

Effect of Climate Change and Rainfall on Soil

The profound impact of climate change and altered rainfall patterns on the delicate balance of soil ecosystems. Uncover how these environmental shifts are transforming the very foundation of our terrestrial landscapes.





Problem Statement

Climate Change Impacts

Climate change is leading to more extreme weather patterns, such as droughts, floods, and temperature fluctuations, which can have significant impacts on soil health and productivity.

Soil Degradation

Changes in rainfall patterns and temperature can accelerate soil erosion, desertification, and loss of nutrients, posing a threat to agricultural systems and food security.

Adaptation Challenges

Understanding the complex interactions between climate change, rainfall, and soil dynamics is crucial for developing effective strategies to mitigate the negative impacts and adapt to these changes.

Objective

1 Understand the Impact

Assess how climate change and rainfall patterns are affecting soil quality, composition, and health.

2 Identify Mitigation Strategies

Explore potential methods to mitigate the negative effects of climate change on soil, such as improving soil management practices.

3 Inform Sustainable Practices

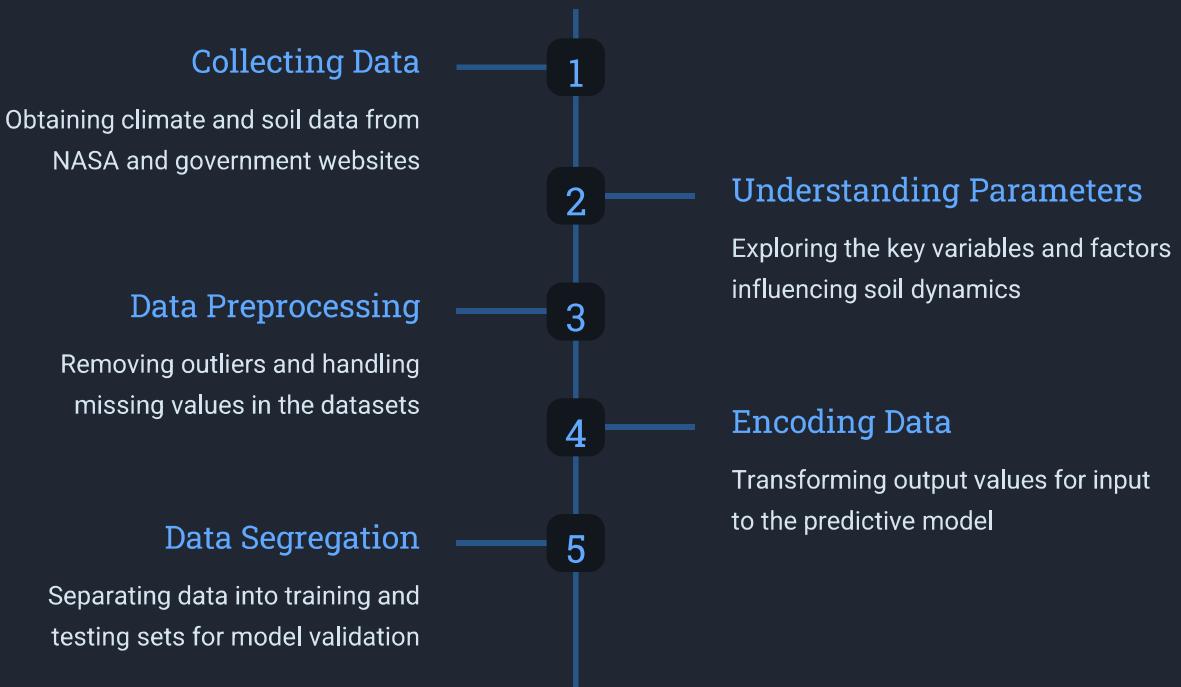
Provide data-driven insights to guide the development of more sustainable agricultural and land use policies.

4 Raise Awareness

Educate stakeholders, including policymakers and the general public, about the critical role of soil in addressing climate change challenges.



Data Preprocessing Flow



Literature Review

Author(s): S.L.K. Rosa et al.

Year: 2023

Title: NASA Power and surface weather stations on evapotranspiration estimation.

Summary: NASA Power's air temperature predictions are consistent across continental, polar, and semi-arid climates, but they deviate in tropical locations, particularly in wind speed and humidity estimates. Despite its limitations, it accurately calculates solar radiation and shows promise for estimating evapotranspiration, which is useful for water and soil engineering applications in agriculture.



Literature Review

Author(s): Osama A. Marzouk

Year: 2021

Title: "Investigation of Long-Term Warming Trends Using NASA POWER Data: A Case Study in Al Buraimi, Sultanate of Oman".

Summary: The study found a considerable long-term increase in 2-meter air temperature, averaging 0.039°C per year and totaling approximately 1.5°C over four decades. Standard deviation remains constant. Temperature changes are seen between specific years. When compared to meteorological station readings, the dependability of NASA POWER in determining air temperature is validated.



Literature Review

Author(s): Puteri Nur Atiqah Bandira et al.

Year: 2023

Title: Assessment of NASA POWER for Climate Change Analysis using the De Martonne Climate Index in Northern Peninsular Malaysia.

Summary: The study discovered significant agreement between NASA POWER and ground-based weather station data for rainfall and mean temperature in Northern Peninsular Malaysia (correlation coefficients of 0.78 and 0.87, respectively). The Dc index from NASA POWER agreed with ground data, confirming growing aridity in the region over 38 years, which is line with broader Southeast Asian patterns.



Methodology

1. Data Collection and Preprocessing

- Satellite imagery from NASA
- Data cleaning: handling missing values, normalization

2. Exploratory Data Analysis (EDA)

- Time-series plots for temperature, precipitation
- Correlation analysis between variables

3. Model Comparison

- Logistic Regression, Lasso Regression, SVR, Ridge Regression
- Evaluation metric: R-squared score
- LSTM outperformed other models ($R^2 = 0.82$)

4. Spatial Analysis

- Mapping climate data onto region-specific maps
- Identifying areas of highest aridity and changes over time



Results

1. Impact of Soil moister in Jodhpur.

We can see there is no significant change in rain pattern in last 12 years , but still a great difference can be seen in Soil moisture content, why?

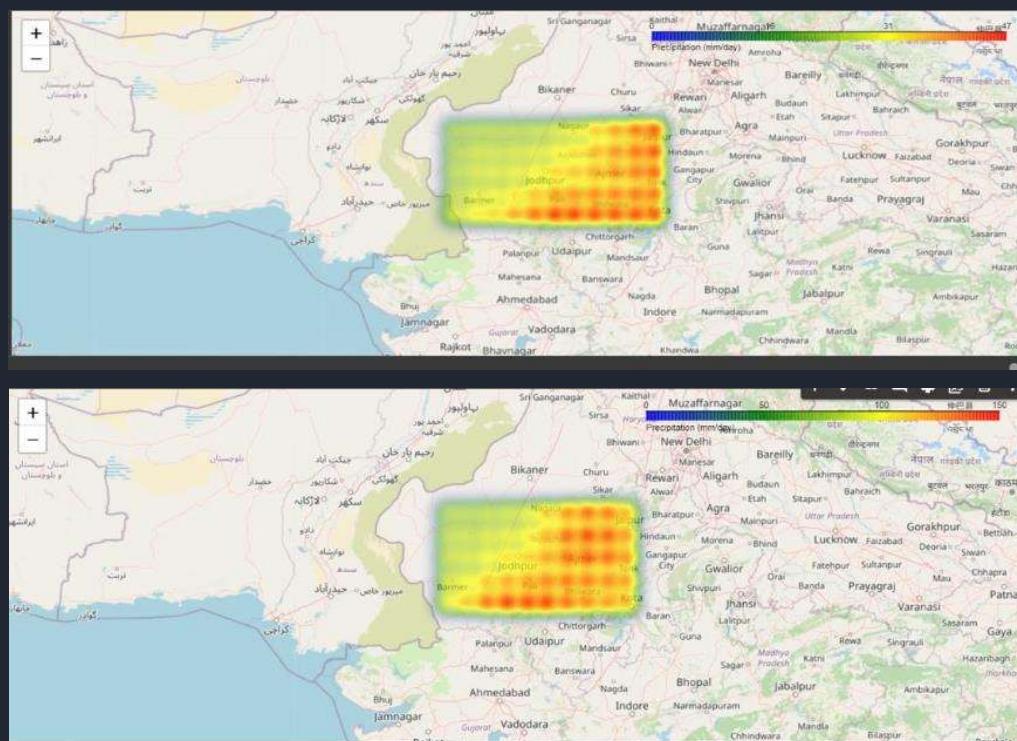


fig- Rain in Jodhpur top-2010 and bottom-2022

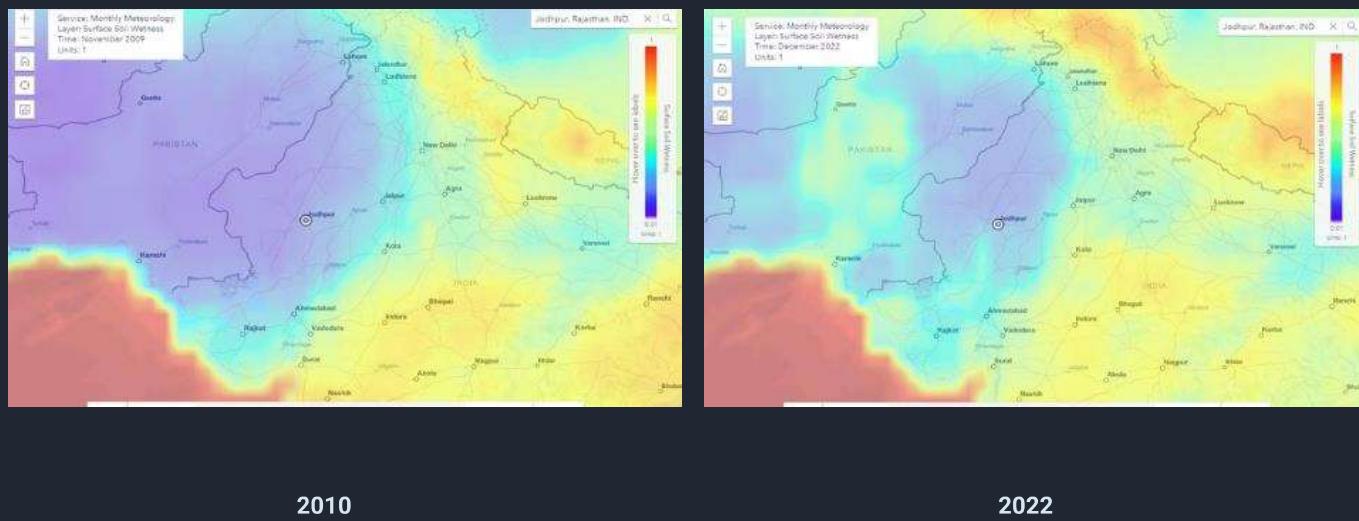


Fig- soil moisture content of Jodhpur

The reason is Indra canal which was constructed in 2015 near Jodhpur , which caused a significant impact on soil moisture content level.

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Results

2. Monsoon Pattern shift seen near Amritsar

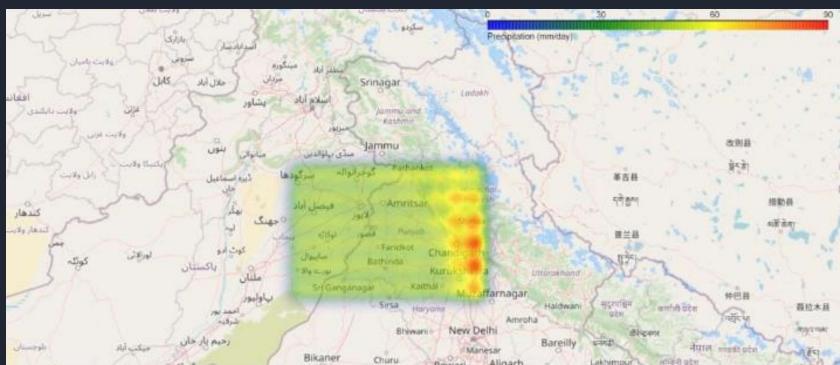


fig- Rain pattern of Punjab region 2010.

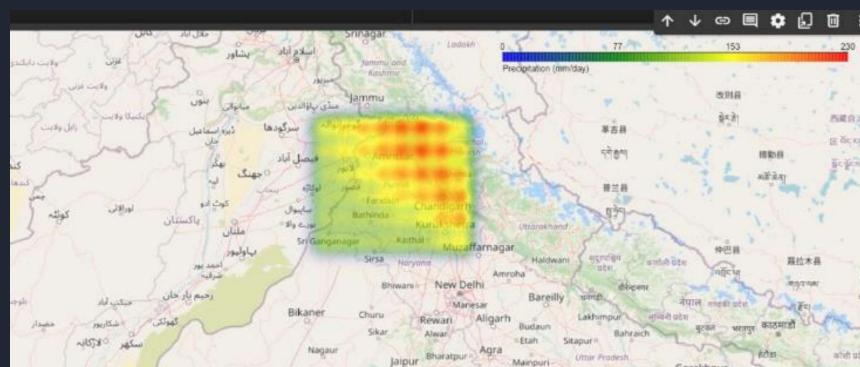


fig- Rain pattern of Punjab region 2022.

Results

We can see a monsoon shift in this region due to change in westerly winds which is responsible for these shifts .

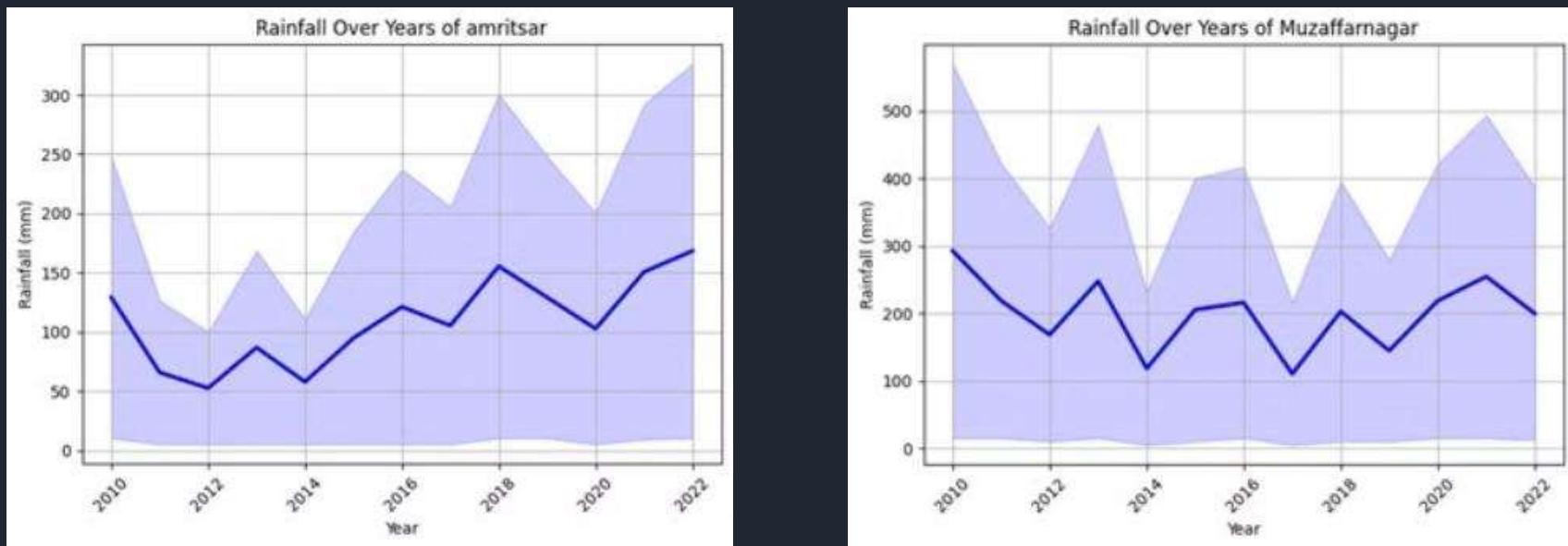
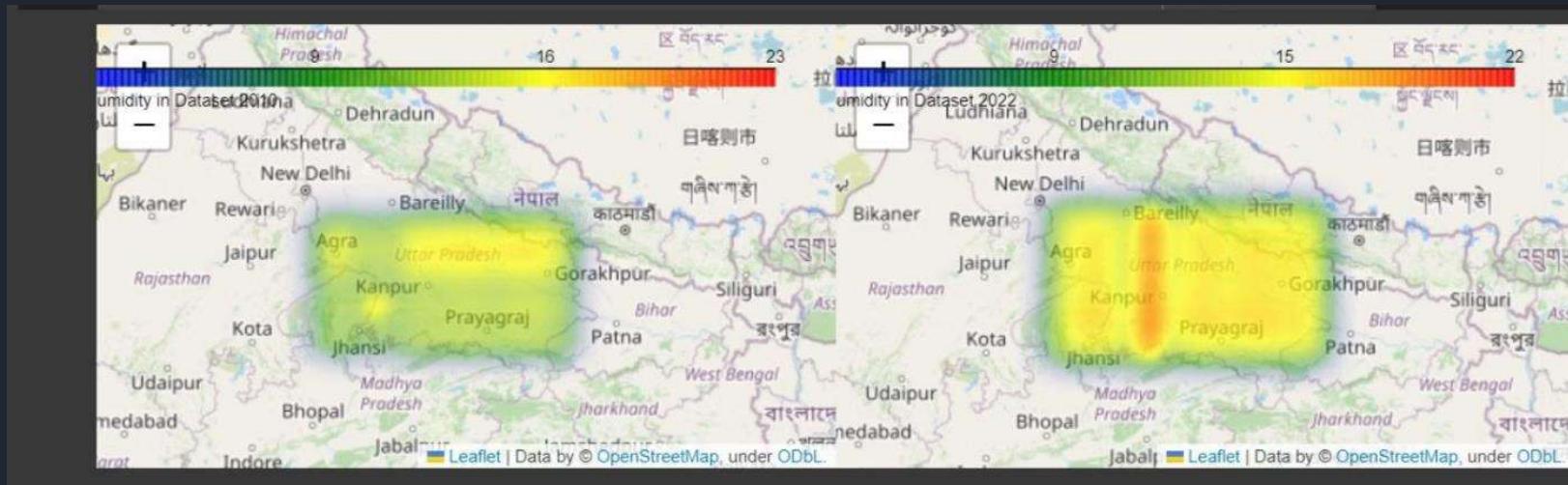


Fig. Time series plot of Amritsar and Muzaffarnagar

Results



In both the images We can clearly see there is increase in humidity in Uttar Pradesh region in 12-14 years.

Which has cause more uneven distribution of water bodies in the region as there will be less evaporation .

Results

Rain Prediction!

Average Surface Temperature: 12.25 Wind Speed: 1.93

Humidity: 2.01 Temperature of Wet Bulb: 3.49

Temperature of Dew and Frost Point: -8.17

Predict Rain

Soil Prediction!

Precipitation (mm) for Soil Quality Prediction: 0.00

Predict Soil Profile

Soil contains just the amount of water required.

Soil predictor portal is created which accurately determines the quality of soil for the Amritsar region .so that Farmers can know about the quality of soil and how they can improve it.

Future Innovations in Agriculture

1

Climate change portal

A climate change portal can be created which will deliver more such climate change news pictographically , which helps user to see clear difference.

2

Pollution and Ice Caps Visualization

Discover the hidden connections between pollution and melting ice caps. Through advanced data visualization techniques, we aim to showcase the impact of pollution in Delhi on the alarming rate of ice cap melting, unravelling the complex relationship between these two critical environmental factors.

3

Use of open Weather API

open Weather API can be integrated with soil predictor model which will seamlessly add values in the required columns making it accessible to everyone.

Conclusion

To create awareness, we can show people real-time changes using interactive choropleth maps. This helps them visualize the impact of climate change.

In addition, we can support farmers by providing detailed soil analysis. By understanding the soil composition, they can optimize their crop growth.

In the future, we plan to expand our models to cover more cities and diverse climatic conditions. This will enable us to provide tailored insights for different regions.

Furthermore, we are developing a data analysis portal specifically designed for in-depth exploration of city-specific and climate-specific data.