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The Current Situation of Climate Change in Vietnam

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Abstract
This study employed a combination of methods to provide an initial assessment of climate change (CC) status and to project future climate change trends in Vietnam. The results indicate that Vietnam is experiencing significant impacts of climate change, characterized by rising temperatures, irregular rainfall, stronger storms, and rapidly increasing sea levels. Over the past 60 years, the average temperature has increased by nearly 0.9°C, winters have become warmer, and heatwaves have become more intense. Extreme rainfall, drought, saltwater intrusion, and flooding are becoming increasingly severe, particularly in the Mekong Delta. Projections toward the end of the 21st century suggest that average temperatures could rise by 2–4°C, while sea levels may rise by up to 70 cm, posing serious threats to Vietnam's socio-economic development and environmental security. Therefore, proactive adaptation, greenhouse gas (GHG) emission reduction, and integration of climate change scenarios into development planning are essential to ensure sustainable development in the context of increasing global climate variability.

Keywords: Climate Change, Sea Level Rise, Impacts, Temperature, Vietnam

1. Introduction

Vietnam's economy is heavily dependent on agricultural production and is among the five countries most severely affected by climate change (CC) [1]. The impacts of CC extend across multiple sectors — including natural resources, energy, food security, livelihoods, poverty, and development policies — posing significant challenges to national sustainability [2, 3]. Among all sectors, agriculture is the most vulnerable due to its direct exposure to extreme climate events such as landslides, flash floods, droughts, storms, heavy rainfall, cold spells, and frost, along with irregular weather patterns, pest outbreaks, sea-level rise, and saltwater intrusion [4]. Mountainous provinces and coastal regions are the most affected areas, where CC not only threatens livelihoods and food security but also exerts broad impacts on local socio-economic development and environmental stability. According to the Global Climate Risk Index by Germanwatch, Vietnam ranks 6th among the world's top ten countries most vulnerable to climate risks [5]. The impacts of CC in Vietnam are evident across multiple dimensions. A 1-meter rise in sea level could result in the loss of approximately 5% of national land area—mostly agricultural land—reduce agricultural output by 7%, affect 11% of the population, and cause an estimated 10% GDP decline [6]. CC also leads to increased average temperatures, erratic rainfall, rising sea levels, and higher frequency and intensity of natural disasters such as droughts, heatwaves, floods, and tropical storms [7]. Furthermore, secondary and synergistic impacts may occur as CC interacts with socio-economic and political factors, exacerbating overall consequences.

Over the past six decades (1958–2018), Vietnam's climate has exhibited complex changes. Both average temperature and precipitation have increased, with more frequent extreme heat days nationwide. Although cold days have decreased, severe cold spells and rare snow or frost events have been recorded in northern mountainous provinces (notably in 2008, 2015, and 2016) [8]. Heavy rainfall events have become more frequent and intense, with increasingly unpredictable patterns. These changes have altered cultivation conditions and cropping calendars, increased the incidence of pests and diseases, and created additional challenges, causing severe losses to agriculture and threatening the long-term sustainability of the production system.

Therefore, this study aims to provide an initial assessment of the current state of CC in Vietnam and to forecast its future trends. The findings serve as a crucial foundation for evaluating the impacts of CC on agricultural production, food security, and other sectors. Moreover, they provide scientific evidence to support the development of adaptive strategies and mitigation measures, contributing to sustainable agricultural development and food security in Vietnam.

2. Research methods

To conduct this study, the author applied a combination of research methods, including secondary research, comparative analysis, and data analysis and synthesis.

2.1. Data collection and synthesis method

Objective: To collect existing data, statistics, and documents from reliable sources.

Implementation:

- Collected meteorological and statistical reports from the Ministry of Natural Resources and Environment (MONRE), the General Department of Meteorology and Hydrology, IPCC, UNDP, World Bank (WB), and FAO, among others.
- Compiled data on temperature, rainfall, storms, sea level rise, and socio-economic damages.
- Reviewed relevant research studies, scientific articles, and national reports on climate change.

2.2. Comparative method

Objective: To assess differences in climate change patterns across regions or time periods.

Implementation:

- Compared climate change indicators among regions (North–Central–South) or between different time periods (e.g., before 1980 vs. after 2000).
- Compared Vietnam's data with that of Southeast Asia or global averages to determine the relative severity of climate change impacts.

2.3. Data analysis and processing method

Objective: To evaluate the trends and magnitude of climate change over time.

Implementation:

- Utilized meteorological datasets on temperature, precipitation, storms, and sea level rise from the past 30–60 years.
- Employed statistical software such as Excel, SPSS, R, or Python to calculate trends, averages, standard deviations, and correlations.

3. Results and discussion

3.1. Climate change trends in Vietnam

a) Changes in Temperature and Precipitation

Observational data from 1958–2018 show significant fluctuations in temperature and rainfall across Vietnam.

Temperature:

The national annual average temperature increased by approximately 0.89°C during 1958–2018. Particularly, in 1986–2018, the rise reached 0.74°C, indicating an accelerating warming trend. Notably, the maximum temperatures and the number of hot days increased in most regions, with several record-high temperatures observed in recent years.

Precipitation:

The national average rainfall increased by around 2.1% between 1958 and 2018; however, the trend varied by region. Southern climatic zones experienced increasing rainfall, while the North saw a decline. Extreme rainfall indices (Rx1day, Rx5day) decreased in the Red River Delta but rose sharply in the South-Central Coast and Central Highlands.

Extreme Weather Events:

Extreme climatic phenomena have become more frequent and complex. The number of hot days has increased across most regions, while cold spells and frost days have decreased in the North. Droughts have become more severe in the Red River Delta, but less so in Central and Southern Vietnam, especially the Central Highlands. Furthermore, the number of strong storms has tended to increase, with storm centers gradually shifting southward.

b) Sea level rise trends

Hydrological observations indicate a significant rise in sea levels along Vietnam's coastline:

At most stations, sea level increased by 2.7 mm/year during 1958–2018, with Cửa Ông recording the highest rate of 6.7 mm/year.

Between 1993–2018, the average rise was 3 mm/year.

Satellite data for the same period show the South China Sea (East Sea) rising by 4.1 mm/year, with the central basin increasing the fastest (6–7.2 mm/year). Along Vietnam's coast, the average rise was approximately 3.6 mm/year.

3.2. Projected climate change trends in Vietnam

According to the Vietnam Climate Change Scenarios Report (MONRE, 2022), major projected trends toward the end of the 21st century include:

a) Temperature Projections

Average annual temperature across the country will continue to rise:

- **Medium scenario (RCP 4.5):** +1.2–1.7°C by mid-century and +1.6–2.4°C by the end of the century.
- **High scenario (RCP 8.5):** +1.7–2.3°C by mid-century and +3.2–4.2°C by the end of the century.

The northern regions are expected to warm faster than the south.

Extreme temperatures will also increase notably:

- **Under RCP 4.5:** maximum temperature +1.7–2.6°C, minimum temperature +1.7–2.1°C.
- **Under RCP 8.5:** maximum temperature +3.2–4.7°C, minimum temperature +3.3–4.1°C.

b) Precipitation projections

Rainfall is projected to increase in most regions:

- **RCP 4.5:** +10–15% by mid-century and +15–20% by the end of the century.
- **RCP 8.5:** +10–15% by mid-century and +15–25% by the end of the century.

Extreme precipitation will increase significantly:

- Under RCP 4.5, the maximum 1-day rainfall may

increase by 20–30% by century's end (30–40% in the North).
- Under RCP 8.5, the increase could reach 25–40%, and 40–50% in the North.

c) Scenarios on extreme climate events
- **Storms and tropical depressions:** little change in number, but stronger intensity and a southward shift in storm tracks.
- **Summer monsoon:** onset time remains stable, but duration and intensity increase.
- **Cold spells:** decline in the Northern mountainous, Red River Delta, and North Central regions.
- **Heatwaves:** increase nationwide, especially in North Central, Red River Delta, and Southern regions.
- **Droughts:** intensify in North Central, Central Highlands, and parts of Northern and Southern deltas, but decrease in Northern and Central coastal areas.

d) Sea level rise projections
- **Medium scenario:** sea levels along Vietnam's coast will rise by 23 cm by 2050 and 53 cm by 2100.
- **High scenario:** 27 cm by 2050 and 73 cm by 2100.

If sea levels rise by 100 cm, projected inundation risks are:
- **Mekong Delta:** 47.3% of the area (Ca Mau: 79.6%; Kien Giang: 75.7%).
- **Red River Delta:** 13.2%; Quảng Ninh: 1.9%.
- **Central coastal provinces:** average 1.5% (highest in Thua Thien Hue: 5.5%).
- **Ho Chi Minh City:** 17.2%; Ba Ria – Vung Tau: 4.8%.

Thus, climate change in Vietnam is becoming increasingly complex and unpredictable, characterized by rising temperatures, increasing rainfall, rising sea levels, and more frequent extreme weather events. These changes profoundly affect every aspect of Vietnamese life, production, and mental well-being. Therefore, Vietnam must develop and implement flexible adaptation strategies to minimize risks and enhance resilience across economic sectors in the face of escalating climate impacts.

4. Conclusion

Vietnam is experiencing increasingly severe impacts of climate change, reflected in rising temperatures, erratic rainfall, more extreme weather, and rapid sea-level rise. Over the past 60 years (1958–2018), the national mean temperature has increased by 0.89°C, including 0.74°C during 1986–2018. The number of hot days and maximum temperatures have surged, especially in the Central and Northern regions, while cold days have sharply declined—indicating warmer, shorter winters.

Average annual rainfall increased by 2.1%, though unevenly distributed: increasing in the South-Central Coast, Central Highlands, and Southern regions, but decreasing in the North. Extreme rainfall has intensified in the Central and Highland regions, heightening the risk of flash floods, landslides, and inundation, while droughts have become more common in the North.

Strong storms are gradually shifting southward, with increasing frequency and intensity. Sea levels in Vietnam have risen by 2.7–3.6 mm/year, higher than the global average, with some sites (e.g., Cửa Ông) recording 6.7 mm/year. Satellite data indicate that the South China Sea is rising by 4–7 mm/year, threatening low-lying coastal and delta regions.

According to MONRE (2022), by the end of the 21st century, temperatures could rise by 1.6–4.2°C, rainfall by 15–25%, and sea level by 53–73 cm. A 1-meter rise could inundate nearly 50% of the Mekong Delta. Climate change is profoundly affecting Vietnam's economy, food security, water resources, and ecosystems. Therefore, proactive adaptation and greenhouse gas mitigation are urgent priorities to ensure sustainable development amid an increasingly volatile global climate.

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