*[Speaker video]*

# A Cross-Regional Analysis of Precipitation Extremes and Agricultural Vulnerability (1981-2021)


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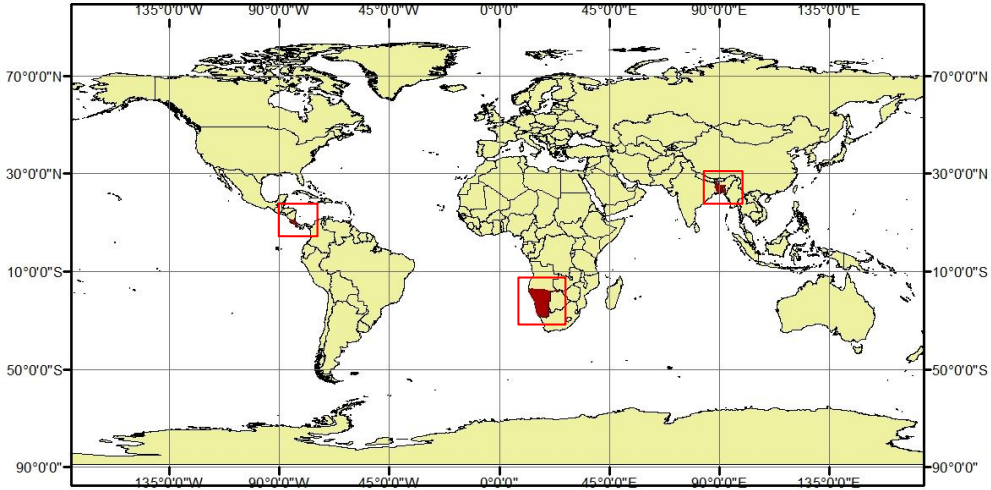
*[Captions]*

# Introduction

*[Speaker video]*




This study analyzes precipitation anomalies during wet and dry seasons across 1981-2021 to detect shifts in rainfall patterns.

We cross this data with cereal crop information from Namibia, Costa Rica, and Bangladesh to understand the impact on agriculture in different climates.

Represent diverse climates and agricultural systems.

Their unique challenges

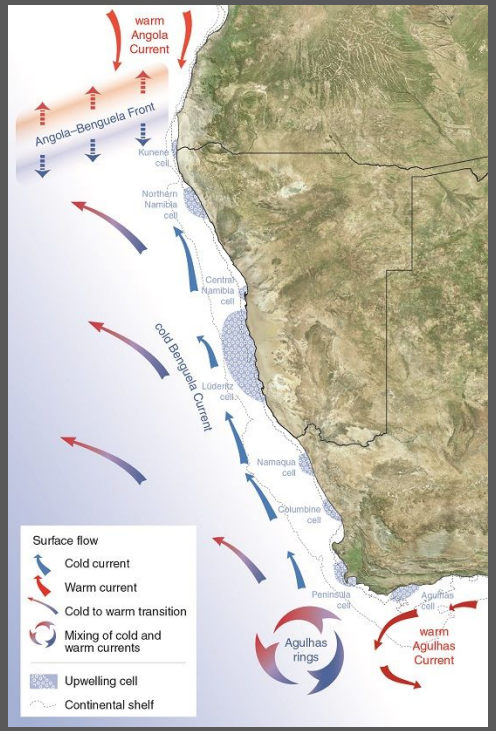

View of how precipitation anomalies impact crops



*[Captions]*

# Namibia


- **Arid Climate:** Dominated by the Namib and Kalahari Deserts.
- **Subtropical High-Pressure Belt:** Contributes to persistent dryness.
- **Lack of Mountains:** Allows dry air to flow unimpeded across the country.
- **ENSO:** El Niño conditions lead to below-average rainfall.
- **Benguela Current:** Cooling effect caused by upwelling reinforces dry conditions inland.
- **Temperature trends**: Average temperatures have increased by more than 1.2°C since 1960.




https://atlasofnamibia.online/chapter-3/why-is-namibia-so-dry

*[Speaker video]*

## Major cereal crops

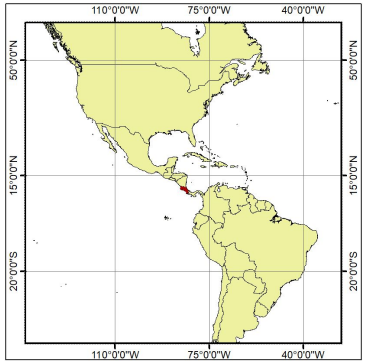
Mostly rainfed subsistence farming

- Millet
- Maize
- Wheat



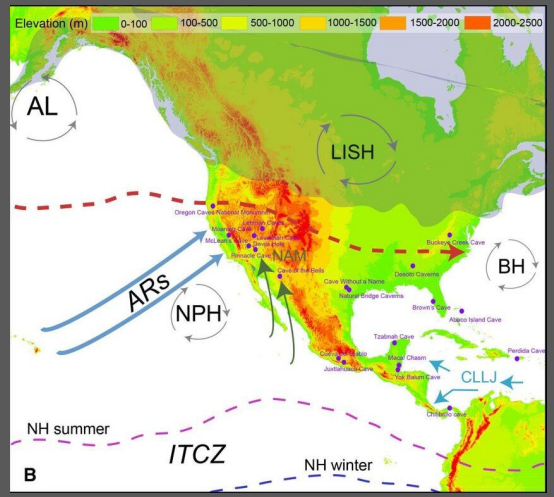
*[Captions]*

# Costa Rica




- **Ocean Temperature Fluctuations (PDO)**: Affect rainfall patterns.
- **ITCZ**: Annual north-south shift impacts regional rainfall variability.
- **ENSO**: El Niño causes drought on the Pacific coast.
- **Subtropical High-Pressure System**: Affects rainfall, especially on the Caribbean slope.
- **Trade Winds & Caribbean Low-Level Jet**: Influence precipitation on the Caribbean side.
- **Volcanic Mountains**: Alter atmospheric circulation and precipitation patterns.
- **Rain Shadow Effect**: Pacific slope experiences dry seasons, while the Caribbean side gets year-round rain.

*[Speaker video]*




https://www.researchgate.net/publication/330292328_Speleothem_Paleoclimatology_for_the_Caribbean_Central_America_and_North_America?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6Il9kaXJlY3QiLCJwYWdlIjoiX2RpcmVjdCJ9fQ

## Major cereal crops

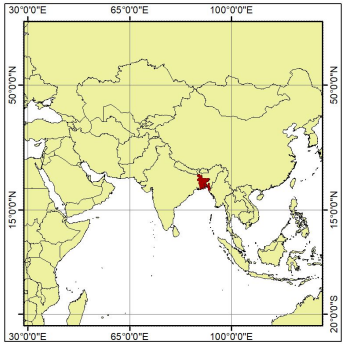
Mostly rainfed subsistence farming, cereals are not the main crops produced by Costa Rica

- Rice
- Maize

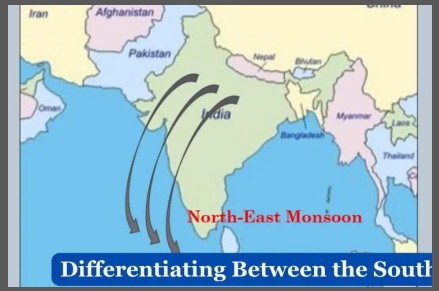


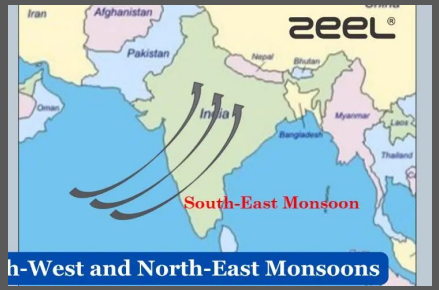
*[Captions]*

# Bangladesh




- **Monsoon Circulations:** The Southwest monsoon brings warm, moist air from the Indian Ocean, driving heavy rainfall during the rainy season (June-October).
- **Tropical Cyclones:** These storms, particularly in the pre- and post-monsoon seasons, bring intense rainfall, high winds, and storm surges, fueled by warmer Bay of Bengal waters.
- **Deltaic Geography:** Bangladesh's low elevation and deltaic landscape make it prone to flooding and salinization, which is worsening with climate change.
- **Temperature and Humidity Changes:** Rising temperatures and changing humidity levels are affecting precipitation and crop-growing seasons.




*[Speaker video]*

## Major cereal crops

Mostly rainfed with adaptations made for Monsoon season.

- Rice
- Wheat
- Maize



*[Captions]*

# Methodology:

[Speaker video]

- **Data Sources**:
  - **Precipitation**: CHIRPS daily data.
  - **Vegetation Index**: AVHRR NDVI via NOAA AWS (monthly, filtered for high quality.
  - **Cereal Yield**: FAO production and land data (yield = production / area)

**Processing Steps**:

1. **Anomaly Detection:**
- *Dry spells*: ≥30 consecutive days with <0.1 mm/day
- *Wet bursts*: ≥50 mm over any 3-day window
- Annual counts extracted per country

2. **Vegetation Filtering**
- Monthly NDVI from the 1st of each month
- Cloud-free data selected using QA flags
- Regional means computed for each country

1. **Yield Calculation:**
- Annual cereal yield (t/ha) computed
- Cleaned and aligned with precipitation and NDVI timelines

2. **Visualization**
- Line plots with **regression trend lines** to show long-term changes

3. **Analysis**
- **Correlation matrices** computed to explore relationships between yield, precipitation anomalies, and NDVI

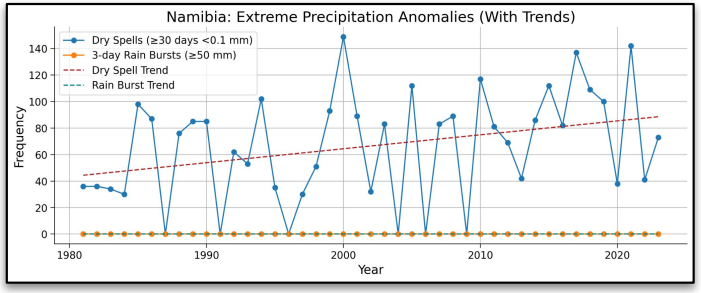


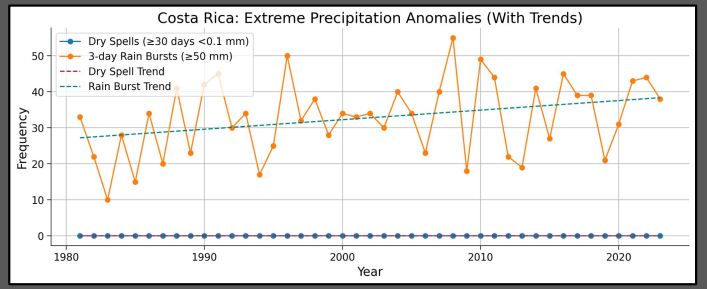
[Captions]

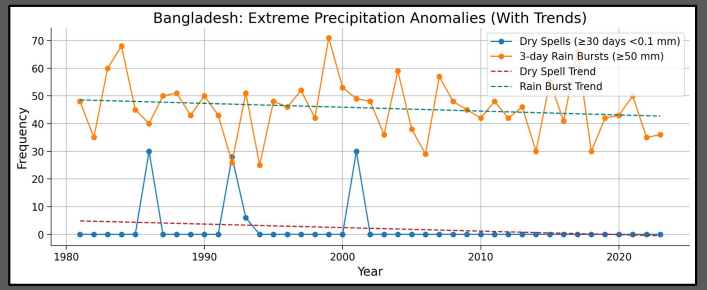
# Results - Precipitation

*[Speaker video]*

- Dry Spell:
  - (≥ 30 days < 0.1 mm)
- Rain Spell:
  - (≥ 50 mm)



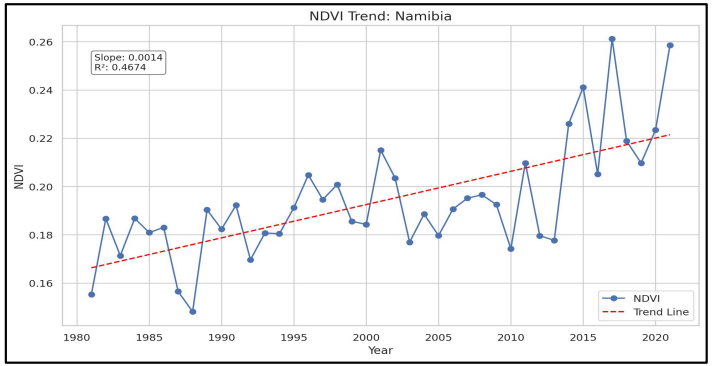



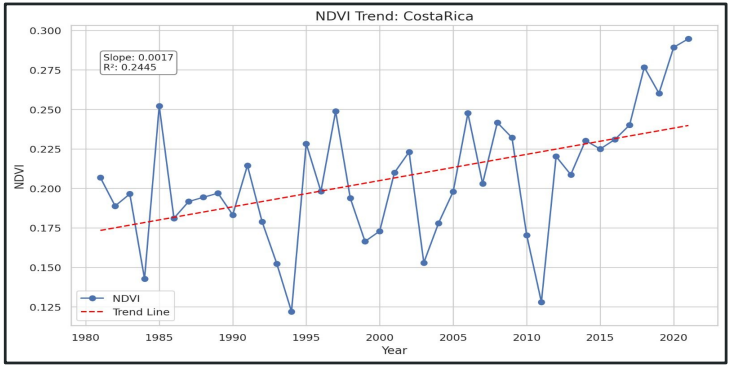


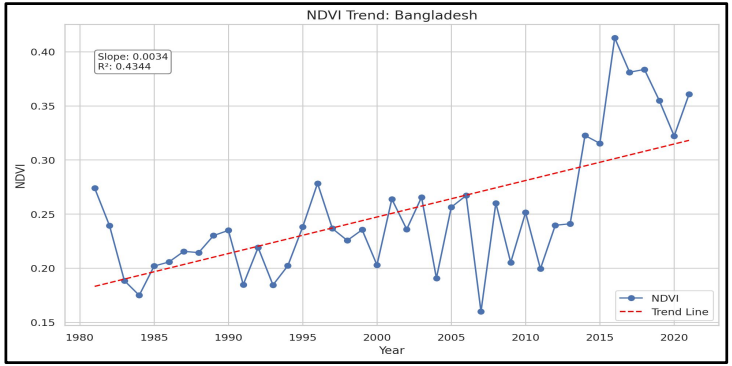

*[Captions]*

# Results - Vegetation

*[Speaker video]*



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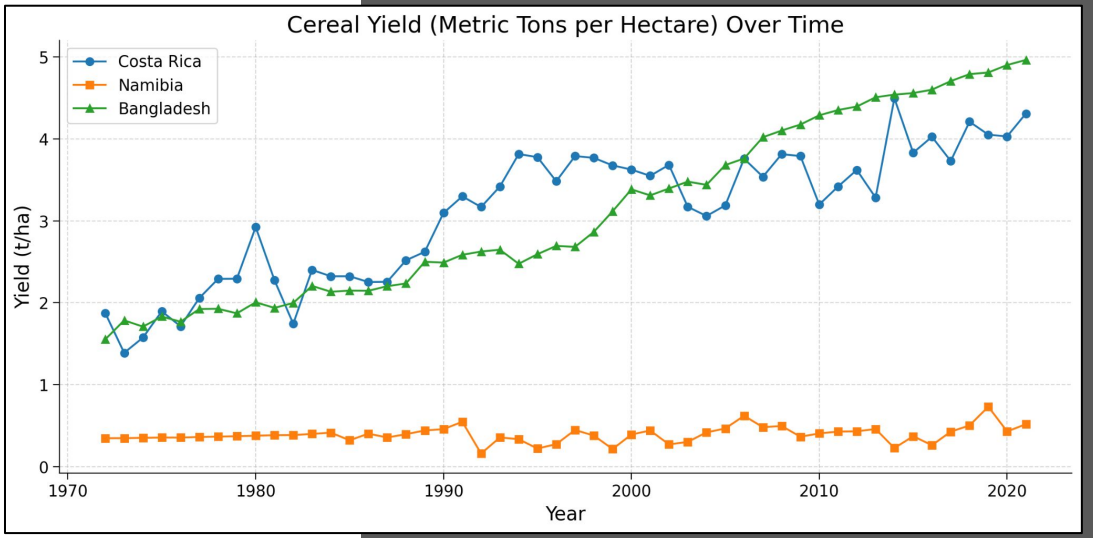
# Results - Crop Yield

*[Speaker video]*

- Crops = Cereals
- Yield = Production / area



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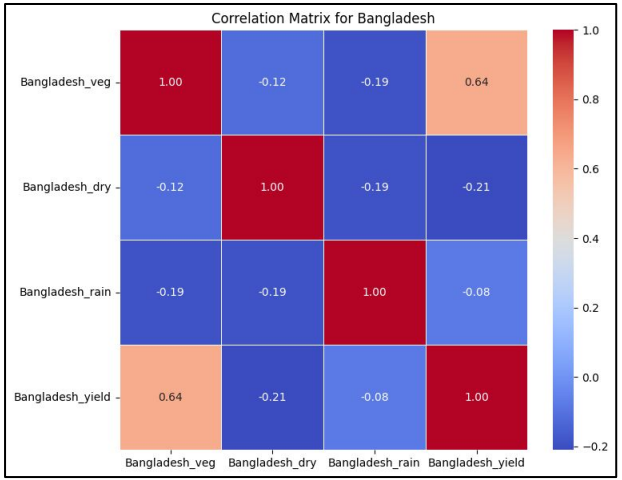
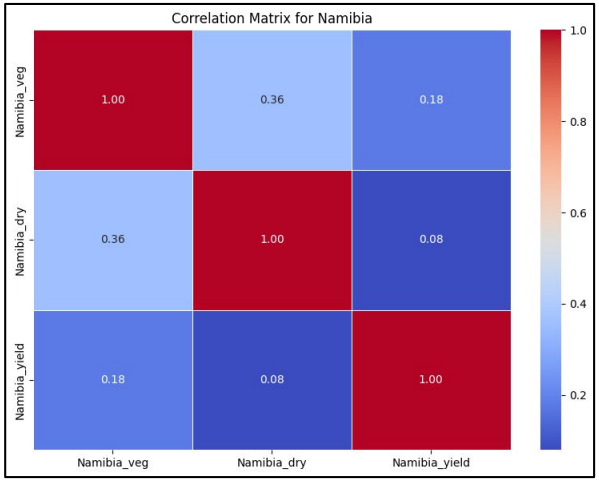
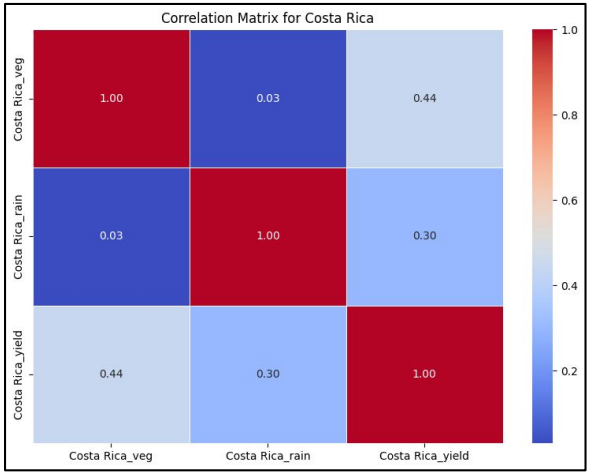
# Results

*[Speaker video]*






*[Captions]*

# Conclusions and Future Research

*[Speaker video]*

**Bangladesh-**
Negative correlation correlation between dry spell and yield
No correlation between rain burst and yield
Positive correlation between vegetation index and yield
Weak negative correlation between vegetation index and dry spell and rain burst

**Namibia-**
No significant relationship between dry spell and yield

**Costa Rica-**
Positive correlation between yield & rain burst and vegetation index.



*[Captions]*

# Future Research

- Looking into micro data sets to find the effect of anomaly for different crop group in different regions.
- Deep dive into more variables affecting the crop yield, could be used to help us predict future crop yield in different regions.

*[Speaker video]*



*[Captions]*

# References

*[Speaker video]*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*[Captions]*