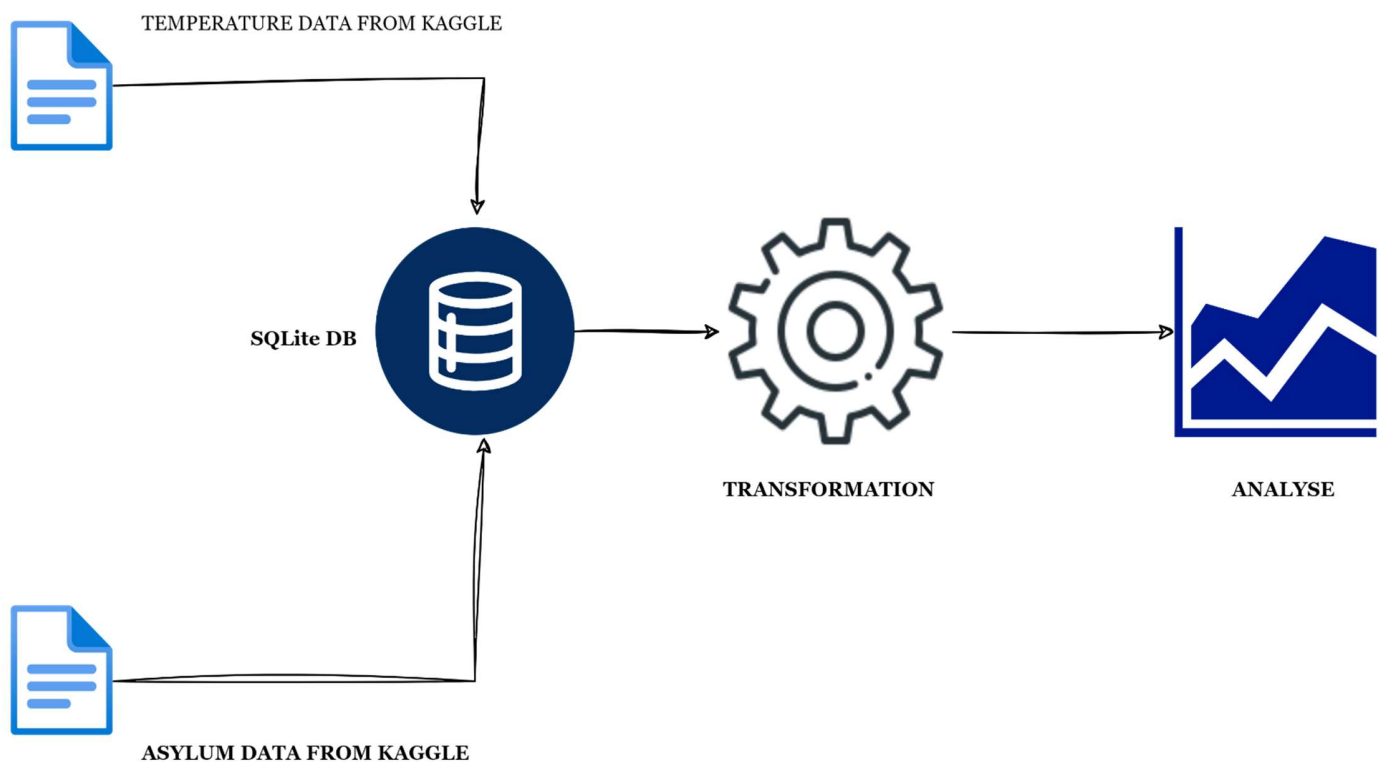


# Relation Between Climate Change and Immigration

## 1 - Introduction:

The relationship between climate change and immigration is an increasingly urgent topic of concern for both individuals and governments worldwide. This project aims to explore how climate change impacts migration patterns, with a particular focus on countries deemed most vulnerable to climate change according to the United Nations World Food Program<sup>1</sup>. The selected countries for this analysis are Madagascar, Pakistan, Somalia, Sudan, Chad, Burkina Faso, Niger, Mali, El Salvador, Honduras, and Guatemala. Although South Sudan is listed among the most vulnerable countries, it was excluded from this study due to the lack of available data. Consequently, this project focuses on examining the data from these 11 countries to understand the interplay between climatic factors and migration trends.

## 2 – Data



### 2.1 – Data Structure

After completing the ETL process, we have two primary SQL tables utilized for the analysis: one containing asylum application data and the other containing temperature data. The structure is shown below.

#### Asylum Applications Table:

- **Country of origin:** The country from which the asylum seekers originate.
- **Year:** The year the asylum applications were recorded.
- **Applied:** The number of asylum applications.

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<sup>1</sup> <https://www.wfpusa.org/articles/countries-most-affected-by-climate-change/>

## Temperature Table:

- **Country:** The country for which the temperature data is recorded.
- **Year:** The year the temperature data was recorded.
- **AverageTemperature:** The daily average temperature recorded for that year.
- **dt:** The day temperature data was recorded.

In the analysis, we will ignore the 'dt' column in the temperature dataset. Since 'dt' is a datetime object, performing sum operations on it would result in errors. Instead, we will utilize the 'Year' column, as the project focuses on annual trends and relationships between climate change and immigration.

## 2.2 – Data Licences

The data used in this analysis complies with the respective data licenses of the sources. The asylum application data, which details the number of asylum applications submitted to various countries, is licensed under CC0: Public Domain, allowing unrestricted use of the data. The temperature data, sourced from the "Global Land Temperature by Country" file, is licensed under CC BY-NC-SA 4.0, which permits its use in this project provided attribution is given, and the use is non-commercial and shared alike.

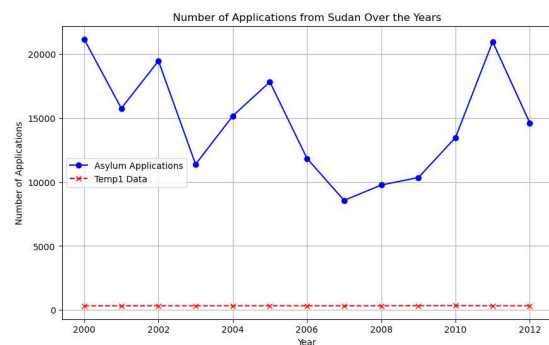
By structuring the data in this manner, we ensure a comprehensive analysis of annual movements and relationships, aligning with the project's objectives.

## 3 – Analysis

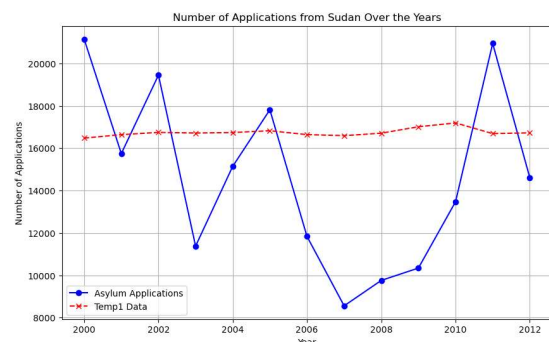
In this analysis, we aim to explore the relationship between climate change and immigration by examining the asylum application data and temperature records of the most climate-vulnerable countries. The process involved several steps to ensure the results were interpretable and meaningful.

### 3.1 – Graphical Visualization

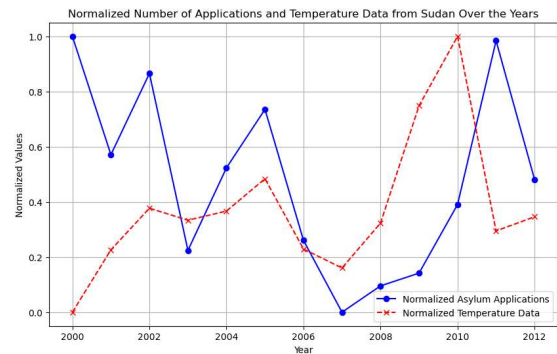
Initially, a histogram was plotted to visualize the amount of asylum applications alongside the temperature data. However, the initial results indicated a significant disparity between the scales of temperature and asylum applications, making it difficult to interpret the graph effectively.



To address this issue, the temperature values were multiplied by 50 to bring the temperature line closer to the scale of asylum applications. While this adjustment centered the temperature line within the graph, it still did not provide a clear and interpretable visualization.



To achieve a more meaningful comparison, we normalized both the asylum application and temperature values. Normalization scales the data to a common range, eliminating the disparity between the scales and allowing for a clearer visualization of trends and patterns.

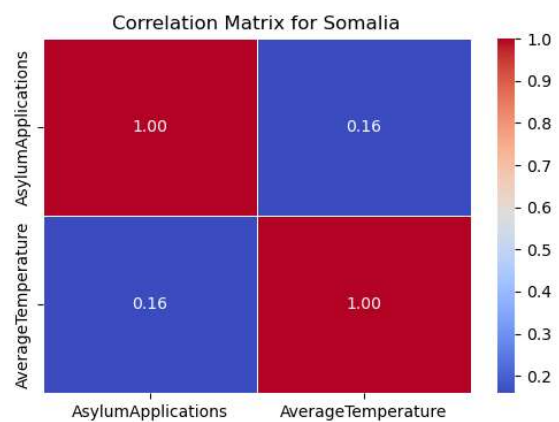


## 3.2 – Correlation Matrix

Following the graphical visualization, a correlation matrix was created to quantify the relationship between temperature and asylum applications. The correlation matrix provides a statistical measure of how closely related these two variables are across different

By normalizing the data and analyzing the correlation matrices, we were able to effectively illustrate and quantify the relationship between climate change and immigration. This comprehensive approach provided valuable insights into how environmental factors may drive migration patterns, aligning with the project's

objectives.countries.



## 4 – Results and Conclusion

### 4.1 – Results

The objective of this project was to examine the relationship between climate change and immigration, specifically focusing on the most climate-vulnerable countries. By analyzing the asylum application data and temperature records, we aimed to identify any significant correlations that might indicate a link between these two variables. The correlation coefficients for the selected countries are as follows:

- Madagascar: 0.08
- Pakistan: -0.42
- Somalia: 0.16
- Sudan: -0.23
- Chad: 0.01
- Burkina Faso: -0.42
- Niger: -0.24
- Mali: -0.30
- El Salvador: -0.54
- Honduras: -0.08
- Guatemala: 0.01

These results indicate a range of correlations between temperature changes and asylum applications, with some countries showing a slight positive correlation and others showing a negative correlation.

## 4.2 - Interpretation

The positive correlation observed in countries such as Somalia (0.16) and Madagascar (0.08) suggests a potential link between rising temperatures and increased asylum applications. This could imply that as temperatures rise, these countries experience conditions that drive more people to seek asylum. Conversely, the negative correlations in countries such as El Salvador (-0.54), Pakistan (-0.42), and Burkina Faso (-0.42) suggest that other factors may be influencing asylum applications in these regions, potentially overshadowing the impact of temperature changes.

The varied correlation results highlight the complexity of the relationship between climate change and immigration. While some countries exhibit patterns that support the hypothesis that climate change drives migration, others show little to no correlation or even a negative correlation, indicating that additional factors must be considered.

## 4.3 - Conclusion

The analysis provides partial evidence supporting the hypothesis that climate change impacts immigration patterns. However, the relationship is not consistent across all countries, suggesting that climate change is one of many factors influencing migration. The following key points summarize the findings:

- Some countries, like Somalia and Madagascar, show a positive correlation between rising temperatures and asylum applications, indicating that climate change may be a driving factor in these regions.
- Other countries, such as El Salvador and Pakistan, exhibit a negative correlation, suggesting that other socio-economic, political, or environmental factors may play a more significant role in influencing asylum applications.
- The overall variability in the correlation results underscores the complexity of migration patterns and the multifaceted nature of climate change impacts.

## 5 - Limitations and Future Work

Several limitations must be acknowledged in this analysis:

1. **Data Quality and Availability:** The datasets used, while sourced from reputable organizations, may not capture all aspects of asylum applications and temperature variations. Missing data or inaccuracies can impact the results.
2. **Temporal Scope:** The analysis focuses on annual data, which may smooth out short-term variations and obscure more immediate responses to climate events.
3. **Multifactorial Influences:** Migration is influenced by a multitude of factors, including economic conditions, political stability, and social networks, which were not accounted for in this analysis.

To fully understand the relationship between climate change and immigration, future work could include:

- Incorporating additional variables such as economic indicators, conflict data, and social factors to provide a more comprehensive analysis.
- Extending the analysis to include more granular data, such as monthly or quarterly records, to capture more immediate responses to climate variations.
- Conducting case studies or qualitative analyses to complement the quantitative findings and provide deeper insights into the motivations behind asylum applications.

In conclusion, while the analysis offers valuable insights into the relationship between climate change and immigration, it also highlights the need for a more nuanced approach to fully understand the complexities involved. The findings serve as a foundation for further research, aiming to uncover the intricate interplay between environmental changes and human migration.