Drought and Contraceptive Use: Does Environmental Stress Lead to Delayed Pregnancy in Kenya?

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Introduction

Climate change is reshaping livelihoods, health, and socio-economic conditions across the globe, with sub-Saharan Africa experiencing some of the most profound impacts (Serdeczny et al., 2017; Shukla et al., 2021; Sikarwar & Golaz, 2024). Among the environmental stressors linked to climate change, drought stands out due to its recurrent and intensifying nature, particularly in East Africa (Gebremeskel Haile et al., 2019). Drought disrupts agricultural production, causes water scarcity, and contributes to economic instability. In such contexts, individuals and families are often compelled to adjust their behaviors, including decisions related to reproduction and family planning (Brooks et al., 2023; Eissler et al., 2019). Understanding how environmental stressors like drought influence fertility behaviors is especially critical in regions heavily affected by climate change. While prior research has established the negative impacts of drought on child health and nutrition (Bakhtsiyarava et al., 2018; Cooper et al., 2019; Davenport et al., 2017; Grace et al., 2015), as well as its associations fertility (Casey et al., 2019; Grace & Nagle, 2015; Segal & Giudice, 2022), much less is known about how drought intensity and duration might influence the decision to delay pregnancies through increased contraceptive use.

This study investigates the potential link between drought and reproductive behavior, focusing on the use of contraceptives as a behavioral adaptation to environmental stress. Specifically, we explore whether women in Kenya increase their contraceptive use during or following periods of drought, possibly as a strategy to delay pregnancy in response to environmental and economic uncertainties. By examining this relationship, we aim to determine whether environmental stress leads to shifts in reproductive decisions, contributing to the growing body of literature on how climate change influences fertility behavior (Brooks et al., 2023; Eissler et al., 2019; Somefun et al., 2024). Methodologically, this study seeks to explore whether the incidence and intensity of drought are associated with increased contraceptive use, signaling a decision to delay pregnancy. Additionally, we aim to identify which drought measures—such as short-term versus long-term or cumulative drought severity—are most effective in predicting changes in contraceptive behavior. Furthermore, the study will examine how spatial factors such as livelihood zones, urban versus rural classifications, and vegetation indices, as well as socio-economic factors like wealth, education, and employment, mediate or modify this relationship. By utilizing monthly calendar data of individual women, this study provides new insights into delayed pregnancies as a coping mechanism in response to environmental stress. These findings contribute to the broader discourse on climate change's impact on demographic trends and could inform policy interventions in reproductive health and climate adaptation, particularly in regions like Kenya, where drought is a recurring threat.

Data and Methods

To analyze the impact of drought on contraceptive use, this study will use two primary datasets:

Drought Data: Drought conditions will be measured using the Standardized Precipitation-Evapotranspiration Index (SPEI), a well-established drought index that accounts for both precipitation and potential evapotranspiration (Gebrechorkos et al., 2023). This dataset will be derived from high-resolution monthly climate data and aggregated at a 10 km spatial resolution around the DHS cluster locations (Figure 1). Multiple drought measures will be tested, including: *Short-term Drought:* Drought intensity measured over the preceding 1-3 months. *Medium-term Drought:* Drought intensity measured over 4-6 months. *Long-term Drought:* Drought conditions persisting for over 6 months. We will also explore additional environmental indicators such as vegetation health via the Normalized Difference Vegetation Index (NDVI), temperature anomalies, and rainfall levels to complement drought measures.

Contraceptive Use and Pregnancy Data: The main data on reproductive behavior comes from the Demographic and Health Surveys for Kenya-2022, specifically the calendar data that tracks individual women's contraceptive use and pregnancy histories over the past five years for each month. This rich dataset enables us to capture month-by-month patterns in contraceptive use, allowing us to align this with drought periods.

Spatial Indicators: In addition to drought intensity, we will incorporate spatial variables that help contextualize the local environmental and socio-economic conditions: *Urban vs. Rural:* To capture the differences in infrastructure, access to healthcare, and economic opportunities. *Livelihood Zones:* These zones categorize areas based on predominant livelihoods (e.g., agricultural, pastoral, or mixed systems), (Figure 1) which may influence how drought affects reproductive decisions.

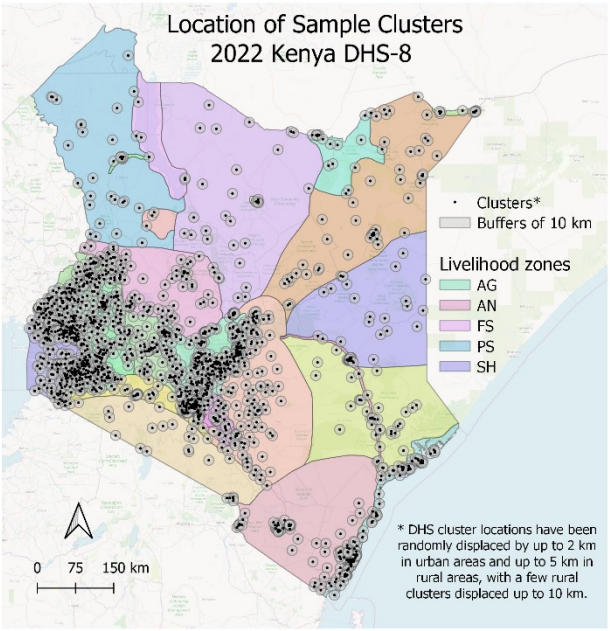

Figure 1 Locations of clusters sampled in the Kenya DHS-8. Map also illustrates the 10km buffers around clusters and livelihood zones. Source: Designed by the authors using DHS and FEWSNET data.

Socio-economic Indicators: We will also integrate socio-economic variables from DHS data to explore how economic and social contexts shape the relationship between drought and contraceptive use: Wealth Quintile, Education Level, Employment Status: Economic participation could influence reproductive decisions during times of stress, Marital Status, Religion: To account for cultural factors that may affect contraceptive decisions, Access to Healthcare etc.

Analytical Approach: We will use multilevel logistic regression models to analyze the data. These models are appropriate given the hierarchical structure of the data, where individuals are nested within spatial clusters. This allows us to account for both individual-level factors (e.g., age, education, wealth) and area-level drought and spatial indicators. The model will include: *Fixed effects* for individual socio-economic characteristics and drought measures and *Random effects* for the DHS clusters to account for within-cluster correlation. We will first test different drought measures and compare their explanatory power using metrics such as *AIC (Akaike Information Criterion)* and *BIC (Bayesian Information Criterion)*. Interaction terms will be included to explore how socio-economic and spatial factors mediate the relationship between drought and contraceptive use.

Preliminary analyses on temporal aggregation of drought

Figure 2 presents the trends of monthly SPEI (Standardized Precipitation-Evapotranspiration Index) for Kenya from 2018 to 2022, covering the five years preceding the Kenya DHS-8 survey. The SPEI values fluctuate significantly across this period, reflecting substantial variability in drought conditions month to month. Periods of positive SPEI values indicate relatively wet conditions, while negative values suggest increasing drought severity. Notably, the chart shows frequent oscillations, with both the intensity and frequency of drought conditions appearing to rise over time. This suggests a growing environmental stress in Kenya, where periods of extreme drought become more recurrent and severe.

We also examined drought conditions in Kenya using the Standardized Precipitation-Evapotranspiration Index (SPEI) across different time frames—one month, three months, one year, and two years. Our goal was to investigate how varying temporal aggregations of drought reflect different patterns. Figure 3 demonstrate that different time frames—one month, three months, one year, and two years—reveal varying patterns of drought across Kenya. For instance, the one-month SPEI for January 2022 captures short-term fluctuations with localized extremes, while the three-month and one-year averages provide a more stable view of drought persistence. By the two-year average (2020–2021), drought patterns become more uniform, reflecting moderate drought across the country. These

variations underscore the need to carefully choose the temporal scale when linking drought to behavioral outcomes, such as reproductive decisions.

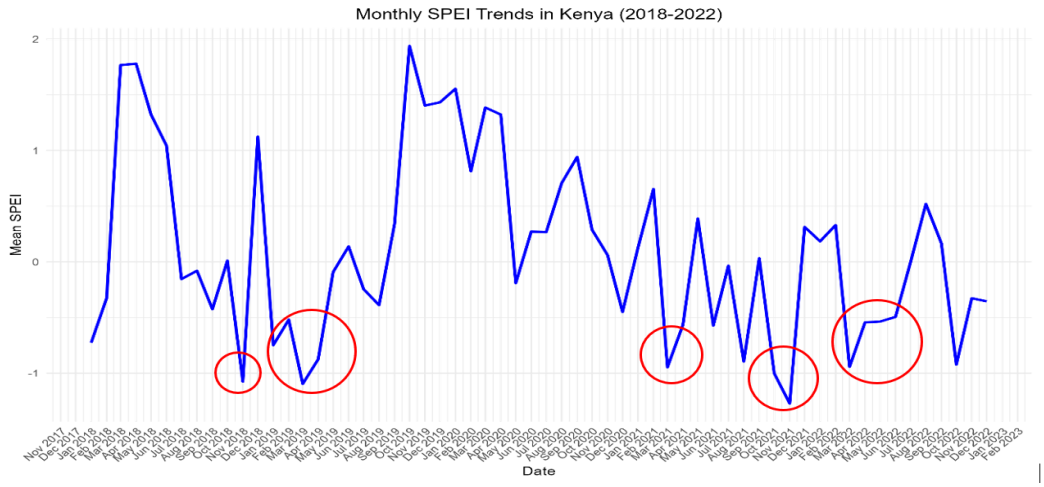

Figure 2: Monthly Trends of Standardized Precipitation-Evapotranspiration Index (SPEI) in Kenya (2018–2022). Red circles highlight the drought episodes.

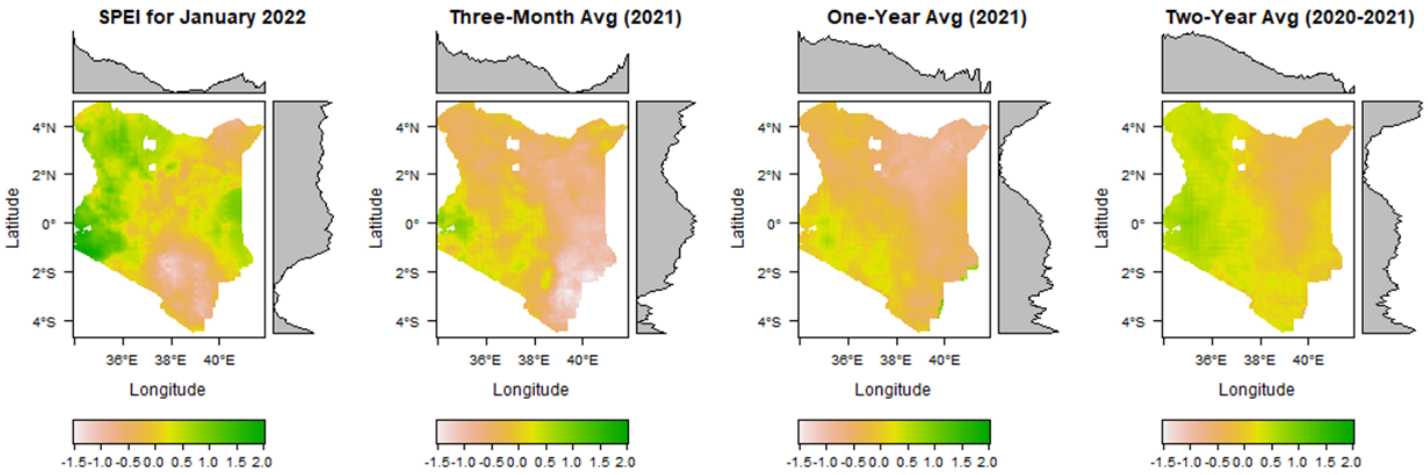

Figure 3: Temporal Aggregation of SPEI in Kenya Across Different Time Frames (January 2022, Three-Month Average, One-Year Average, and Two-Year Average)

Expected Findings

We anticipate several key findings from our ongoing analysis: *Increased Contraceptive Use During Drought:* We expect to find a positive relationship between drought intensity and contraceptive use. In times of environmental stress, it is likely that women, particularly in rural and agricultural zones, will use contraceptives to delay pregnancies, reflecting the economic and social strain of drought. *Variation by Drought Measure:* It is anticipated that different measures of drought (e.g., short-term vs. long-term) will have varying impacts on contraceptive use. Short-term droughts may not be severe enough to trigger changes in reproductive behavior, whereas longer and more intense droughts are likely to have stronger effects. *Socio-economic and Spatial Heterogeneity:* We expect the effects of drought on contraceptive use to be mediated by socio-economic status, education, and geographic location. Women from wealthier households may be less affected by drought, while those in poorer households or pastoralist livelihood zones may be more sensitive to environmental stress. Urban women might be less impacted due to better access to healthcare and family planning services, whereas rural women might face greater constraints. *Regional Differences:* Livelihood zones, particularly those dependent on rain-fed agriculture or pastoralism, will likely exhibit stronger responses to drought in terms of contraceptive use. This study will contribute to our understanding of how environmental stressors, particularly drought, influence reproductive behavior through contraceptive use. The findings will have implications

for both climate adaptation strategies and reproductive health policies, particularly in regions vulnerable to climate change like Kenya.

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