

# Religious Participation Under Climate Uncertainty

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## 1. Introduction

- Literature & contributions

## 2. Data

- Household Survey
- SPEI
- CHIRPS

## 3. Empirical Context

- Descriptive Stats
- The Agricultural Calendar
- Climate Variability

## 4. Empirical Specification

- Main Specifications

## 5. First Results

- Households
- Community

## 6. Remaining Questions

## How do climate conditions shape religiosity and religious participation?

- Long-term climate change trends (e.g., drought or flood conditions).

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- Long-term climate change trends (e.g., drought or flood conditions).
- Approximating agents' own religious contribution and demand for "religious insurance"?
- The spatial relationship between religious intensity, economic shocks and climate uncertainty. What makes some regions more religious?

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- **Religious organization matters for coping with (climatic) shocks & uncertainty.**
  - An old relationship that can be traced back to early sedentary societies (Chaney, 2013; Fagan, 2009).

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- **Religious organization matters for coping with (climatic) shocks & uncertainty.**
  - An old relationship that can be traced back to early sedentary societies (Chaney, 2013; Fagan, 2009).
  - Chen (2010) finds differentiated impacts of the financial crisis in Indonesia on religious intensity.
  - Empirical evidence of increased religious giving after crises → religious institutions as public good providers (Iannaccone, 1992).

- **Religion as Insurance.**

- Can shape preferences for insurance (Kasim et al., 2016; Clark and Lelkes, 2005) and be a substitute for formal insurance (Auriol et al., 2020).

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- Can shape preferences for insurance (Kasim et al., 2016; Clark and Lelkes, 2005) and be a substitute for formal insurance (Auriol et al., 2020).
- There is evidence of increased religious participation where access to state welfare is low. (Scheve et al. (2006); Gruber and Hungerman (2007)).
- Going beyond that, demand for spiritual insurance and supply side effects.

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- The World Bank's General Household Panel Survey (GHS) in Nigeria, where the population is almost perfectly divided between Christians and Muslims.
  - Four waves, two visits per wave: post-planting and post-harvest.
  - Households and plots are geo-located (5km radius).

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- 2 The Standardized Precipitation Evapotranspiration Index (SPEI):
  - A “water balance” index used for drought prediction, using precipitation, temperature and potential evapotranspiration (PET).
  - Measures the influence of climate change on drought probability/severity/frequency at longer time-scales (Vicente-Serrano et al., 2010).
  - Gridded on a spatial resolution of  $0.5^{\circ} \times 0.5^{\circ}$  lat/lon (approx. 55km).
  - Monthly temporal resolution (time scale from 1-48 months starting in 1901).

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- ③ Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS):
  - 35+ year quasi-global rainfall data set.
  - 0.05 degree resolution.
  - Temporal resolution from daily to annual (1981-2023).

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Table 1: Summary Statistics: Households by Survey Year

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2010 (pp)	2011 (ph)	2012 (pp)	2013 (ph)	2015 (pp)	2016 (ph)	2018 (pp)	2019 (ph)
	mean	mean	mean	mean	mean	mean	mean	mean
Religious donations (log)	2.757	2.627	3.326	3.193	3.440	2.611	3.049	3.045
Donated to church/mosque	0.392	0.381	0.472	0.458	0.483	0.358	0.399	0.394
Christian	0.547	0.543	0.548	0.544	0.553	0.552	0.587	0.589
Muslim	0.434	0.438	0.434	0.438	0.429	0.431	0.398	0.398
Traditional	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001
Age of the household head	49.549	49.687	51.673	52.019	52.986	52.849	49.759	49.692
Male household head	0.849	0.850	0.845	0.846	0.801	0.796	0.805	0.799
Size of the household	5.521	5.754	6.178	6.338	6.977	7.165	6.006	6.089
Rural sector	0.676	0.681	0.686	0.688	0.679	0.680	0.680	0.678
Observations	4997	4916	4746	4770	4611	4582	5049	5072

**Table 2:** Summary Statistics: Community Groups

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Observations</b>
Village Development Committee	0.627	0.484	3362
Agricultural Coop.	0.009	0.094	3362
Business Association	0.004	0.064	3362
Women Group	0.017	0.128	3362
Youth Group	0.005	0.071	3362
Political Group	0.007	0.081	3362
Cultural Group	0	0	3362
Health Committee	0	0	3362
School Committee	0.002	0.049	3362
Parent-Teacher Association	0.003	0.052	3362
NGO	0	0	3362
Comunity Police Watch	0.002	0.049	3362
Disabled Association	0	0	3362

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- Define growing season SPEI as average SPEI over the period March-October (Odekunle, 2004).

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- Define rainfall onset as the point corresponding to the time when an accumulated 7% of the annual rainfall totals has been obtained and rainfall cessation as the point corresponding to the time when an accumulated 90% has been reached (Ilesanmi, 1972).

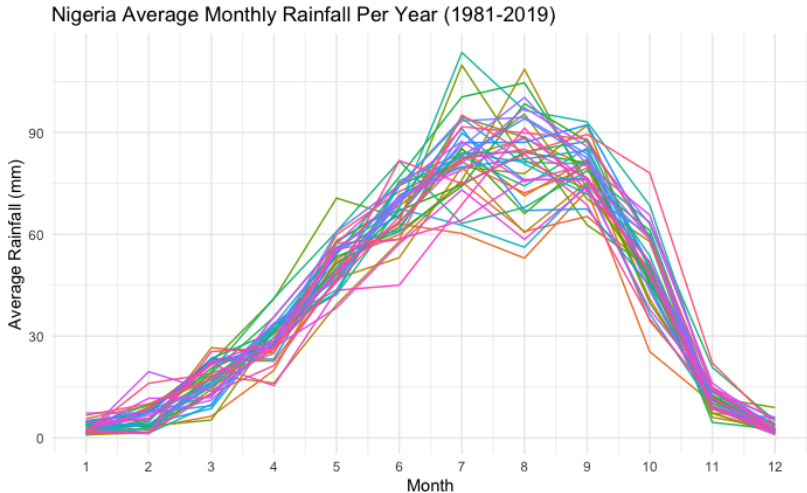


Figure 1: Nigeria Agricultural Calendar



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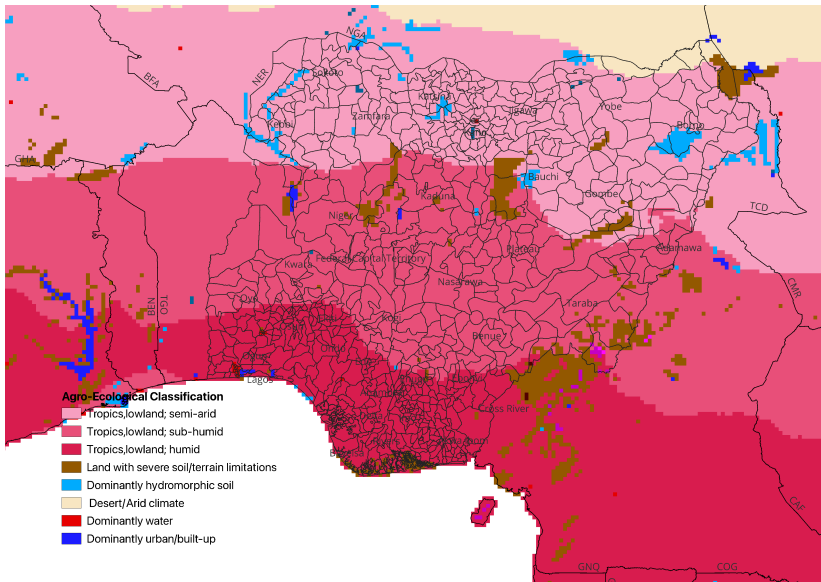


Figure 2: Nigeria's Agroecological Zones

(a) Growing Season

(b) Dry Season

**Figure 3:** Visualized long-term climate conditions of the current season for the growing and dry periods between 2010-2019

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- **Households:**

- *Intensive margin:* Log of religious expenditures in the past six months.
- *Extensive margin:* Whether or not an individual has donated.

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$$Y_{igt} = \sum_{x=0}^{x=4} \alpha_x \text{drought}_{t-x,g} + \gamma_t + \rho_g + X_i + \epsilon_{igt} \quad (1)$$

- $Y_{igt}$ : religious expenditure outcome variable for household  $i$  in LGA  $g$  in year  $t$ .
- $\text{drought}_{t-x,g}$ : if a one-, two, three or four-month drought occurred for household  $i$  in year  $t$  until year  $t - 3$ .
- $\gamma_t, \rho_g, X_i$ : year-fixed effects, LGA fixed effects and household controls.

- **Communities:**

- *Village Development Group*: Likelihood that a community has one.
- *Religious Leader*: Community has at least one religious leader.

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- *Village Development Group*: Likelihood that a community has one.
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$$Y_{igt} = \sum_{x=0}^{x=4} \alpha_x \text{drought}_{t-x,g} + \gamma_t + \rho_g + X_i + \epsilon_{igt} \quad (2)$$

- $Y_{igt}$ : community outcome variable for community  $i$  in state  $g$  in year  $t$ .
- $\text{drought}_{t-x,g}$ : if a one-, two, three or four-month drought occurred for community  $i$  in year  $t$  until year  $t - 3$ .
- $\gamma_t, \rho_g, X_i$ : year-fixed effects, state fixed effects and community controls.



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**Table 3: Effect of Current and Lagged Shocks on Religious Expenditure**

	Dependent variable: Log Religious Expenditure						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Min. 1 drought-months (SPEI<-1.9) Current Year	0.234** (0.029)						0.336*** (0.005)
Min. 1 drought-months (SPEI<-1.9) Year-1	0.159* (0.098)						0.229** (0.048)
Min. 1 drought-months (SPEI<-1.9) Year-2	0.184 (0.111)						0.236* (0.093)
Min. 1 drought-months (SPEI<-1.9) Year-3	0.211** (0.031)						0.339*** (0.005)
Min. 1 drought-months (SPEI<-1.9) Year-4	-0.153* (0.071)						-0.0829 (0.417)
Min. 1 drought-months (SPEI<-1.5) Current Year		0.0781 (0.333)					-0.0112 (0.912)
Min. 1 drought-months (SPEI<-1.5) Year-1		0.0773 (0.274)					0.0201 (0.820)
Min. 1 drought-months (SPEI<-1.5) Year-2		0.0791 (0.267)					0.171** (0.046)
Min. 1 drought-months (SPEI<-1.5) Year-3		0.0921 (0.244)					0.0461 (0.626)
Min. 1 drought-months (SPEI<-1.5) Year-4		0.0258 (0.730)					0.129 (0.132)
Min. 2 drought-months (SPEI<-1.5) Current Year			0.158 (0.262)				0.0217 (0.888)
Min. 2 drought-months (SPEI<-1.5) Year-1			-0.1113 (0.313)				-0.211 (0.131)
Min. 2 drought-months (SPEI<-1.5) Year-2			-0.267** (0.047)				-0.442** (0.017)
Min. 2 drought-months (SPEI<-1.5) Year-3			0.0659 (0.659)				-0.0105 (0.951)
Min. 2 drought-months (SPEI<-1.5) Year-4			-0.0445 (0.714)				-0.234* (0.098)
Min. 3 drought-months (SPEI<-1.5) Current Year				-0.168 (0.225)			-0.113 (0.509)
Min. 3 drought-months (SPEI<-1.5) Year-1				0.0330 (0.714)			
Min. 3 drought-months (SPEI<-1.5) Year-2				0.108 (0.680)			0.0308 (0.910)
Min. 3 drought-months (SPEI<-1.5) Year-3				0.00975 (0.978)			-0.289 (0.479)
Min. 3 drought-months (SPEI<-1.5) Year-4				0.0568 (0.856)			0.126 (0.729)
Min. 4 drought-months (SPEI<-1.5) Current Year					-0.868*** (0.007)		-0.986** (0.033)
Min. 4 drought-months (SPEI<-1.5) Year-1					-0.876** (0.013)		-0.826* (0.060)
Min. 4 drought-months (SPEI<-1.5) Year-2					-0.582** (0.046)		-0.661 (0.187)
<input type="checkbox"/> Perceived drought in past 5 years						0.798*** (0.000)	
<input type="checkbox"/> Observations	38356	38356	38356	38356	38356	14436	38356
<input type="checkbox"/> LGA Fixed Effects	yes	yes	yes	yes	yes	yes	yes
<input type="checkbox"/> Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes
<input type="checkbox"/> Household controls	yes	yes	yes	yes	yes	yes	yes
<input type="checkbox"/> Weather trend control	yes	yes	yes	yes	yes	yes	yes

**Table 4: Effect of Current and Lagged Shocks on Religious Expenditure**

	Dependent variable: Donation Probability						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Min. 1 drought-months (SPEI<-1.9) Current Year	0.0289*						0.0505***
	(0.051)						(0.064)
Min. 1 drought-months (SPEI<-1.9) Year-1	0.0204						0.0359**
	(0.130)						(0.036)
Min. 1 drought-months (SPEI<-1.9) Year-2	0.0189						0.0285
	(0.245)						(0.168)
Min. 1 drought-months (SPEI<-1.9) Year-3	0.0222*						0.0461***
	(0.099)						(0.007)
Min. 1 drought-months (SPEI<-1.9) Year-4	-0.0234*						-0.00792
	(0.052)						(0.595)
Min. 1 drought-months (SPEI<-1.5) Current Year	0.00640						-0.00582
	(0.568)						(0.683)
Min. 1 drought-months (SPEI<-1.5) Year-1	0.00316						-0.00491
	(0.746)						(0.695)
Min. 1 drought-months (SPEI<-1.5) Year-2	0.00862						0.0239*
	(0.392)						(0.054)
Min. 1 drought-months (SPEI<-1.5) Year-3	0.00648						0.00128
	(0.556)						(0.923)
Min. 1 drought-months (SPEI<-1.5) Year-4	-0.00205						0.0132
	(0.843)						(0.271)
Min. 2 drought-months (SPEI<-1) Current Year		0.00995					-0.00405
		(0.594)					(0.851)
Min. 2 drought-months (SPEI<-1.5) Year-1		-0.0102					-0.0327*
		(0.465)					(0.099)
Min. 2 drought-months (SPEI<-1.5) Year-2		-0.0367**					-0.0588**
		(0.050)					(0.028)
Min. 2 drought-months (SPEI<-1.5) Year-3		0.00649					-0.00113
		(0.751)					(0.963)
Min. 2 drought-months (SPEI<-1.5) Year-4		-0.0220					-0.0485**
		(0.203)					(0.014)
Min. 3 drought-months (SPEI<-1) Current Year			-0.0415**				-0.0272
			(0.030)				(0.261)
Min. 3 drought-months (SPEI<-1.5) Year-1			-0.000379				
			(0.974)				
Min. 3 drought-months (SPEI<-1.5) Year-2			0.0230				0.0130
			(0.552)				(0.745)
Min. 3 drought-months (SPEI<-1.5) Year-3			0.000620				-0.0399
			(0.990)				(0.484)
Min. 3 drought-months (SPEI<-1.5) Year-4			0.00315				0.0234
			(0.941)				(0.630)
Min. 4 drought-months (SPEI<-1) Current Year				-0.133***			-0.135**
				(0.007)			(0.036)
Min. 4 drought-months (SPEI<-1.5) Year-1				-0.122**			-0.119**
				(0.014)			(0.045)
Min. 4 drought-months (SPEI<-1.5) Year-2				-0.0818*			-0.0754
				(0.052)			(0.290)
Perceived drought in past 5 years						0.118***	
						(0.090)	
Observations	38399	38399	38399	38399	38399	14453	38399
LGA Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Household controls	yes	yes	yes	yes	yes	yes	yes
Weather trend control	yes	yes	yes	yes	yes	yes	yes

- Effects are driven by Christians and rural households.
- Timing seems to matter: stronger results post-harvest.
- Negative or no effect for those with access to irrigation.

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Table 5: Community Outcome 1: Village Development Group

	<i>Dependent variable: Village Dev. Group</i>						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Min. 1 drought-months (SPEI < -1.9) Current Year Growing	0.0278 (0.592)						
Min. 1 drought-months (SPEI < -1.9) Year-1 Growing	0.0855 (0.161)						
Min. 1 drought-months (SPEI < -1.9) Year-2 Growing	0.0121 (0.840)						
Min. 1 drought-months (SPEI < -1.9) Year-3 Growing	-0.0359 (0.554)						
Min. 1 drought-months (SPEI < -1.9) Year-4 Growing	-0.125** (0.030)						
Min. 1 drought-months (SPEI < -1.9) Current Year Dry		0.0570 (0.141)					
Min. 1 drought-months (SPEI < -1.9) Year-1 Dry		-0.0688* (0.060)					
Min. 1 drought-months (SPEI < -1.9) Year-2 Dry		0.0472 (0.353)					
Min. 1 drought-months (SPEI < -1.9) Year-3 Dry		-0.00134 (0.974)					
Min. 1 drought-months (SPEI < -1.9) Year-4 Dry		0.0427 (0.565)					
Min. 1 drought-months (SPEI < -1.5) Current Year Growing			0.0378 (0.393)				
Min. 1 drought-months (SPEI < -1.5) Year-1 Growing			-0.0356 (0.365)				
Min. 1 drought-months (SPEI < -1.5) Year-2 Growing			-0.0384 (0.412)				
Min. 1 drought-months (SPEI < -1.5) Year-3 Growing			-0.0162 (0.726)				
Min. 1 drought-months (SPEI < -1.5) Year-4 Growing			-0.00644 (0.872)				
Min. 1 drought-months (SPEI < -1.5) Current Year Growing				0.0910** (0.035)			
Min. 1 drought-months (SPEI < -1.5) Year-1 Dry				-0.0307 (0.420)			
Min. 1 drought-months (SPEI < -1.5) Year-2 Dry				-0.0109 (0.799)			
Min. 1 drought-months (SPEI < -1.5) Year-3 Dry				-0.0453 (0.272)			
Min. 1 drought-months (SPEI < -1.5) Year-4 Dry				-0.0305 (0.537)			
Min. 3 drought-months (SPEI < -1.5) Current Year Growing					0.0522 (0.581)		
Min. 3 drought-months (SPEI < -1.5) Year-1 Growing					-0.0391 (0.656)		
Min. 3 drought-months (SPEI < -1.5) Year-2 Growing					0.112 (0.310)		
Min. 3 drought-months (SPEI < -1.5) Year-3 Growing					0.00568 (0.946)		
Min. 3 drought-months (SPEI < -1.5) Year-4 Growing					-0.0851 (0.374)		
Min. 3 drought-months (SPEI < -1.5) Current Year Dry						-0.133 (0.598)	
Min. 3 drought-months (SPEI < -1.5) Year-1 Dry						0.0237 (0.849)	
Min. 3 drought-months (SPEI < -1.5) Year-2 Dry						0.250* (0.079)	
Min. 3 drought-months (SPEI < -1.5) Year-3 Dry						0.0400 (0.754)	
Min. 3 drought-months (SPEI < -1.5) Year-4 Dry						-0.194 (0.177)	
Observations	1646	1676	1646	1676	1646	1676	
State Fixed Effects	yes	yes	yes	yes	yes	yes	
Year Fixed Effects	yes	yes	yes	yes	yes	yes	
Weather trend control	yes	yes	yes	yes	yes	yes	

- Heterogeneity: what are the possible mechanisms driving positive and negative effects?
  - *Adaptation & Access to Infrastructure*: Households living in rural areas are more exposed to climate uncertainty with fewer buffers to absorb the shocks (higher competition, price fluctuations).
  - *Structural differences between religions*: Better understanding the cyclicity of religious donations across religions.
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- Mapping religious expenditure and distance from normal conditions.
- How to distinguish between the good shocks and the bad shocks?