Is migration drought-induced in Mali?

An empirical analysis using panel data on Malian localities and districts over the 1987-2009 period

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"Migration, Environment and Climat: What Risk Inequalities? "
22nd and 23nd October

Motivation I

- Migration and population mobility have been a common response to drought in many settings, especially in Africa.
  - During the great drought of 1969-1974: population shifts toward the cities of the Sahel (Gervais, 1987; Ouedraogo, 1988)
  - In 2011: large-scale displacements in the Horn of Africa
- Climate change is expected to result in warmer and more frequent hot days and nights, and in heavy precipitation events (Intergovernmental Panel on Climate Change (IPCC)).

Motivation II

- This has led many to warn about the impact of climate change on human migration.
  - *"Climate change will create world's biggest refugee crisis'"* (The Guardian, Nov 2, 2017)
  - *"Le réchauffement climatique va accentuer la pression migratoire aux portes de l'Europe"* (Le Monde, Dec 22, 2017)
  - *"La amenaza de las migraciones climàticas"* (El Pais, March 24, 2018)
- Yet estimates of the volume of climate-induced migration are difficult to provide at the world level. By 2050, they range:
  - From 200 million (The UN International Organization for Migration (IOM))
  - To one billion individuals (Christian Aid, 2017)

Objectives

- Study to what extent climate variability generates internal and international migratory flows in the case of Mali.
- Distinguish short-distance/long-distance migration as short-run/long-run migration.
- Disentangle flows by gender and by age-groups.
- Provide projections of migration flows.

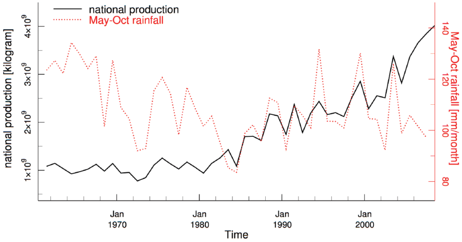
This project:

- involves a broder team of researchers including experts in Geo-Information Science and Earth Observation at Espace-Dev.
- is funded by the Foreign workers' Directorate of the French Ministry of Interior.

Mali: an interesting case study I

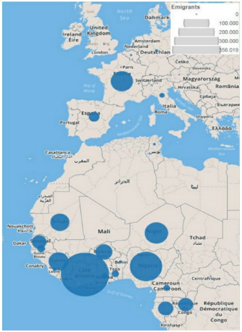
1. Mali's economy heavily relies on agriculture:
   - 66% of the population is engaged in agriculture (WB, 2015).
   - High contribution of agriculture to gross domestic product (39.6% in 2006) (WB, 2015).
2. Agricultural production is dominated by rainfed production: only 8.9% of cultivated areas are irrigated.

Figure: Rainfall and agricultural production in Mali



Mali: an interesting case study II

3. Mali has been characterized by large emigration movements for several decades.
   - At the international level : as of 2010, 6.7% Malians were living abroad.
   - Within Mali : internal migrants represented 16% of the Mali's population in 2009 (INSTAT, 2012).



Malian migrants abroad

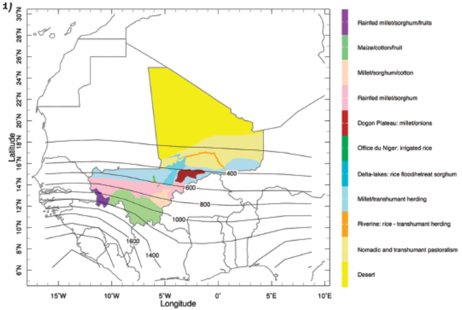
Malian refugees abroad

Figure: Scale of Mali's international migration

Mali: an interesting case study III

4. Various climate and livelihoods zones:
    - In the Desert North, pastoralism and trans-saharan trade
    - In the Sahelian Center (400mm - 800mm/year), sorghum and millet
    - In the Sudanian South (more that 800mm/year), cotton, maize and fruits

Figure: Livelihoods and climate of Mali



Literature Review I

The literature analysing the effect of weather and climate events on migration is recent but rapidly growing.

1. Cross-country analysis:
    - International migration (Coniglio and Pesce (2015), Cai et al (2016))
    - Internal migration (Beine and Parsons (2015))
    - Both internal and international migration (Marchiori et al (2012))

   → Results depend on the data, on the number of countries in the analyses, and on the specifications.

2. Country-level studies:
    - Internal migration is environmentally-induced (Henry *et al* (2004))
    - Lewin *et al* (2012) on Malawi rejects the hypothesis of low rainfall acting as a push factor for migration (liquidity constraints).
    - Households' response to drought is gender specific (Dillon *et al* (2011), Gray and Mueller (2012), Findley (1994)).

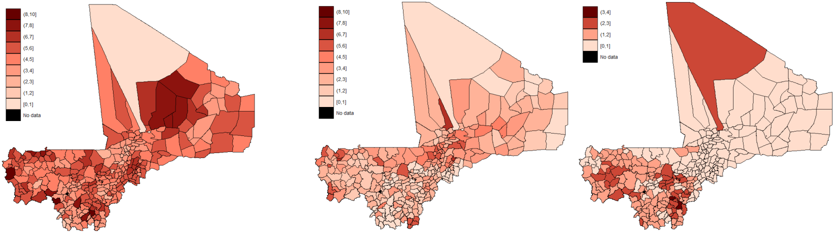
   → Focus on internal migration.

Data sources

We combine different data sources:

- The censuses conducted in Mali in 1987, 1998 and 2009.
  $\rightarrow$ measures of inter-district migration and international migration.
- Standardized Precipitation Evapotranspiration Index (SPEI) (Vicente-Serrano et al., 2010).
  - Account for precipitation, temperature and the potential evapotranspiration for a well-watered reference surface.
  - Express in standard deviations from the historical mean of the locality.
  - We compute the SPEI for the growing cycle in Mali: June to October.
  - Definition of a drought: when the SPEI was below its historical mean by more than one standard deviation.
  - We compute the frequency of drought.
- SPEI projections.
  - We exploit data of bias-corrected CMIP5 global climate model (GCM) constructed by Famien et al (2018).
  - Prediction of SPEI for two climate scenario: the RCP 2.6 ("friendly-climate scenario") and the RCP 8.5 ("pessimistic climate scenario").

Figure: Frequency of drought in Mali



1977-1987 period 1988-1998 period 1999-2009 period

Model specification I

- Migration measure

  we use the indirect method described in Iqbal and Roy (2014). The population increase between two dates is the result of:
  - natural increase (births-deaths)
  - net migratory movement.

Since the different waves of the census are spaced by eleven years, we deduce that the population size of a given age-group is expressed as:

$$Pop.\ size_{j,t} = Pop.\ size_{j,t-11}(proba\ surviving_{[t-11,t]}) + immigrants_{j,[t-11,t]} - emigrants_{j,[t-11,t]}$$

$$Emigrants_{j,[t-11,t]} = Pop.\ size_{j,t-11}(proba\ surviving_{[t-11,t]}) - Pop.\ size_{j,t} + immigrants_{j,[t-11,t]}$$

Probability of surviving over the next 10 years (%)

Age-groups	10-20	20-30	30-40	40-50	50-60	60-70
	95.57	94.23	92.79	88.73	77.13	51.57

Sources: DESA, Population Division, United Nation. Notes: These probabilities are computed for the 2000-2010 period.

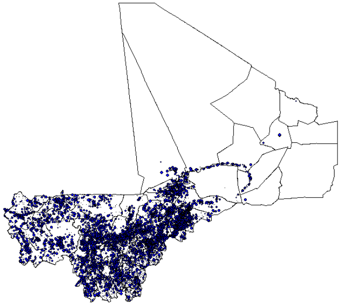
- Model specification:

$$M_{age,j,[t-11,t]} = \beta_0 + \beta_1 Urban + \beta_2 \sum_{t-k}^{t} drought_{j,t-k} + \beta_3 \sum_{t-k}^{t} drought_{i,t-k} * Urban + \delta_j + \delta_t + \epsilon_{j,t}$$

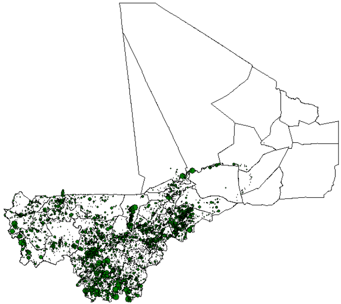
$M_{age,j,[t-11,t]}$ is inter-census migration rate at the locality level where j and t refer to locality and time, respectively.

Migration rates I

Figure: Immigration and emigration rates



Emigrants aged 32 to 41

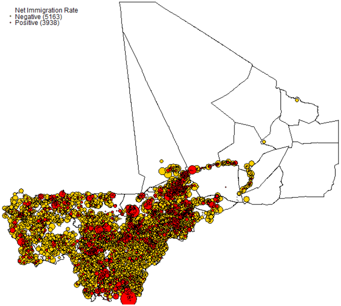


Immigrants aged 32 to 41

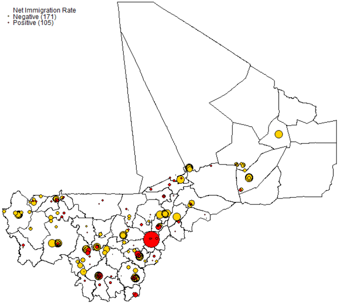
We compute immigration, emigration, and net immigration rates for each Malian locality, by age-groups, gender and type of localities -rural vs. urban.

Migration rates II

Figure: Net immigration rates among 32-41



Rural localities



Urban localities

Results I

Drought-induced inter-census migration

Table 1: Drought-induced migration of men aged 20 to 29

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	-0.003	0.040***	-0.043***
	(0.004)	(0.007)	(0.007)
Urban×Nb. shocks from t-10 to t	0.005	-0.088***	0.093***
	(0.005)	(0.029)	(0.030)
Nb. shocks from t-10 to t (june-oct)	-0.004	0.035***	-0.038***
	(0.004)	(0.006)	(0.007)
Urban×Nb. shocks from t-10 to t (june-oct)	0.005	-0.129**	0.134**
	(0.004)	(0.053)	(0.054)
Nb. shocks from t-5 to t	-0.006	0.052***	-0.058***
	(0.006)	(0.016)	(0.014)
Urban×Nb. shocks from t-5 to t	0.010	-0.141***	0.151***
	(0.009)	(0.051)	(0.053)
Nb. shocks from t-10 to t-5	-0.006	0.030***	-0.035***
	(0.004)	(0.009)	(0.012)
Urban×Nb. shocks from t-10 to t-5	0.007	-0.088***	0.094***
	(0.008)	(0.031)	(0.031)
Observations	19,282	19,282	19,282
Number of villages	10,058	10,058	10,058
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors in parentheses corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

Heterogeneity

- By age-cohorts and by gender.
  → No significant difference between men and women.
  → Lower effect for older age-cohorts.
  - 20-29 women
  - 30-39 men
  - 30-39 women
  - 40-39 men
  - 40-49 women
  - 50-59 men
  - 50-59 women
  - 60-69 men
  - 60-69 women
- By crops' diversification
  → The higher is the crops' diversification, the lower is the magnitude of the effect.
  - Crop diversification

Specification II

- We estimate another model in which the dependent variable is inter-census population change at the locality level:

$$log(Population_{j,t}) = \beta_0 + \beta_1 Urban + \beta_2 \sum_{t-k}^{t} drought_{j,t-k} + \beta_3 \sum_{t-k}^{t} drought_{j,t-k} * Urban + \delta_j + \delta_t + \epsilon_{j,t}$$

where j and t refer to locality and time, respectively.
Estimated marginal effect of drought on population change Marg. effect

- We infer the change in the size of the urban population that is potentially drought-induced:

$$= \frac{(\beta_2 + \beta_3) * Urban\ Pop\ size_{t-11} * Nb.\ shocks}{11} \tag{1}$$

  - Average annual in-flow from 1987 to 1998: about 19, 000
  - Average annual in-flow from 1998 to 2009: about 17, 000

Model Specification III

- Migration measure:
  We compute inter-district (n=49) migration flows using questions on current place of residence (destination district), previous place of residence (origin district) and duration of stay. .

- Inter-district model specification:

$$M_{ij,t} = \beta_0 + \beta_1 Urban_j + \beta_2 \sum_{t-k}^{t} shocks_{i,t-k} + \beta_3 \sum_{t-k}^{t} shocks_{j,t-k} + \beta_4 \sum_{t-k}^{t} shocks_{j,t-k} * Urban_j + \delta_{i,t} + \delta_{j,t} + \delta_{i,j} + \delta_t + \epsilon_{ij,t}$$

where $mi_{ij,t}$ is the bilateral migration rate from district i to district j during year *t-1* and t.

Results

Effect of climate shocks on inter-district migration flows

	(1) log(number migrants)	(2) log(migration flows)	(3) log(number migrants)	(4) log(migration flows)
Nb. $shocks_{origin}$ from t-5 to t	0.00919	2.76e-06	0.0144	7.68e-06
	(0.0470)	(4.31e-06)	(0.0441)	(5.55e-06)
Nb. $shocks_{destination}$ from t-5 to	-0.0805***	-5.19e-06*	-0.202***	-1.91e-05***
	(0.0165)	(2.72e-06)	(0.0218)	(4.45e-06)
Urban*Nb. $shocks_{destination}$ from t-5 to	0.161***	1.23e-05***	0.261***	2.01e-05***
	(0.0180)	(2.92e-06)	(0.0199)	(3.76e-06)
R-squared	0.324	0.119	0.274	0.130
Nb. $shocks_{origin}$ from t-5 to t (June-Oct)	0.00429	1.30e-06	0.0382	5.58e-06
	(0.0562)	(5.29e-06)	(0.0519)	(5.64e-06)
Nb. $shocks_{destination}$ from t-5 to t (June-Oct)	-0.140***	-9.04e-06***	-0.191***	-1.95e-05***
	(0.0188)	(2.93e-06)	(0.0217)	(4.32e-06)
Urban*Nb. $shocks_{destination}$ from t-5 to t (June-Oct)	0.167***	1.16e-05***	0.253***	2.23e-05***
	(0.0193)	(2.63e-06)	(0.0215)	(4.05e-06)
R-squared	0.324	0.119	0.269	0.130
Nb monthly $shocks_{origin}$ from t-5 to t	0.0195	1.88e-06**	0.00166	-4.28e-07
	(0.0130)	(7.74e-07)	(0.0119)	(1.07e-06)
Nb monthly $shocks_{destination}$ from t-5 to t	-0.0195***	-3.07e-06***	-0.0268***	-2.82e-06**
	(0.00331)	(7.49e-07)	(0.00589)	(1.06e-06)
Urban* Nb monthly $shocks_{destination}$ from t-5 to t	0.0403***	4.47e-06***	0.0666***	6.15e-06***
	(0.00364)	(7.32e-07)	(0.00405)	(8.05e-07)
R-squared	0.325	0.121	0.278	0.133
$SPEI_{t,origin}$	-0.0716	-1.51e-06	0.0259	-6.37e-06
	(0.0704)	(7.26e-06)	(0.0506)	(6.34e-06)
$SPEI_{t,destination}$	0.325***	3.20e-05***	0.232***	1.30e-05*
	(0.0376)	(8.85e-06)	(0.0298)	(6.83e-06)
Urban*$SPEI_{t,destination}$	-0.427***	-4.69e-05***	-0.406***	-3.69e-05***
	(0.0335)	(9.09e-06)	(0.0309)	(7.30e-06)
Observations	15,484	15,484	15,484	15,484
Origin × destination F.E	yes	yes	yes	yes
Years F.E	yes	yes	yes	yes
destination × Years F.E			yes	yes
Origin × Years F.E			yes	yes

Sample: Flows from 1997, 1998, 2008 and 2009. Note: Standard errors are clustered at the original district and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

Robustness checks

- Heterogeneity by education level ▸ education
- We consider the shocks over the last 10 years ▸ 10 year periods
- Poisson model ▸ poisson

Model Specification IV

- We finally estimate the climate effects on international migration using the 2009 census.

$$IM_{jt} = \beta_0 + \beta_1 \sum_{t-k}^{t} shocks_{j,t-k} + \delta_j + \delta_t + \epsilon_{j,t}$$

where j and t refer to locality and year, respectively.

- We disaggregate international migration by group of destination countries (neighbouring countries, other African countries, Non-African countries excluding France, France).
- The aim is to infer the international migration flows that are drought-induced:

Estimated of annual climate-induced international migration from 2004 to 2009

Destination	Mean scenario
All.	2543.75
Border countries	1148.5
Africa	772.5
France	648.5

Which scenario in the future? I

Number of shocks over 10 years computed from observed and predicted SPEI

	Mean	Var	Min	Max
Simulated (RCP 2.6) nb. shocks from 1999 to 2009	0.666	0.703	0	3
Simulated (RCP 8.5) nb. shocks from 1999 to 2009	2.016	2.368	0	6
Simulated (RCP 2.6) nb. shocks from 2018 to 2027	0.662	2.093	0	5
Simulated (RCP 8.5) nb. shocks from 2018 to 2027	2.050	7.446	0	10
Simulated (RCP 2.6) nb. shocks from 2028 to 2037	0.743	2.641	0	8
Simulated (RCP 8.5) nb. shocks from 2028 to 2037	1.634	5.139	0	10
Simulated (RCP 2.6) nb. shocks from 2038 to 2047	3.160	5.114	0	10
Simulated (RCP 8.5) nb. shocks from 2038 to 2047	2.433	5.870	0	10

Sources: observed SPEI (Vicente-Serrano et al., 2010) and predicted SPEI (data from the IPSLCM-5A-LR model, bias-corrected by Famien et al., 2018).

- The maximum number of climate shocks will increase in the next two decades.
- The average number of climate shocks will increase after 2038.

Which scenario in the future? II

1. From 2018 to 2037:
   - The RCP 2.6 scenario give close figures to what it has been observed in the past : about 10, 000.
   - The urban population growth under the RCP 8.5 scenario is much more higher: 30, 000
2. From 2038 to 2047:
   Under both scenario, the urban population growth is larger to what it has been observed: between 30,000 and 46, 000.

Prediction of drought-induced urban population

VARIABLES	20-29	30-39	40-49	50-59
		Scenario RCP 2.6		
From 2018 to 2027	2,961.272	3,347.839**	2,081.855**	1,339.950**
	(2,138.520)	(1,437.354)	(1,029.907)	(627.334)
From 2028 to 2037	3,314.946	3,747.895**	2,331.043**	1,500.348**
	(2,393.930)	(1,609.113)	(1,153.182)	(702.428)
From 2038 to 2047	14,145.446	16,002.738**	9,947.296**	6,403.431**
	(10,215.313)	(6,870.580)	(4,920.991)	(2,997.937)
		Scenario RCP 8.5		
From 2018 to 2027	9,184.702	10,388.547**	6,458.334**	4,156.913**
	(6,632.849)	(4,460.196)	(3,194.979)	(1,946.170)
From 2028 to 2037	7,314.666	8,272.711**	5,143.417**	3,310.696**
	(5,282.378)	(3,551.788)	(2,544.481)	(1,549.991)
From 2038 to 2047	10,877.337	12,303.901**	7,648.135**	4,924.017**
	(7,855.206)	(5,282.530)	(3,783.581)	(2,305.310)
Observations	29,152	29,157	29,119	29,096

Sample: Census from 1987, 1998 and 2009. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

Conclusion

Findings

- Adverse climate conditions accentuate the rural exodus
- International migration flows are also drought induced but the magnitude in the case of Mali is much less worrying than the current narratives suggest.

Limitations

- Short-cycle labour migration is not well accounted in the village-level specification.
- in the specification in which we use inter-district migration flows , we miss intra-district migration, which is likely to represent a large part of internal migration.

Extensions

- We will push further the analysis of the heterogeneity in climate effects that we observe between livelihood zones.
- We plan to use mobile phone data from the two main operators of Mali to get a picture of very-short term moves.

Table 2: Drought-induced migration of women aged 20 to 29

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.005	0.025***	-0.020**
	(0.004)	(0.009)	(0.008)
Urban×Nb. shocks from t-10 to t	0.013***	-0.143**	0.156**
	(0.004)	(0.063)	(0.064)
Nb. shocks from t-10 to t (june-oct)	0.004	0.025***	-0.020***
	(0.004)	(0.007)	(0.008)
Urban×Nb. shocks from t-10 to t (june-oct)	0.014**	-0.255**	0.269**
	(0.006)	(0.122)	(0.126)
Nb. shocks from t-5 to t	0.005	0.051**	-0.046**
	(0.005)	(0.023)	(0.020)
Urban×Nb. shocks from t-5 to t	0.029***	-0.249**	0.279**
	(0.009)	(0.106)	(0.111)
Nb. shocks from t-10 to t-5	0.003	0.007	-0.003
	(0.004)	(0.009)	(0.008)
Urban×Nb. shocks from t-10 to t-5	0.015***	-0.140**	0.154**
	(0.005)	(0.060)	(0.061)
Observations	19,278	19,278	19,278
Number of villages	10,058	10,058	10,058
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors in parentheses corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 3: Drought-induced migration of men aged 30 to 39

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	-0.003	0.040***	-0.043***
	(0.004)	(0.007)	(0.007)
Urban$\times$Nb. shocks from t-10 to t	0.005	-0.088***	0.093***
	(0.005)	(0.029)	(0.030)
Nb. shocks from t-10 to t (june-oct)	-0.004	0.035***	-0.038***
	(0.004)	(0.006)	(0.007)
Urban$\times$Nb. shocks from t-10 to t (june-oct)	0.005	-0.129**	0.134**
	(0.004)	(0.053)	(0.054)
Nb. shocks from t-5 to t	-0.006	0.052***	-0.058***
	(0.006)	(0.016)	(0.014)
Urban$\times$Nb. shocks from t-5 to t	0.010	-0.141***	0.151***
	(0.009)	(0.051)	(0.053)
Nb. shocks from t-10 to t-5	-0.006	0.030***	-0.035***
	(0.004)	(0.009)	(0.012)
Urban$\times$Nb. shocks from t-10 to t-5	0.007	-0.088***	0.094***
	(0.008)	(0.031)	(0.031)
Observations	19,282	19,282	19,282
Number of villages	10,058	10,058	10,058
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors in parentheses corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

Go back

Table 4: Drought-induced migration of women aged 30 to 39

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.001	0.022***	-0.021***
	(0.002)	(0.006)	(0.005)
Urban × Nb. shocks from t-10 to t	0.011***	-0.187*	0.198**
	(0.002)	(0.097)	(0.098)
Nb. shocks from t-10 to t (june-oct)	0.000	0.025***	-0.025***
	(0.002)	(0.004)	(0.004)
Urban × Nb. shocks from t-10 to t (june-oct)	0.014***	-0.351*	0.365*
	(0.003)	(0.188)	(0.190)
Nb. shocks from t-5 to t	0.001	0.041***	-0.040***
	(0.004)	(0.014)	(0.011)
Urban × Nb. shocks from t-5 to t	0.026***	-0.310*	0.335**
	(0.006)	(0.166)	(0.169)
Nb. shocks from t-10 to t-5	-0.002	0.012**	-0.014**
	(0.003)	(0.006)	(0.006)
Urban × Nb. shocks from t-10 to t-5	0.015***	-0.187*	0.202**
	(0.003)	(0.098)	(0.098)
Observation	19,249	19,249	19,249
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 5: Drought-induced migration of men aged 40 to 49

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.000	0.014**	-0.014*
	(0.003)	(0.007)	(0.007)
Urban × Nb. shocks from t-10 to t	0.018***	-0.128***	0.146***
	(0.007)	(0.046)	(0.043)
Nb. shocks from t-10 to t (june-oct)	-0.003	0.019***	-0.022***
	(0.003)	(0.005)	(0.005)
Urban × Nb. shocks from t-10 to t (june-oct)	0.017***	-0.201**	0.218***
	(0.005)	(0.085)	(0.084)
Nb. shocks from t-5 to t	-0.002	0.042**	-0.044***
	(0.005)	(0.019)	(0.016)
Urban × Nb. shocks from t-5 to t	0.037***	-0.224***	0.261***
	(0.011)	(0.081)	(0.081)
Nb. shocks from t-10 to t-5	-0.003	-0.001	-0.002
	(0.003)	(0.006)	(0.007)
Urban × Nb. shocks from t-10 to t-5	0.024**	-0.140***	0.164***
	(0.010)	(0.049)	(0.046)
Observations	19,247	19,247	19,247
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 6: Drought-induced migration of women aged 40 to 49

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.002	0.014***	-0.013***
	(0.001)	(0.004)	(0.003)
Urban × Nb. shocks from t-10 to t	0.004**	-0.139***	0.143***
	(0.002)	(0.047)	(0.047)
Nb. shocks from t-10 to t (june-oct)	0.000	0.013***	-0.013***
	(0.001)	(0.003)	(0.003)
Urban × Nb. shocks from t-10 to t (june-oct)	0.003*	-0.221**	0.224**
	(0.002)	(0.093)	(0.093)
Nb. shocks from t-5 to t	0.001	0.014	-0.013*
	(0.003)	(0.010)	(0.008)
Urban × Nb. shocks from t-5 to t	0.009**	-0.243***	0.252***
	(0.004)	(0.082)	(0.083)
Nb. shocks from t-10 to t-5	-0.001	0.021***	-0.022**
	(0.002)	(0.008)	(0.009)
Urban × Nb. shocks from t-10 to t-5	0.015***	-0.214**	0.229***
	(0.003)	(0.086)	(0.087)
Observations	19,272	19,272	19,272
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 7: Drought-induced migration of men aged 50 to 59

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	-0.001	0.007	-0.008
	(0.002)	(0.005)	(0.005)
Urban×Nb. shocks from t-10 to t	0.005*	-0.128***	0.133***
	(0.003)	(0.027)	(0.026)
Nb. shocks from t-10 to t (june-oct)	-0.003	0.008*	-0.010**
	(0.002)	(0.004)	(0.005)
Urban×Nb. shocks from t-10 to t	0.002	-0.166***	0.168***
	(0.003)	(0.047)	(0.046)
Nb. shocks from t-5 to t	-0.000	0.021*	-0.021**
	(0.003)	(0.013)	(0.011)
Urban×Nb. shocks from t-10 to t	0.012**	-0.244***	0.256***
	(0.006)	(0.047)	(0.047)
Nb. shocks from t-10 to t-5	-0.004*	0.001	-0.005
	(0.002)	(0.005)	(0.006)
Urban×Nb. shocks from t-10 to t-5	0.007*	-0.135***	0.142***
	(0.004)	(0.029)	(0.028)
Observations	19,210	19,210	19,210
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 8: Drought-induced migration of women aged 50 to 59

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.001	0.014***	-0.013***
	(0.001)	(0.004)	(0.004)
Urban×Nb. shocks from t-10 to t	0.001	-0.141***	0.142***
	(0.002)	(0.047)	(0.047)
Nb. shocks from t-10 to t (june-oct)	0.001	0.018***	-0.018***
	(0.001)	(0.004)	(0.004)
Urban×Nb. shocks from t-10 to t (june-oct)	0.002	-0.222**	0.224**
	(0.002)	(0.093)	(0.094)
Nb. shocks from t-5 to t	0.002	0.029*	-0.027*
	(0.002)	(0.016)	(0.014)
Urban× Nb. shocks from t-5 to t	0.006*	-0.249***	0.254***
	(0.003)	(0.082)	(0.083)
Nb. shocks from t-10 to t-5	-0.000	0.009	-0.010
	(0.002)	(0.008)	(0.007)
Urban×Nb. shocks from t-10 to t-5	0.002	-0.149***	0.151***
	(0.002)	(0.047)	(0.047)
Observations	19,203	19,203	19,203
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 9: Drought-induced migration of men aged 60 to 69

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.001	0.011**	-0.010**
	(0.001)	(0.004)	(0.004)
Urban × nb_shocks_drought12_Wurb	0.011***	-0.219**	0.231**
	(0.002)	(0.103)	(0.105)
Nb. shocks from t-10 to t (june-oct)	-0.000	0.012***	-0.012***
	(0.001)	(0.003)	(0.003)
Urban × Nb. shocks from t-10 to t (june-oct)	0.016***	-0.393*	0.409*
	(0.004)	(0.207)	(0.210)
Nb. shocks from t-5 to t	0.002	0.016*	-0.014
	(0.002)	(0.009)	(0.009)
Urban × nNb. shocks from t-5 to t	0.021***	-0.368**	0.388**
	(0.005)	(0.173)	(0.176)
Nb. shocks from t-10 to t-5	-0.002	0.013**	-0.015**
	(0.002)	(0.005)	(0.006)
Urban × Nb. shocks from t-10 to t-5	0.013***	-0.233**	0.247**
	(0.003)	(0.099)	(0.100)
Observations	19,138	19,138	19,138
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 10: Drought-induced migration of women aged 60 to 69

	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-10 to t	0.001	0.011**	-0.010**
	(0.001)	(0.004)	(0.004)
Urban×nb_shocks_drought12_Wurb	0.011***	-0.219**	0.231**
	(0.002)	(0.103)	(0.105)
Nb. shocks from t-10 to t (june-oct)	-0.000	0.012***	-0.012***
	(0.001)	(0.003)	(0.003)
Urban×Nb. shocks from t-10 to t (june-oct)	0.016***	-0.393*	0.409*
	(0.004)	(0.207)	(0.210)
Nb. shocks from t-5 to t	0.002	0.016*	-0.014
	(0.002)	(0.009)	(0.009)
Urban×nNb. shocks from t-5 to t	0.021***	-0.368**	0.388**
	(0.005)	(0.173)	(0.176)
Nb. shocks from t-10 to t-5	-0.002	0.013**	-0.015**
	(0.002)	(0.005)	(0.006)
Urban×Nb. shocks from t-10 to t-5	0.013***	-0.233**	0.247**
	(0.003)	(0.099)	(0.100)
Observations	19,138	19,138	19,138
Number of villages	10,052	10,052	10,052
Village F.E	×	×	×
Year F.E	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Effect of climatic shocks on migration flows of the 20-29 age cohort by crop diversification

	Rural location		
	Immig. rate	Emig. rate	Immig. net rate
Nb. shocks from t-5 to t	-0.003	0.097***	-0.099***
	(0.007)	(0.014)	(0.010)
shock*Diversification 2	-0.034	-0.025	-0.010
	(0.024)	(0.018)	(0.030)
shock*Diversification 3	0.009	-0.091***	0.100***
	(0.009)	(0.017)	(0.013)
shock*Diversification 4	0.018**	-0.109***	0.127***
	(0.007)	(0.028)	(0.028)
shock*Diversification 5 (high)	0.009	-0.080***	0.089***
	(0.008)	(0.022)	(0.021)
Observations	18,669	18,669	18,669
District F.E	×	×	×

Sample: Census from 1987,1998 and 2009. Note: Standard errors are reported in parentheses and corrected for serial correlation over one period and for spatial correlation up to a distance cutoff at 500 km. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 12: Effect of climatic shocks on population growth by village

VARIABLES	20-29	30-39	40-49	50-59
Nb. shocks from t-10 to t	-0.013***	-0.009**	-0.008*	-0.006
	(0.004)	(0.005)	(0.004)	(0.004)
Urban*Nb. shocks from t-10 to t	0.059*	0.078***	0.069**	0.061**
	(0.033)	(0.029)	(0.030)	(0.026)
R-squared	0.233	0.189	0.176	0.144
Nb. shocks from t-5 to t	-0.010	-0.009	-0.015**	-0.000
	(0.007)	(0.007)	(0.007)	(0.006)
Urban*Nb. shocks from t-5 to t	0.062**	0.083***	0.072**	0.067**
	(0.030)	(0.029)	(0.028)	(0.026)
R-squared	0.232	0.188	0.176	0.144
Nb. ext. shocks from t-5 to t	0.003	0.001	-0.021**	-0.009
	(0.009)	(0.010)	(0.009)	(0.007)
Urban*Nb. ext. shocks from t-5 to t	0.090**	0.112***	0.101**	0.097***
	(0.039)	(0.039)	(0.039)	(0.035)
R-squared	0.231	0.187	0.175	0.143
Nb. shocks from t-5 to t (June-Oct)	-0.007	-0.013*	-0.016***	0.003
	(0.006)	(0.007)	(0.006)	(0.006)
Urban*Nb. shocks from t-5 to t (June-Oct)	0.064**	0.081***	0.074**	0.069***
	(0.030)	(0.029)	(0.029)	(0.026)
R-squared	0.232	0.188	0.176	0.144
Nb. shocks from t-10 to t-5	-0.011**	-0.005	-0.003	-0.010**
	(0.005)	(0.005)	(0.005)	(0.005)
Urban*Nb. shocks from t-10 to t-5	0.052	0.078**	0.071*	0.058**
	(0.041)	(0.034)	(0.038)	(0.029)
R-squared	0.231	0.185	0.173	0.142
Nb. monthly shocks from t-10 to t	-0.002	-0.001	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Urban*Nb. monthly shocks from t-10 to t	0.015*	0.021**	0.018**	0.018**
	(0.009)	(0.009)	(0.008)	(0.008)
R-squared	0.232	0.188	0.175	0.144
Observations	29,383	29,388	29,350	29,326
Number of villages	10,107	10,107	10,107	10,104
Village F.E	×	×	×	×
Year F.E	×	×	×	×

Sample: Census from 1987, 1998 and 2009. Note: Standard errors are clustered by geographical unit (0,5*0,5) and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 18: Estimates of drought-induced rural population from 1987 to 1998 in the mean scenario

VARIABLES	20-29	30-39	40-49	50-59
Nb. shocks from t-10 to t	-1,756.630***	-865.947**	-493.289*	-225.519
	(595.189)	(434.779)	(270.901)	(157.264)
Nb. shocks from t-5 to t	-1,135.413	-738.731	-795.935**	-2.877
	(826.324)	(561.516)	(344.348)	(204.789)
Nb. ext. shocks from t-5 to t	172.502	39.925	-550.626**	-146.321
	(553.250)	(405.371)	(230.089)	(123.488)
Nb. shocks from t-5 to t (June-Oct)	-873.197	-1,007.799*	-824.294***	102.534
	(752.052)	(527.958)	(303.954)	(188.244)
Nb. shocks from t-10 to t-5	-386.245**	-127.909	-40.380	-98.228**
	(182.749)	(131.291)	(85.911)	(46.511)
Nb. monthly shocks from t-10 to t	-1,262.341	-609.224	-207.164	14.608
	(865.361)	(575.635)	(323.255)	(218.582)
Observations	29,383	29,388	29,350	29,326
Number of villages	10,107	10,107	10,107	10,104

Sample: Census from 1987, 1998 and 2009. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

Table 19: Estimates of drought-induced rural population from 1998 to 2009 in the mean scenario

VARIABLES	20-29	30-39	40-49	50-59
Nb. shocks from t-10 to t	-3,463.775***	-1,934.705**	-1,156.356*	-586.718
	(1,173.611)	(971.388)	(635.040)	(409.144)
Nb. shocks from t-5 to t	-1,242.107	-915.684	-1,035.150**	-4.152
	(903.973)	(696.020)	(447.841)	(295.588)
Nb. ext. shocks from t-5 to t	74.804	19.617	-283.862**	-83.717
	(239.911)	(199.176)	(118.617)	(70.653)
Nb. shocks from t-5 to t (June-Oct)	74.804	19.617	-283.862**	-83.717
	(239.911)	(199.176)	(118.617)	(70.653)
Nb. shocks from t-10 to t-5	-2,055.230**	-771.177	-255.435	-689.622**
	(972.417)	(791.563)	(543.459)	(326.535)
Nb. monthly shocks from t-10 to t	-2,961.781	-1,619.600	-577.846	45.220
	(2,030.364)	(1,530.303)	(901.659)	(676.654)
Observations	29,383	29,388	29,350	29,326
Number of villages	10,107	10,107	10,107	10,104

Sample: Census from 1987, 1998 and 2009. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

Table 22: Effect of climate shocks on inter-district migration flows

	(1) log(number migrants)	(2) log(migration flows)	(3) log(number migrants)	(4) log(migration flows)
Nb. $shocks_{origin}$ from t-10 to t	0.0527	5.82e-06**	0.438***	3.10e-05***
	(0.0339)	(2.80e-06)	(0.0868)	(8.07e-06)
Nb. $shocks_{destination}$ from t-10 to t	-0.0491***	-4.45e-06***	0.378***	1.98e-05***
	(0.0119)	(1.38e-06)	(0.0385)	(3.48e-06)
Urban*Nb. $shocks_{destination}$ from t-10 to t	0.144***	1.23e-05***	0.182***	1.40e-05***
	(0.0117)	(1.81e-06)	(0.0129)	(2.21e-06)
R-squared	0.327	0.121	0.235	0.120
Nb. $shocks_{origin}$ from t-10 to t (June-Oct)	0.0504	5.52e-06*	0.0670	2.94e-06
	(0.0360)	(2.85e-06)	(0.0499)	(6.23e-06)
Nb. $shocks_{destination}$ from t-10 to t (June-Oct)	-0.0783***	-6.13e-06***	-0.0305	-6.95e-06**
	(0.0130)	(1.71e-06)	(0.0193)	(2.65e-06)
Urban*Nb. $shocks_{destination}$ from t-10 to t (June-Oct)	0.139***	1.13e-05***	0.184***	1.47e-05***
	(0.0120)	(1.95e-06)	(0.0138)	(2.32e-06)
R-squared	0.326	0.120	0.275	0.130
Nb monthly $shocks_{origin}$ from t-10 to t	0.0117	1.61e-06**	0.0145	0.0145
	(0.00929)	(7.21e-07)	(0.0116)	(0.0116)
Nb monthly $shocks_{destination}$ from t-10 to t	-0.0119***	-1.04e-06**	-0.0174***	-0.0174***
	(0.00293)	(4.68e-07)	(0.00564)	(0.00564)
Urban* Nb monthly $shocks_{destination}$ from t-10 to t	0.0291***	2.79e-06***	0.0411***	0.0411***
	(0.00236)	(4.65e-07)	(0.00287)	(0.00287)
R-squared	0.325	0.121	0.275	0.275
Observations	15,484	15,484	15,484	15,484
Origin× destination F.E	yes	yes	yes	yes
Years F.E	yes	yes	yes	yes
destination×Years F.E			yes	yes
Origin×Years F.E			yes	yes

Sample: Flows from 1997, 1998, 2008 and 2009. Note: Standard errors are clustered at the original district and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 24: Effect of climate shocks on inter-district migration by education

	(1)	(2)	(3)	(4)	(5)	(6)
	No edu		Little edu		High edu	
	$log(nb.\ migrants_{ij,t})$	$log(\frac{nb.\ migrants_{ij,t}}{Pop\ size_{ij,98}})$	$log(nb.\ migrants_{ij,t})$	$log(\frac{nb.\ migrants_{ij,t}}{Pop\ size_{ij,98}})$	$log(nb.\ migrants_{ij,t})$	$log(\frac{nb.\ migrants_{ij,t}}{Pop\ size_{ij,98}})$
Nb. $shocks_{origin}$ from t-10 to t	0.291***	8.08e-06***	0.201***	5.73e-06	0.190***	4.94e-06***
	(0.0824)	(2.13e-06)	(0.0583)	(3.55e-06)	(0.0462)	(1.56e-06)
Nb. $shocks_{destination}$ from t-10 to t	0.388***	1.04e-05***	0.146***	1.02e-06	0.165***	1.42e-06*
	(0.0381)	(1.15e-06)	(0.0245)	(1.64e-06)	(0.0241)	(7.54e-07)
Urban*Nb. $shocks_{destination}$ from t-10 to t	-0.0385***	-1.19e-06***	0.201***	1.05e-05***	0.0981***	1.47e-06***
	(0.00936)	(3.34e-07)	(0.0149)	(1.45e-06)	(0.00866)	(2.83e-07)
R-squared	0.439	0.188	0.450	0.189	0.255	0.149
Nb. $shocks_{origin}$ from t-5 to t	0.0484	-6.32e-07	0.0812**	2.08e-06	0.0654**	-1.29e-08
	(0.0445)	(1.34e-06)	(0.0380)	(1.38e-06)	(0.0301)	(6.66e-07)
Nb. $shocks_{destination}$ from t-5 to t	0.137***	3.90e-06***	-0.0446**	-3.59e-06	-0.0560***	-8.31e-07*
	(0.0291)	(1.26e-06)	(0.0176)	(2.37e-06)	(0.0175)	(4.49e-07)
Urban*Nb. $shocks_{destination}$ from t-5 to t	-0.0575***	-1.95e-06***	0.368***	2.07e-05***	0.180***	3.21e-06***
	(0.0156)	(5.60e-07)	(0.0260)	(2.54e-06)	(0.0152)	(5.18e-07)
R-squared	0.475	0.210	0.480	0.202	0.282	0.158
Nb. $shocks_{origin}$ from t-10 to t-5	-0.0143	1.08e-06	-0.0730**	-2.06e-06	-0.0339	1.34e-06
	(0.0320)	(1.01e-06)	(0.0348)	(2.23e-06)	(0.0274)	(1.14e-06)
Nb. $shocks_{destination}$ from t-10 to t-5	-0.0181	-1.76e-06**	-0.208***	-1.12e-05***	-0.107***	-2.87e-06***
	(0.0137)	(7.22e-07)	(0.0240)	(2.08e-06)	(0.0142)	(5.71e-07)
Urban*Nb. $shocks_{destination}$ from t-10 to t-5	-0.0502***	-1.29e-06***	0.286***	1.51e-05***	0.138***	2.01e-06***
	(0.0131)	(4.42e-07)	(0.0217)	(2.38e-06)	(0.0132)	(4.11e-07)
R-squared	0.474	0.210	0.470	0.197	0.276	0.157
Observations	13,464	13,464	13,448	13,448	13,820	13,820
Number of flows	3,366	3,366	3,362	3,362	3,455	3,455
Origin × Years F.E	yes	yes	yes	yes	yes	yes
destination × Years F.E	yes	yes	yes	yes	yes	yes
Years F.E	yes	yes	yes	yes	yes	yes
Bilateral F.E.	yes	yes	yes	yes	yes	yes

Sample: Flows from 1997, 1998, 2008 and 2009. Note: Standard errors are clustered at the original district and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Effect of climate shocks on inter-district migration flows: PPML estimations

	(1)	(2)	(3)	(4)
	$Nb\ migrants_{ij,t}$		$\frac{Nb\ migrants_{ij,t}}{pop\ size_{i,98}}$	
	log	PPML model	log	PPML model
Nb. $shocks_{origin}$ from t-5 to t	0.00984	0.0533	2.79e-06	0.0212
	(0.0471)	(0.0838)	(4.32e-06)	(0.0932)
Nb. $shocks_{destination}$ from t-5 to t	-0.0797***	-0.113**	-5.13e-06*	-0.0923**
	(0.0165)	(0.0462)	(2.73e-06)	(0.0449)
Urban*Nb. $shocks_{destination}$ from t-5 to t	0.161***	0.259***	1.23e-05***	0.192***
	(0.0180)	(0.0520)	(2.92e-06)	(0.0647)
Nb. $shocks_{origin}$ from t-5 to t (June-Oct)	0.00516	-0.00355	1.33e-06	-0.00901
	(0.0563)	(0.101)	(5.30e-06)	(0.117)
Nb. $shocks_{destination}$ from t-5 to t (June-Oct)	-0.139***	-0.292***	-8.97e-06***	-0.271***
	(0.0187)	(0.0612)	(2.94e-06)	(0.0599)
Urban*Nb. $shocks_{destination}$ from t-5 to t (June-Oct)	0.167***	0.309***	1.16e-05***	0.217***
	(0.0193)	(0.0651)	(2.63e-06)	(0.0812)
Nb monthly $shocks_{origin}$ from t-5 to t	0.0195	0.0347*	1.89e-06**	0.0435***
	(0.0130)	(0.0194)	(7.76e-07)	(0.0153)
Nb monthly $shocks_{destination}$ from t-5 to t	-0.0194***	-0.0437***	-3.06e-06***	-0.0432***
	(0.00331)	(0.00645)	(7.52e-07)	(0.0103)
Urban* Nb monthly $shocks_{destination}$ from t-5 to t	0.0403***	0.0740***	4.47e-06***	0.0706***
	(0.00364)	(0.0107)	(7.32e-07)	(0.0135)
$SPEI_{t,origin}$	-0.0718	-0.00836	-1.48e-06	-0.0293
	(0.0703)	(0.130)	(7.28e-06)	(0.106)
$SPEI_{t,destination}$	0.325***	0.488***	3.21e-05***	0.493***
	(0.0376)	(0.0868)	(8.87e-06)	(0.0904)
Urban*$SPEI_{t,destination}$	-0.427***	-0.599***	-4.69e-05***	-0.648***
	(0.0335)	(0.118)	(9.09e-06)	(0.113)
Observations	15,484	15,484	15,484	15,484
Origin F.E	yes	yes	yes	yes
Destination F.E	yes	yes	yes	yes
Years F.E	yes	yes	yes	yes

Sample: Flows from 1997, 1998, 2008 and 2009. Note: Standard errors are clustered at the original district and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 27: Effect of drought on international migration according to the agricultural intensity

	(1) total	(2) Bordering	(3) Africa	(4) Occidental	(5) France
Nb of SPEI shocks over the last 5 years (June-oct)	0.00109	0.000819	0.000513**	-0.000126	1.21e-05
	(0.000754)	(0.000598)	(0.000237)	(0.000129)	(0.000134)
Nb of SPEI shocks over the last 5 years (June-oct)*Agri village	0.00102	0.000383	2.32e-05	0.000129	0.000227*
	(0.000735)	(0.000593)	(0.000221)	(0.000118)	(0.000131)
Observations	58,434	58,434	58,434	58,434	58,434
Number of villages	9,739	9,739	9,739	9,739	9,739
Village F.E.	yes	yes	yes	yes	yes
Years F.E.	yes	yes	yes	yes	yes

Sample: Census from 2009. Note: Standard errors are clustered at the districtof origin and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 28: Effect of climate shocks on international migration flows by agro-ecological zones

	(1) total	(2) Bordering	(3) Africa	(4) Occidental	(5) France
Nb of SPEI shocks over the last 5 years (June-oct)	0.0014*	0.0011	0.0003	-0.0003**	0.0002***
	(0.0008)	(0.0008)	(0.0003)	(0.0001)	(0.0001)
2 Class *Nb of SPEI shocks over the last 5 years (June-oct)	0.0002	0.0003	-0.0002	0.0002	0.0000
	(0.0008)	(0.0008)	(0.0003)	(0.0001)	(0.0000)
3 Class *Nb of SPEI shocks over the last 5 years (June-oct)	0.0013	0.0007	0.0002	0.0003**	0.0001
	(0.0008)	(0.0008)	(0.0003)	(0.0001)	(0.0001)
4 Class *Nb of SPEI shocks over the last 5 years (June-oct)	0.0003	-0.0005	0.0007**	0.0003**	-0.0002*
	(0.0010)	(0.0009)	(0.0003)	(0.0001)	(0.0001)
5 Class *Nb of SPEI shocks over the last 5 years (June-oct)	-0.0045**	-0.0051***	0.0004	0.0001	0.0001**
	(0.0018)	(0.0017)	(0.0004)	(0.0001)	(0.0000)
Observations	57,996	57,996	57,996	57,996	57,996
Number of villages	9,666	9,666	9,666	9,666	9,666
village F.E.	yes	yes	yes	yes	yes
Years F.E.	yes	yes	yes	yes	yes

Sample: Census from 2009. Note: Standard errors are clustered at the districtof origin and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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Table 29: Effect of climate change on international migration according to the village wealth

	(1) total	(2) Bordering	(3) Africa	(4) Occidental	(5) France
Nb of SPEI shocks over the last 5 years (June-oct)	0.00189***	0.00112***	0.000533***	-2.49e-05	0.000191**
	(0.000387)	(0.000294)	(0.000144)	(7.34e-05)	(8.34e-05)
Nb of SPEI shocks over the last 5 years (June-oct)*average wealth	0.000364**	0.000382***	-8.92e-05*	-1.32e-05	-1.23e-05
	(0.000177)	(0.000115)	(5.27e-05)	(3.23e-05)	(4.63e-05)
R-squared	0.044	0.035	0.013	0.005	0.001
Observations	58,434	58,434	58,434	58,434	58,434
Number of idvillage1	9,739	9,739	9,739	9,739	9,739
village F.E.	yes	yes	yes	yes	yes
Years F.E.	yes	yes	yes	yes	yes

Sample: Census from 2009. Note: Standard errors are clustered at the districtof origin and are reported in parentheses. ***,**,* mean respectively that the coefficient is significantly different from 0 at the level of 1%, 5% and 10%.

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