yes	Yes	Yes
Ivory Coast		No				No	Yes	Yes	Yes
Mali	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mauritania		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Niger	No	No	No	No	No	No	Yes	Yes	Yes
Senegal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The Gallup World Polls

Database documenting personal and household characteristics of respondents all over the world since 2005 as well as their opinions on a wide variety of topics

- A typical Gallup survey interviews about a 1000 randomly selected individuals within each country
- Data collected through telephone surveys and face-to-face interviews
- The sampling frame represents the entire civilian, non-institutionalized population aged 15 and over covering the entire country including rural areas

Our sample consists of 41,834 individuals aged 15 to 49 for whom we have information on at least one regional identifier

Migration intentions

We rely on the following two questions from the Gallup World Polls:

- **Intention to move away**: *In the next 12 months, are you likely or unlikely to move away from the city or area where you live?* [WP85]
- **Intention to migrate abroad**: *Ideally, if you had the opportunity, would you like to move permanently to another country, or would you prefer to continue living in this country?* [WP1325]

Excluding arid areas

Note that our six Western African countries partly include **arid areas of the Sahara** (=largest continuously hot area in the world due to the constantly high position of the sun, the extremely low relative humidity, and the lack of vegetation)

The population consists of nomadic and pastoral people making their living from livestock breeding and trading: may exhibit **specific mobility patterns**

$\Rightarrow$ We exclude regions for which the arid areas represent more than half their surface from the sample used in our benchmark specification.

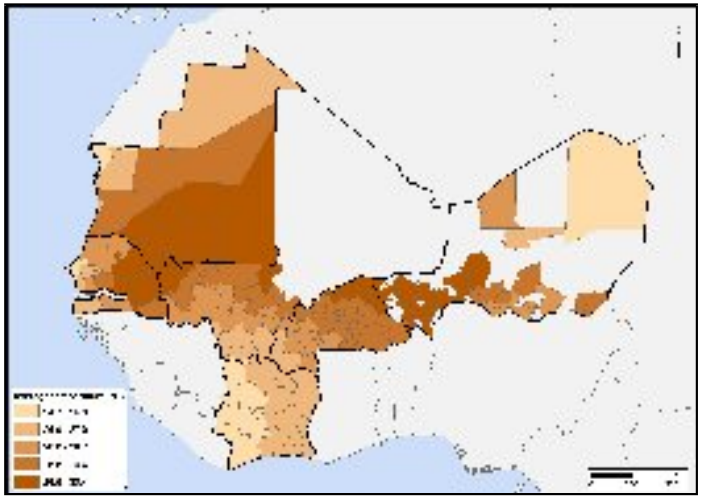
Average weather conditions and adverse shocks

The upcoming figures report average weather conditions and the share of months with extreme weather conditions (2 standard deviations above or below the long-term average for each region) between January 2008 and December 2016 at the fine regional level

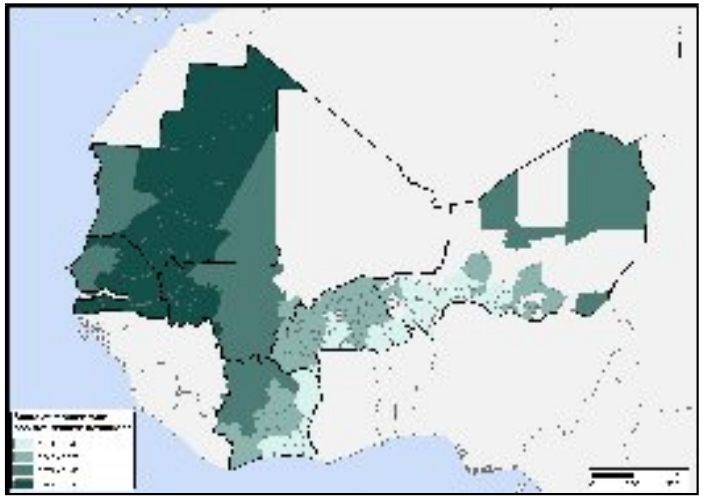
- Average temperature and precipitation
- Share of months with positive (negative) relative deviations for temperature (precipitation)

Average weather conditions and adverse shocks

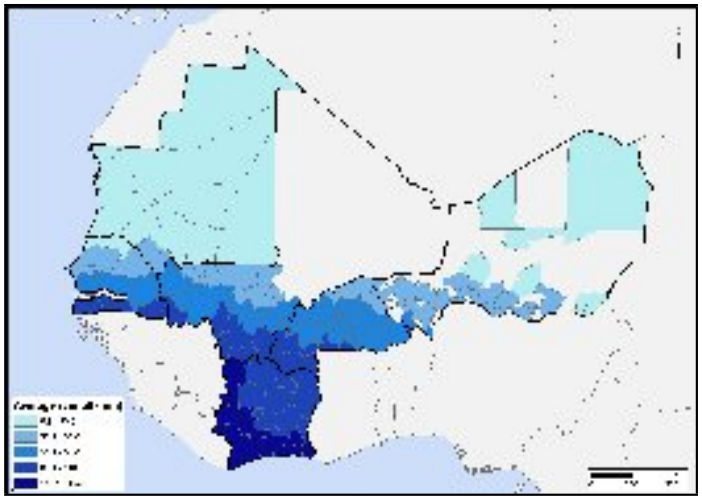
2.a. Average temperature



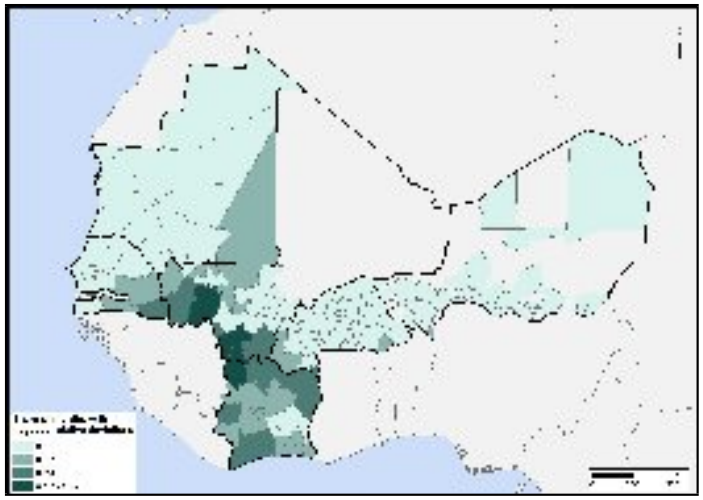
2.b. Adverse temperature shocks



2.c. Average precipitation

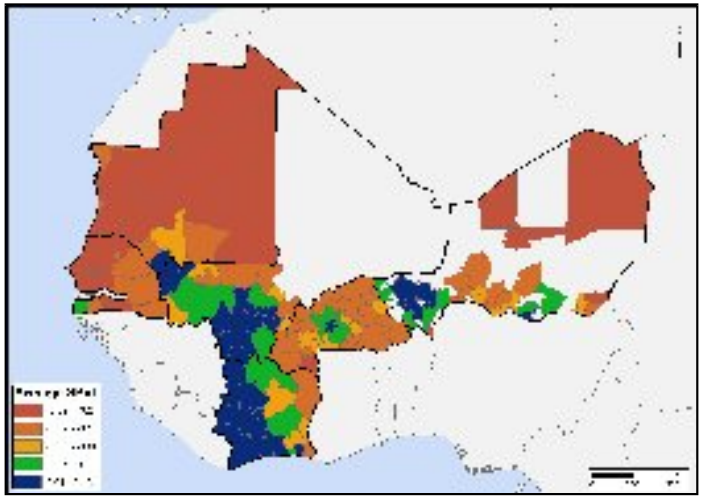


2.d. Adverse precipitation shocks

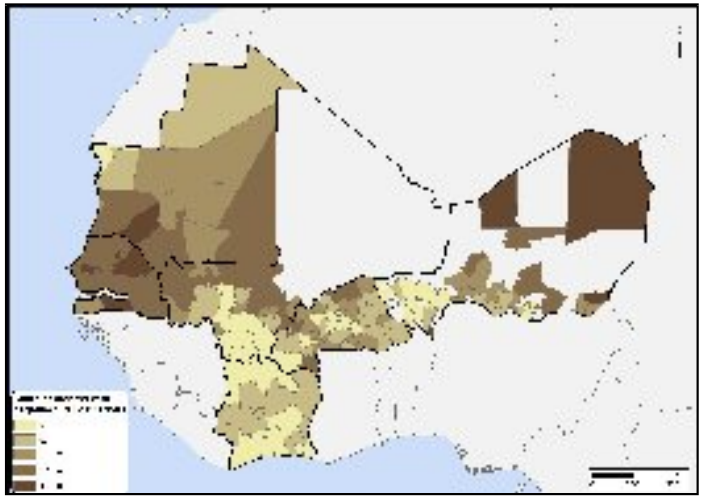


Average weather conditions and adverse shocks

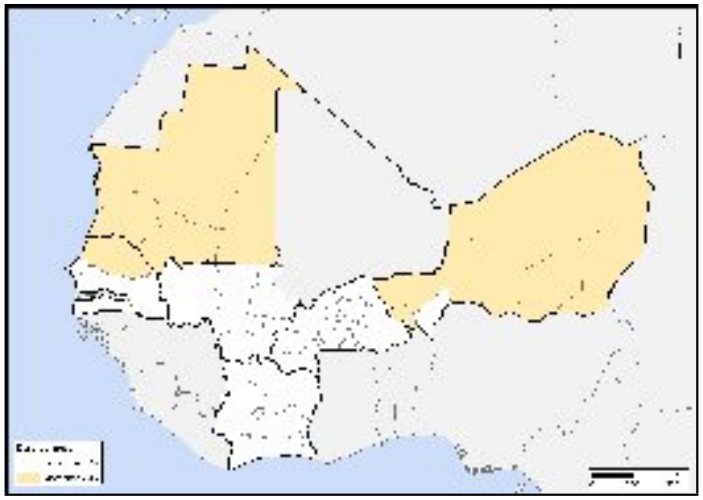
2.e. Average SPEI



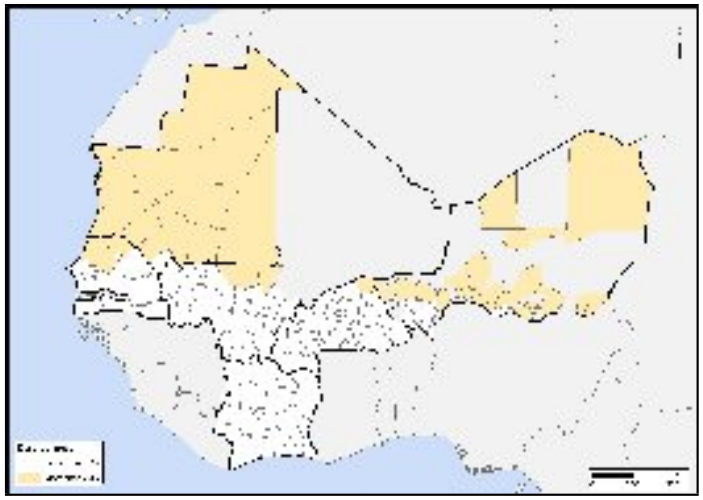
2.f. Adverse SPEI shocks



2.g. Arid areas



2.h. Arid areas



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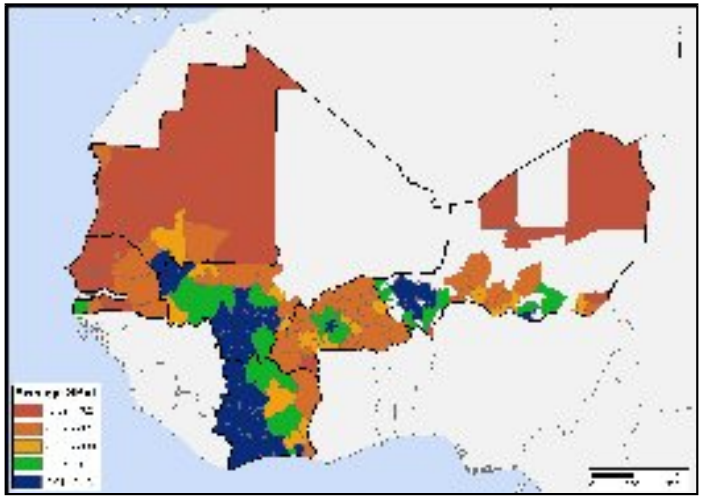
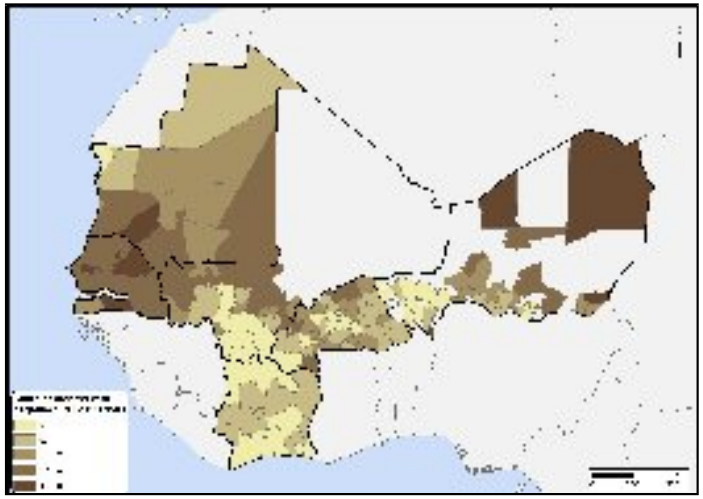
Average weather conditions and adverse shocks

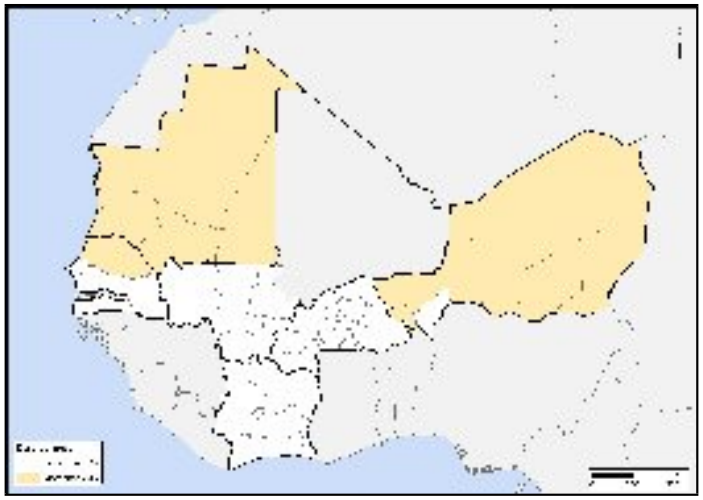
2.e. Average SPEI



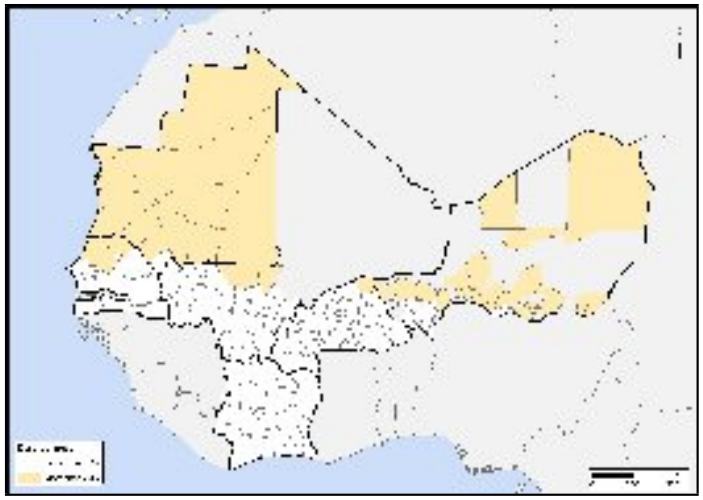
2.f. Adverse SPEI shocks



2.g. Arid areas



2.h. Arid areas



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Weather anomalies

Advantage of the SPEI: incorporates the interaction between rainfall and temperature in determining agricultural yields

- for instance, the effect of a period with below average rainfall (above average temperature) on agricultural output could be mitigated by a below average temperature (above average rainfall)

Disadvantage of the SPEI: available only until December 2015 $\Rightarrow$ estimates based on the SPEI are based on a slightly more restricted sample, which excludes the last wave of the GWP

A drought is characterized by $SPEI_{rt} < 0$

Meta-analysis

Analysis through meta-regressions on 381,024 specifications (for which 308,389 are converging for the intention to move within 12 months and 307,548 for the intention to migrate abroad)

- Correlates of unidentified values for β (90,794)
- Correlates of significant values for β
- Correlates of positive and significant values for β
- Correlates of negative and significant values for β
- Correlates of size of β
- Correlates of the share of observations in the sample that have been correctly predicted

Meta-analysis on intentions to move within 12m

	$\beta\sharp$	β^*	$\beta^* > 0$	$\beta^* < 0$	$\lvert\beta^*\rvert$	Predict
Adverse	0.446***	0.082***	0.086***	-0.004**	0.341***	-0.023*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.011)	(0.013)
Beneficial	0.263***	0.133***	0.031***	0.102***	-0.175***	-0.022
	(0.002)	(0.003)	(0.002)	(0.002)	(0.010)	(0.013)
Precipitation	-0.158***	-0.148***	-0.110***	-0.038***	-0.505***	-0.034
	(0.005)	(0.006)	(0.004)	(0.004)	(0.030)	(0.031)
SPEI	-0.032***	-0.126***	-0.097***	-0.029***	-0.438***	0.957***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.023)	(0.023)
Intens. 2sd	-0.170***	0.027***	0.027***	0.000	0.106***	0.046***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.010)	(0.013)
Intens. 3sd	-0.222***	-0.017***	-0.027***	0.009***	-0.127***	-0.037***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.014)
Length 12	0.078***	0.006***	0.009***	-0.003	0.003	0.157***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.011)
Length 13-24	0.022***	-0.007***	0.003*	-0.009***	0.029***	-0.024**
	(0.002)	(0.002)	(0.001)	(0.002)	(0.009)	(0.011)
Crop season	0.007***	-0.009***	-0.006***	-0.003*	-0.015**	-0.017
	(0.002)	(0.002)	(0.001)	(0.001)	(0.007)	(0.011)
Rural	0.007**	0.010***	0.005**	0.005*	-0.006	0.814***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.012)	(0.020)
Urban	0.028***	0.052***	0.020***	0.032***	-0.065***	-2.084***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.013)	(0.020)
College grads	0.085***	-0.032***	-0.001	-0.031***	0.060***	-0.351***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.018)	(0.017)
Less educated	0.000	0.004	0.001	0.003	-0.021*	0.051***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.011)	(0.017)

Meta-analysis on intentions to move within 12m

	$\beta\sharp$	β^*	$\beta^* > 0$	$\beta^* < 0$	$\lvert\beta^*\rvert$	Predict
Network	0.006**	-0.015***	0.006***	-0.022***	0.068***	-2.492***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.011)	(0.017)
No network	0.005*	-0.013***	-0.006**	-0.007***	-0.016	2.404***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.011)	(0.017)
Rural x Adv	0.014***	0.013*	0.026***	-0.013***	0.119***	0.032
	(0.005)	(0.007)	(0.005)	(0.005)	(0.028)	(0.033)
Rural x Adv x Crop	-0.052***	0.023***	0.041***	-0.018***	0.068*	-0.056
	(0.007)	(0.009)	(0.007)	(0.007)	(0.039)	(0.044)
Urb x Adv	0.054***	0.038***	-0.086***	0.125***	-0.772***	0.047
	(0.005)	(0.007)	(0.005)	(0.005)	(0.032)	(0.033)
Urb x Adv x Crop	-0.044***	-0.015	0.016**	-0.031***	0.166***	-0.166***
	(0.007)	(0.009)	(0.007)	(0.007)	(0.049)	(0.044)
CIV	-0.041***	-0.018***	-0.047***	0.029***	-0.253***	-12.661***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.013)	(0.016)
MLI	-0.044***	0.002	-0.022***	0.024***	-0.160***	-3.253***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.011)	(0.016)
MRT	0.004	0.051***	-0.005**	0.057***	-0.188***	-4.380***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.011)	(0.016)
NER	0.039***	0.188***	0.089***	0.099***	0.005	1.843***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.011)	(0.016)
SEN	-0.027***	-0.021***	-0.035***	0.014***	-0.176***	-10.554***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.012)	(0.016)
Adjusted R^2	0.309	0.058	0.044	0.042	0.024	0.821
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Weights ($1/s.e.\_\beta$)	No	No	No	No	Yes	No
Observations	308389	211125	211125	211125	211125	308389

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Meta-analysis on international migration intentions

	$\beta\sharp$	β^*	$\beta^* > 0$	$\beta^* < 0$	$\lvert\beta^*\rvert$	Predict
Adverse	0.441***	0.120***	0.099***	0.022***	0.239***	-0.026**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.012)	(0.013)
Beneficial	0.266***	0.092***	0.047***	0.045***	-0.195***	-0.040***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.011)	(0.013)
Precipitation	-0.161***	0.005	-0.070***	0.075***	-0.652***	-0.032
	(0.005)	(0.006)	(0.004)	(0.004)	(0.031)	(0.030)
SPEI	-0.032***	0.011**	-0.011***	0.021***	-0.326***	0.662***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.024)	(0.023)
Intens. 2sd	-0.174***	0.010***	0.002	0.008***	0.008	0.028**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.011)	(0.013)
Intens. 3sd	-0.220***	-0.008***	-0.001	-0.007***	-0.044***	0.040***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.010)	(0.013)
Length 12	0.073***	-0.010***	-0.018***	0.008***	0.004	0.080***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.011)
Length 13-24	0.020***	-0.020***	-0.011***	-0.009***	0.004	-0.033***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.011)
Crop season	0.006***	-0.021***	-0.009***	-0.013***	0.031***	0.053***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.010)
Rural	0.012***	-0.040***	-0.014***	-0.025***	0.104***	0.829***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.013)	(0.019)
Urban	0.024***	0.090***	0.016***	0.074***	-0.067***	-2.055***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.014)	(0.019)
College grads	0.096***	-0.031***	-0.036***	0.005*	0.044**	2.161***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.018)	(0.017)
Less educated	-0.000	0.000	-0.001	0.002	0.014	-0.000
	(0.003)	(0.003)	(0.002)	(0.002)	(0.012)	(0.017)

Meta-analysis on international migration intentions

	$\beta\nexists$	β^*	$\beta^* > 0$	$\beta^* < 0$	$\lvert\beta^*\rvert$	Predict
Network	0.011***	-0.031***	-0.025***	-0.006**	0.061***	-2.324***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.012)	(0.017)
No network	0.003	-0.002	-0.005**	0.003	0.055***	2.700***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.012)	(0.017)
Rural x Adv	0.016***	0.038***	0.037***	0.001	0.009	0.031
	(0.005)	(0.007)	(0.005)	(0.005)	(0.029)	(0.032)
Rural x Adv x Crop	-0.053***	-0.022**	-0.017**	-0.004	-0.064	-0.085**
	(0.007)	(0.009)	(0.007)	(0.007)	(0.041)	(0.043)
Urb x Adv	0.057***	-0.044***	-0.067***	0.022***	-0.338***	-0.064**
	(0.005)	(0.007)	(0.005)	(0.006)	(0.034)	(0.032)
Urb x Adv x Crop	-0.038***	0.011	0.031***	-0.020***	0.183***	0.154***
	(0.007)	(0.010)	(0.008)	(0.008)	(0.051)	(0.043)
CIV	-0.038***	0.155***	0.069***	0.085***	-0.064***	-1.751***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.013)	(0.015)
MLI	-0.036***	0.109***	0.019***	0.089***	-0.330***	6.403***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.012)	(0.015)
MRT	0.003	0.063***	0.029***	0.033***	0.049***	3.957***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.012)	(0.015)
NER	0.047***	0.114***	0.062***	0.052***	0.052***	12.471***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.012)	(0.016)
SEN	-0.032***	0.114***	0.034***	0.079***	-0.078***	-4.619***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.012)	(0.016)
Adjusted R^2	0.309	0.040	0.028	0.026	0.018	0.848
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Weights ($1/s.e._\beta$)	No	No	No	No	Yes	No
Observations	307548	209902	209902	209902	209902	307548

Caveats and sensitivity

With the exception of Niger, the effect of SPEI shocks on intentions to move becomes insignificant when extending the length of the period to 24 or 36 months (see col. 2).
The difference in the significance of the coefficient for WS_{rt} that we get depending on the length of the period is open to two alternative (but not mutually exclusive) explanations:

- individuals take their location decisions on the basis of recent (12 months) past weather conditions; when we (incorrectly) expand this period to 24 or 36 months, we are adding noise to our variable of interest, and this reduces its significance;
- individuals take their location decisions on the basis of weather conditions over, say, the past 36 months; if this is the case, given that consecutive waves of the GWP are, on average, only 12 months apart, we have less variability in relevant weather conditions for individuals residing in the same region

Logit estimations: sensitivity of β to SPEI shocks (full sample)

SPEI shocks		CIV	SEN	MLI	NER	BFA	MRT
Intens.	Length	Intentions to move within 12 months					
2 sd	12	6.236**	4.881**	0.988	6.962***	0.217	0.784
1 sd	12	-0.318	0.208	-0.213	-0.037	-0.613	-1.222
2 sd	24	-3.259	0.087	-2.188	13.925***	0.912	-0.961
2 sd	36	-11.666*	-1.262	-0.356	-1.047	2.546	3.728
Intens.	Length	Intentions to emigrate abroad					
2 sd	12	-0.613	-0.550	1.189	8.486***	-0.590	1.215
1 sd	12	-1.196*	0.073	-0.295	0.477	-0.538	-0.130
2 sd	24	-11.671***	-4.426*	-4.726	16.972***	-0.033	0.139
2 sd	36	-14.985***	-5.823*	-10.228**	14.815***	-0.191	9.799***

We include the same controls as before, as well as region, year and month fixed effects.