**From Food Belt to Migration Belt:  
Assessing the Socio-Spatial Impacts of the 2010 Drought on Agricultural Land Use and Rural Migration in Guizhou, China**

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Module Code: CASA0010

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Word Count: xxxxx

Date of Submission: 21/08/2025

**Declaration of Authorship**

I confirm that the work presented in this dissertation is my own. Where information has been derived from other sources, I confirm that this has been indicated in the dissertation.

# Abstract

Provide a concise summary of your research background, aims, methodology, results, and contributions (150–300 words).

# Acknowledgements

Acknowledge any individuals, institutions, or funding bodies who supported your research.

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# 1. Introduction

## 1.1 Background

In recent decades, the frequency and severity of extreme weather events have increased, primarily due to human activities (IPCC, 2021). These events, including droughts, floods, and heatwaves, pose an increasingly serious threat to agricultural systems, rural livelihoods, and socio-ecological resilience. Also, mountainous and ecologically fragile regions are particularly vulnerable due to terrain constraints, reliance on rain-fed agriculture, and limited adaptive capacity (Black *et al.*, 2011).

Worldwide, the Intergovernmental Panel on Climate Change (IPCC) reports that the intensity and frequency of compound extreme events are expected to increase under all future warming scenarios. In China, the average temperature has risen by more than 1.6 degrees Celsius over the past 60 years, and extreme drought events have become more frequent in the southwestern region (China Meteorological Administration, 2023). This trend poses a particular risk to agricultural sustainability in areas where more than half of the rural population is directly dependent on agricultural income for their livelihoods (*The State of Food and Agriculture 2021: Making Agrifood Systems More Resilient to Shocks and Stresses*, 2021).

Southwest China, including Guizhou Province, is highly susceptible to such risks. In 2010, the region experienced the most severe drought in decades, classified as an extreme El Niño-La Niña transition event (Luo *et al.*, 2019). Official statistics from Guizhou Province indicate that the drought affected over 1.5 million hectares of farmland, with disaster rates exceeding 70% in core high-risk counties, including Bijie, Dafang, Jinsha River, and Qianxi (Guizhou Provincial Bureau of Statistics, 2011). This drought was one of the most severe in the past 30 years, second only to the 1992 drought, resulting in widespread crop yield reductions, water shortages, increased forest fires, power outages, and long-term ecological stress. Guizhou's karst terrain has constrained the development of irrigation infrastructure, with rain-fed agriculture dominating (Luo *et al.*, 2019), exacerbating the impacts of insufficient rainfall.

Agriculture remains a key component of Guizhou's economy and livelihood, with over 60% of the population engaged in agricultural activities, and rural residents forming the bulk of the province's labour force (Guizhou Provincial Bureau of Statistics, 2011). The province is a major producer of corn, rice, and tuber crops, but its fragmented farmland and low level of mechanisation make it particularly vulnerable to climate change. As a result, climate shocks such as the 2010 drought not only severely impact agricultural production but also have adverse effects on household income security and migration decisions.

## 1.2 Knowledge Gap and Research Motivation

The relationship between climate shocks, agricultural production, and migration has long been recognised in academic and policy discussions. Existing research indicates that environmental stressors can influence migration through direct channels (when livelihoods become unsustainable) and indirect channels (when agricultural productivity and income decline, prompting labour reallocation) (Black *et al.*, 2011; McLeman, 2018; Cattaneo *et al.*, 2019). However, migration responses are highly context-dependent and influenced by economic opportunities, migration costs, institutional environments, and household capabilities (De Haas, 2021).

In China, evidence suggests that climate change affects rural labour allocation (Wang, Chen and Shen, 2024; Zheng *et al.*, 2024), but most studies have focused on eastern provinces with convenient transportation and high agricultural productivity. For underdeveloped mountainous regions like Guizhou, where migration ability may be constrained, empirical research is scarce. Although the 2010 drought severely reduced agricultural output, it remains unclear whether and to what extent it triggered rural out-migration. Additionally, the spatial heterogeneity of drought impacts (potentially influenced by elevation, agricultural dependency, and infrastructure) has not been systematically evaluated.

Although existing literature on climate-induced migration in China provides valuable insights, it primarily employs national-scale econometric methods or household survey methods. Few studies have conducted spatially explicit analyses of agricultural and migration outcomes using clearly defined extreme climate events. Furthermore, Guizhou's complex socio-ecological environment—karst topography, high rural poverty rates, and limited non-agricultural employment opportunities—suggests that its migration response may differ significantly from patterns observed in more developed regions. This highlights the necessity of conducting case-specific, data-driven research to better understand the causal pathways linking climate shocks, agricultural viability, and population mobility.

## 1.3 Research Aim and Questions

This study aims to explore the socio-spatial impacts of the extreme drought in Guizhou Province in 2010, focusing on agricultural productivity, rural population migration, and the moderating effects of local geographical and socio-economic characteristics. Additionally, this study aims to investigate the potential relationship between agricultural decline and population migration, considering the context of spatial heterogeneity.

The core research questions are:

1. Does extreme drought significantly affect agricultural productivity as measured by seasonal crop NDVI?

2. Does drought affect rural migration patterns?

3. How do county-level characteristics (e.g., altitude, urbanisation, and population density) influence these responses?

4. To what extent is the observed decline in agricultural vitality related to drought occurrence and migration trends?

Research contributions include:

1. Data integration — Combining satellite remote sensing (NDVI), climate indices (SPEI) and census data to construct a county-level panel data set.

2. Causal inference — Using difference-in-differences (DiD) estimation and event study designs to determine the causal effects of drought on agricultural productivity and migration.

3. Focus on spatial heterogeneity — Link climate, agriculture and migration within a framework that considers geographical and socio-economic diversity, with a focus on mountainous areas that are often subject to climate stress.

## 1.4 Significance of the Study

This study contributes to climate-agriculture-migration literature in three ways.

First, it provides event-based empirical evidence from Guizhou, a mountainous and agriculture-dependent region that is largely absent from national and global analyses.

Second, it presents the integration of multi-source datasets (satellite NDVI, drought index (SPEI), and county-level demographic data) to enable spatially explicit assessments of drought impacts.

Third, it employs quasi-experimental methods (Difference-in-Differences and event studies) to strengthen causal inference, revealing spatial heterogeneity shaped by geographical and socio-economic factors.

In addition to academic contributions, the findings are highly aligned with China's rural revitalisation strategy. *The Rural Revitalisation Plan (2024–2027)* emphasises agricultural resilience, food security, improvements to rural infrastructure, and differentiated support for ecologically fragile and underdeveloped regions. By identifying the regions most severely affected by drought and its underlying causes, this study supports the development of targeted adaptation measures, promotes agricultural modernisation, and advances rural livelihood diversification within the framework of the national revitalisation strategy.

# 2. Literature Review

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# 3. Data & Study Area

Describe your study area, data sources, and data processing methods.

# 4. Methodology

Explain your research design, models, and analytical approach.

Example Figure with Caption:

Figure 1. Example figure caption text

Example Table with Caption:

Table 1. Example table caption text

# 5. Results

Present your main findings with figures and tables. Make sure each figure and table has a caption.

# 6. Discussion

Interpret your results, compare with previous research, and discuss implications.

# 7. Conclusion

Summarise your research contributions, limitations, and future work.

# References

Black, R., Adger, W.N., Arnell, N.W., Dercon, S., Geddes, A. and Thomas, D. (2011) The effect of environmental change on human migration. Global Environmental Change, 21(S1), pp. S3–S11.

# Appendices

Include supplementary material such as extended tables, figures, or code.