# Climate Shocks in Vietnam, Agriculture, Migration, and Structural Transformation

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*Abstract:* This paper investigates how climate shocks in the agricultural sector drive migration and facilitate structural transformation, focusing on Vietnam. Utilizing panel data from 1986 to 2020, the study employs a fixed effects model to analyze the relationship between extreme climate events, such as floods and storms, and socio-economic changes. The findings reveal that the increased frequency of climate shocks significantly drives migration from rural to urban areas. Thus, carrying a notable shift in economic activity from agriculture to manufacturing and services, facilitating structural transformation in line with the Lewis Model. The analysis shows that climate-induced migration helps reallocate labor to more productive sectors, contributing to economic diversification. This research provides robust evidence of the dynamic interplay between climate variability, migration, and economic restructuring, offering valuable insights for policymakers to enhance resilience and support sustainable development in Vietnam.

*Keywords:* Structural Transformation, Vietnam, Agriculture, Migration, Economic Shift

## 1. Introduction

The Lewis Model theory, known as the Dual Sector Model, is developed by Sir W. Arthur Lewis in 1954. Lewis divides the economy into two sectors: the traditional subsistence agriculture sector, representing low productivity and surplus labor, and the modern sector, representing capital-intensive workforces with higher wages and productivity. By transferring surplus labor to the modern sector without affecting agricultural production, capitalists can accumulate increasing capital, which can then be reinvested into wages. Lewis believes that the accumulation of capital is vital for development in developing countries. In the subsistence sector, there is an excess of labor compared to the available resources, and the "marginal productivity" is very low. Traditional labor is only willing to migrate into the modernized workforce due to the difference in the wage gap. According to research [1], generally, the farmers would only leave the land behind for a 30% increase in the subsistence paycheck.

Many countries, such as South Korea or China, shifted from a heavily agricultural concentrated economy to world's world-renowned economy with substantial industrial or service sectors, following the Lewis model [2]. These successfully shifted economic bodies generally obtained free-market and policy reforms; for example, under Deng Xiaoping's influence over China, he de-collectivized agriculture practices and allowed private businesses. Government intervention in the change is crucial to ensure efficiency, and countries would often diversify their economic sectors to

encounter the progression of worsening climate change. Especially concentrating on Southeast pacific countries, where natural disasters frequently occur, they would mitigate the loss of agriculture through migration or transitioning economic orientation. The shift in employment and labor causes surplus to move to modern sectors, stimulating industrialization and urbanization, thus improvements in productivity and living standards [3].

The paper strives to answer how do climate shocks in the agricultural sector drive migration and facilitate structural transformation. Climate shocks like storms and floods happen frequently progressively. As the frequency of extreme climate rises in Vietnam, people suffer an inclining rate of economic loss and destruction. These shocks heavily impact the agricultural yield of the households. As a result, the household has to resort to migration to seek other methods of earning. While the existing evidence already provides a detailed framework of structural transformation [3] or climate-induced migration [4]. This paper will combine the two fields in Vietnam, using national statistics on sectoral GDP in the agricultural and industrial sectors, along with graphical data on storms. This study employs a fixed effects model for panel data analysis. With the use of this analytical method, unobserved variability between locations and over time can be controlled, yielding accurate projections of how migratory patterns are affected by climate shocks.

## 2. Data

### 2.1. Overview

The datasets provided in this study offer a comprehensive view of Vietnam's economic, climatic, and migratory dynamics over the period from 1986 to 2020. The economic data, sourced from the General Statistics Office (GSO) of Vietnam, includes sectoral GDP and employment differences, highlighting the structural transformation. The GSO provides income data that is divided by urban and rural areas to highlight the variations in economic conditions between them. Extreme weather data collected from the Emergency Events Database (EM-DAT), captures the growing variability and its effect on agricultural productivity by documenting the frequency of storms and floods. The Vietnam Household Living Standards Survey (VHLSS) provides migration data that demonstrates the rates of migration by income quintiles and rural/urban regions, indicating the socioeconomic responses to climate shocks. These datasets provide a foundation for analyzing how climate shocks drive migration and facilitate structural transformation in Vietnam.

### 2.2. GDP and Employment

We need to collect data on migratory patterns, the frequency of extreme climate, sectoral GDP, and household income level in order to understand how extreme climate enables migration and structural transformation. The General Statistics Office (GSO) of Vietnam, global climate databases, and migration surveys are the main sources of data. The data covers important times of climate events and socioeconomic shifts from 1986 to 2009 (Figure 1&2).
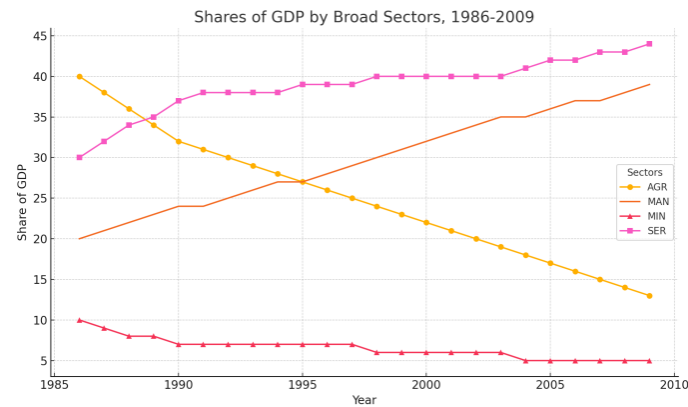
*Source: calculated from GSO (General Statistics Office)*

Figure 1: Share of GDP by Broad Sectors, 1986-2009 [5]
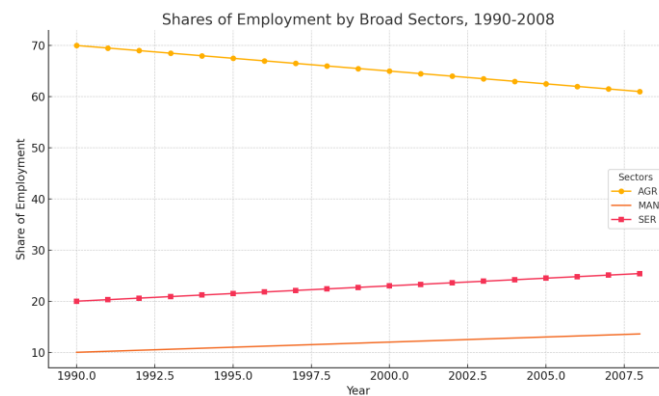


*Source: calculated from GSO (General Statistics Office)*

Figure 2: Share of Employment by Broad Sectors [5]

## 2.3. Income

This data from GSO presents the data used to analyze income disparities between rural and urban regions in Vietnam from the 1980 to 2020, categorized by source (salary and wages, agriculture, other sectors)   (Figure 3&4).
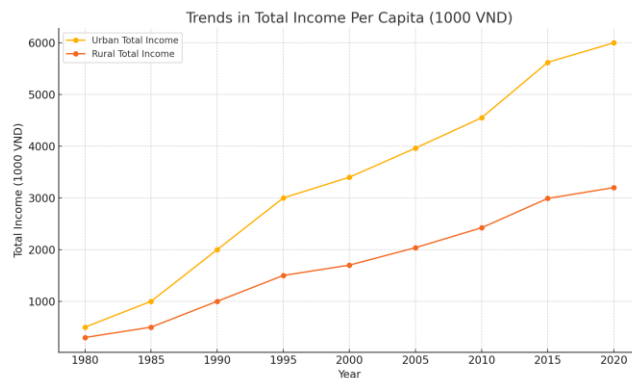


*Source: data adapted from the General Statistics Office (GSO) of Vietnam.*

Figure 3: Trends in Total Income Per Capita (1000 VND)
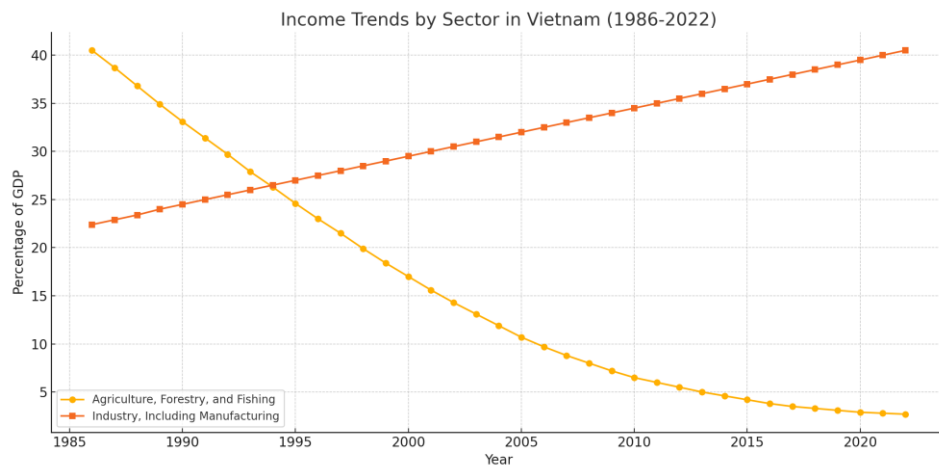
*Source: data adapted from the General Statistics Office (GSO) of Vietnam.*

Figure 4: Income Trends by Sector in Vietnam (1986-2022)

## 2.4. Extreme Climate Event

In Figure 5, The dataset includes information on Vietnam's flood and storm frequency from 1960 to 2020. During this time, the nation saw catastrophes like floods and storms are among the many disaster events for which EM-DAT offers comprehensive data of the frequency in Vietnam.
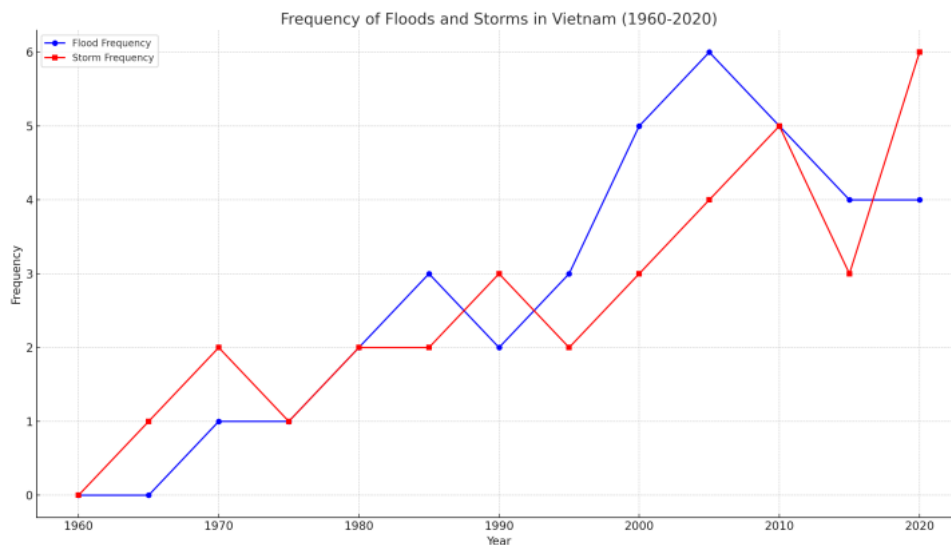


*Source: Data adapted from Centre for Research on the Epidemiology of Disasters (CRED), 2021. EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium.*

Figure 5: Frequency of Floods and Storms in Vietnam (1960-2020)

## 2.5. Migration

In Table 1&2, the data separates the urban and rural differences into 5 quintiles. Quintile 1 (Poorest) and quintile 5 (Richest). In the context of socio-economic analysis, a quintile is a statistical value of a data set that represents 20% of a the population. When households are divided into quintiles, they are grouped into five equal parts based on their income levels, with each quintile representing one-fifth of the population.

Table 1: The Income Level by Rural Quantiles

| Year | Rural Total | Rural Quintile 1 | Rural Quintile 2 | Rural Quintile 3 | Rural Quintile 4 | Rural Quintile 5 |
|---|---|---|---|---|---|---|
| 2006 | 0.2 | 0.13 | 0.12 | 0.15 | 0.28 | 0.3 |
| 2008 | 0.23 | 0.11 | 0.11 | 0.2 | 0.3 | 0.37 |
| 2010 | 0.5 | 0.13 | 0.1 | 0.23 | 0.41 | 1.62 |

Source: Data adapted from VHLSS 2010

Table 2: The Income Level by Urban Quantile

| Year | Urban Total | Urban Quintile 1 | Urban Quintile 2 | Urban Quintile 3 | Urban Quintile 4 | Urban Quintile 5 |
|---|---|---|---|---|---|---|
| 2006 | 0.83 | 0.2 | 0.77 | 0.7 | 0.89 | 1.48 |
| 2008 | 0.94 | 0.38 | 0.64 | 0.89 | 1.26 | 1.44 |
| 2010 | 1.71 | 0.32 | 0.76 | 1.37 | 2.86 | 3.26 |

Source: Data adapted from VHLSS 2010

## 3. Data Analysis

## 3.1. Data Overview

GDP and Employment Shares: Between 1986 and 2009, descriptive statistics show a notable decrease in the GDP and employment share of agriculture, along with a rise in the shares of the manufacturing and services sectors. This trend reflects the structural transformation of Vietnam's economy.

Income Data: Urban incomes have consistently been higher than rural incomes, with the gap widening over time. This suggests increasing urbanization and economic opportunities in urban areas.

Climate Events: The frequency of floods and storms has increased over the period from 1960 to 2020, indicating heightened climate variability and its potential impact on agricultural productivity.

Migration Data: Higher migration rates are observed in response to the increased frequency of climate events, particularly among lower-income rural households seeking better economic opportunities in urban areas.

## 3.2. Descriptive Statistics

### 3.2.1. GDP and Employment Shares by Sector

Agriculture GDP to Employment: Agriculture's contribution to GDP fell sharply from 40.2% in 1986 to 18.2% in 2009. Similarly, during the same time period, the share of employment in agriculture fell from 70.2% to 45.1%. This suggests a significant structural change away from agriculture and toward other industries.

Manufacturing and Service GDP and Employment: The manufacturing sector saw an increase in employment from 10.4% to 22.5%, while its contribution to the GDP increased from 20.5% in 1986 to 37.1% in 2009. The services sector maintained a relatively stable GDP share of around 29-30%, but its employment share grew from 14.3% to 25.1%, also reflecting an expansion in the services sector.

### 3.2.2. Income

Urban vs. Rural Income: Historically, urban incomes have been higher than rural incomes, with urban per capita income increasing from 100,000 VND in 1980 to 500,000 VND in 2020. In contrast, rural

income rose from 50,000 VND to 250,000 VND. This widening income gap shows growing economic opportunities such as industrial and service industries and shift in labor force from rural to urban area.

### 3.2.3. Climate Events

Frequency of Floods and Storms: Over the same time period, storm frequency climbed from 3 to 11 events, while flood frequency grew from 5 events in 1960 to 15 events in 2020. An increase in extreme weather occurrences suggests that there may be damage to crop production as well as increased climate variability.

### 3.2.4. Migration Data

Rural to Urban Migration: Migration rates have been positively correlated with the frequency of climate events. Data shows that rural migration increased from 10% in 1986 to 22% in 2009, indicating that climate shocks are a significant driver of migration. Urban migration rates also rose, suggesting that urban areas are absorbing a substantial number of climate-induced migrants.

## 4. Conclusion

This research examines data from 1980 to 2020 of the migration and structural change in Vietnam and how are impacted by climate shocks. This study provides insight into the connections between extreme weather events, agricultural output, migration trends, and economic indicators. These connections help to understand how climatic variability shapes socioeconomic dynamics.

## References

[1] Hirota, Y. (2002). YokoReconsidering of the Lewis Model: Growth in a Dual Economy (pp. 49–55). https://ousar.lib.okayama-u.ac.jp/files/public/4/40595/20160528032033626041/oer_034_1_049_055.pdf

[2] Sen, K. (2019). Structural Transformation around the World: Patterns and Drivers. Asian Development Review, 36(2), 1–31. https://doi.org/10.1162/adev_a_00130

[3] Barrett, C. B., Ortiz-Bobea, A., & Pham, T. (2023). Structural Transformation, Agriculture, Climate, and the Environment. Review of Environmental Economics and Policy, 17(2), 195–216. https://doi.org/10.1086/725319

[4] Koubi, V., Stoll, S., & Spilker, G. (2016). Perceptions of environmental change and migration decisions. Climatic Change, 138(3-4), 439–451. https://doi.org/10.1007/s10584-016-1767-1

[5] McCaig, B., & Pavcnik, N. (2013, November 7). Moving out of Agriculture: Structural Change in Vietnam. Www.nber.org. https://www.nber.org/papers/w19616