Studying the Effects of Deforestation and Afforestation on Carbon Sequestration

Introduction

In this project, a comprehensive analysis was undertaken to delve into the intricate relationship between deforestation, afforestation, and carbon sequestration in the Uttarakhand region of India. Through meticulous geospatial exploration, the study aimed to unravel the profound implications of altering forest landscapes on the potential for carbon storage. Utilizing cutting-edge geospatial technology, the investigation delved into the dynamics of land use changes, specifically focusing on deforestation and afforestation events. By using satellite imagery, the study elucidated the transformative journey of forests over time. The goal was to provide a comprehensive understanding of how these changes reverberate across the carbon sequestration spectrum, ultimately influencing ecological equilibrium.

Datasets

- Global Forest Change dataset named Hansen Global Forest Change v1.10 (2000-2022), which provides results from a time-series analysis of Landsat images in characterizing global forest extent and change from 2000 through 2022.
  https://developers.google.com/earth-engine/datasets/catalog/UMD_hansen_global_forest_change_2022_v1_10

- Shapefile of Study Area: Uttarakhand

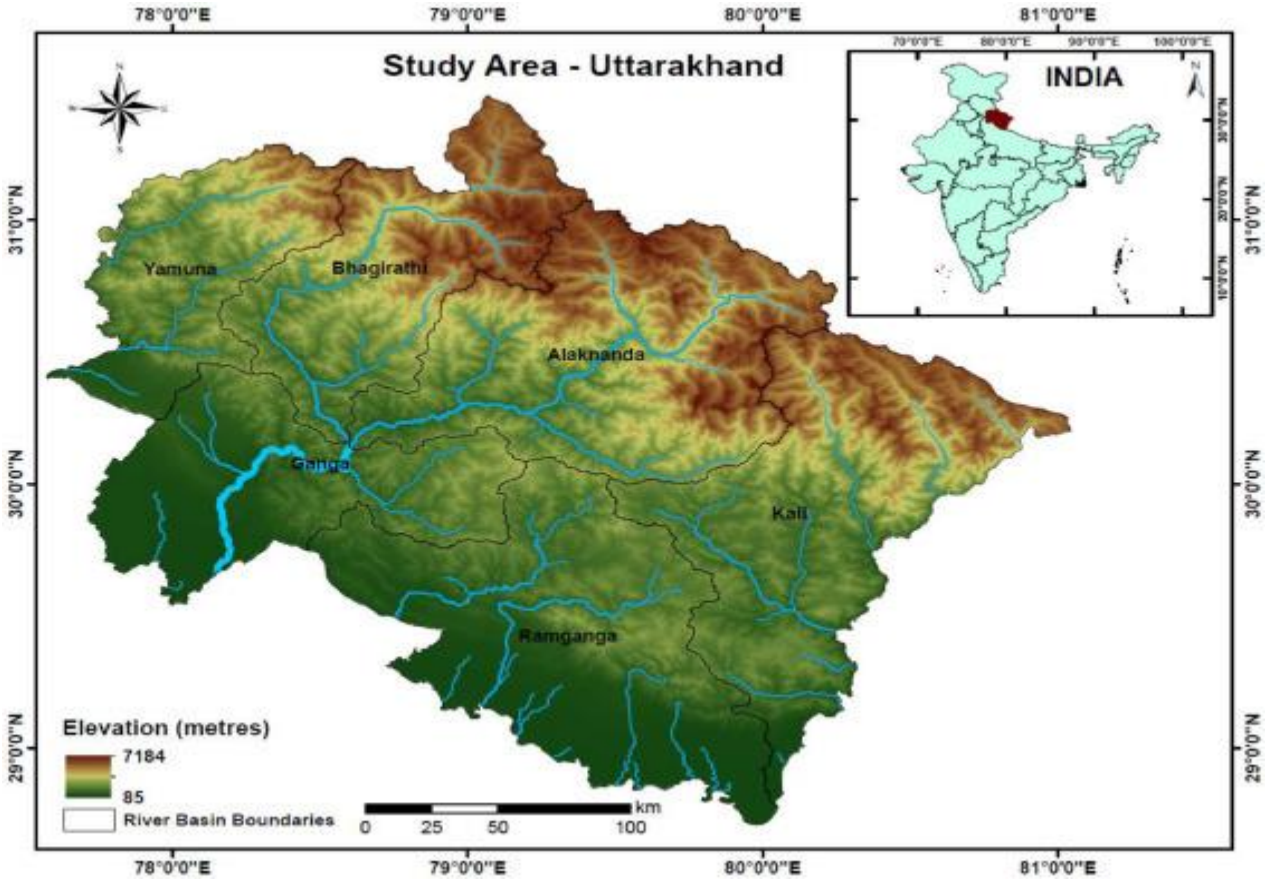
Methodology

The methodology employed in this study involves a comprehensive geospatial analysis to investigate the effects of deforestation and afforestation on carbon sequestration. Leveraging the Global Forest Change dataset, which is derived from a time-series analysis of Landsat images to identify areas experiencing forest loss and gain over the period from 2000 to 2022. By defining masks for deforestation and afforestation, quantified the extent of changes in forest cover. Additionally, carbon sequestration potential was assessed by attributing positive values to areas undergoing afforestation, symbolizing carbon storage, and negative values to regions witnessing deforestation, signifying carbon emissions. Using interactive geospatial technologies, visually depicted these changes on maps, where color-coded layers highlighted loss, gain, and neutral areas. The calculated metrics, including total carbon sequestration, Area of Afforestation and deforestation and afforestation and deforestation rates, provide a comprehensive understanding of the ecological implications of land use changes in the context of carbon balance. This

methodology offers valuable insights into the intricate relationship between forest dynamics and carbon sequestration, contributing to informed conservation and land management strategies.

Study Area

Uttarakhand, located in northern India, is characterized by its rich and diverse forest ecosystems. Encompassing the southern Himalayan range, the state boasts a vital network of forests that play a crucial role in supporting biodiversity, regulating water resources, and providing essential ecosystem services. The study area within Uttarakhand offers a unique opportunity to examine the effects of deforestation and afforestation on carbon sequestration, shedding light on the intricate balance between human activities and the preservation of its invaluable forested landscapes.



Study Area: Uttarakhand, India

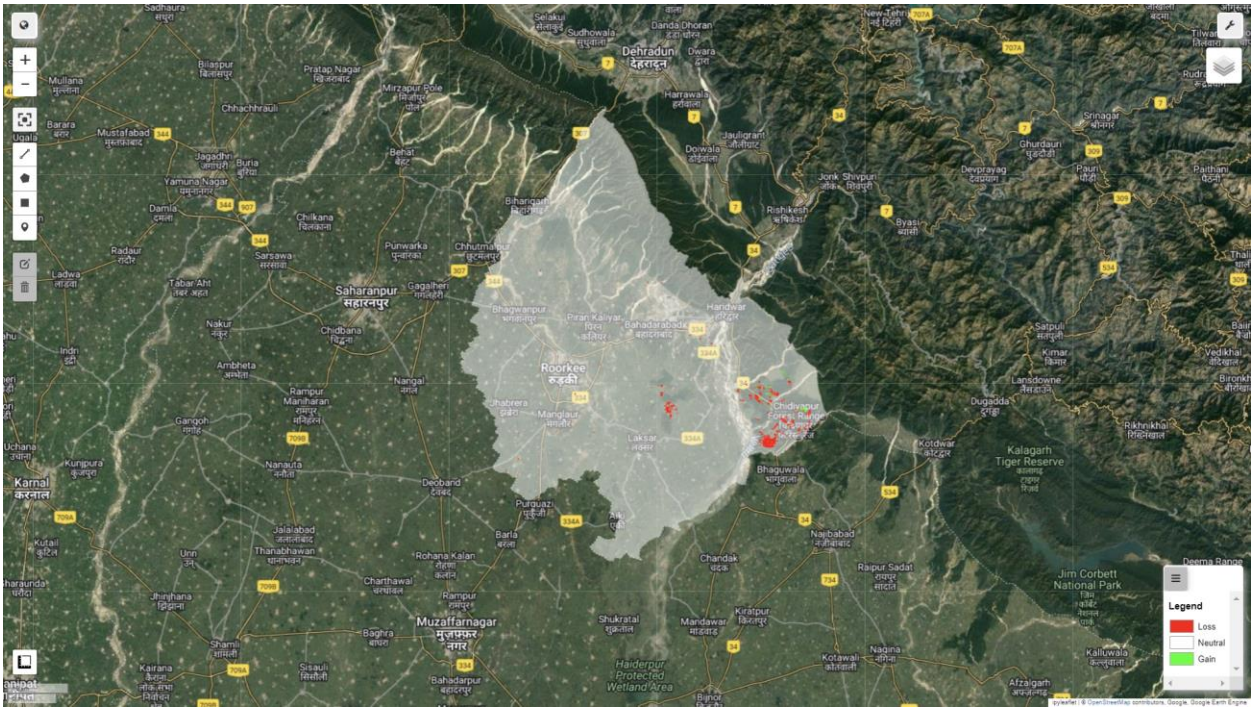
Analysis and Results

The net carbon sequestration represents the balance between carbon storage gained through afforestation and carbon emissions resulting from deforestation within the study area. This metric provides insights into the overall impact of land use changes on the carbon balance of the ecosystem.

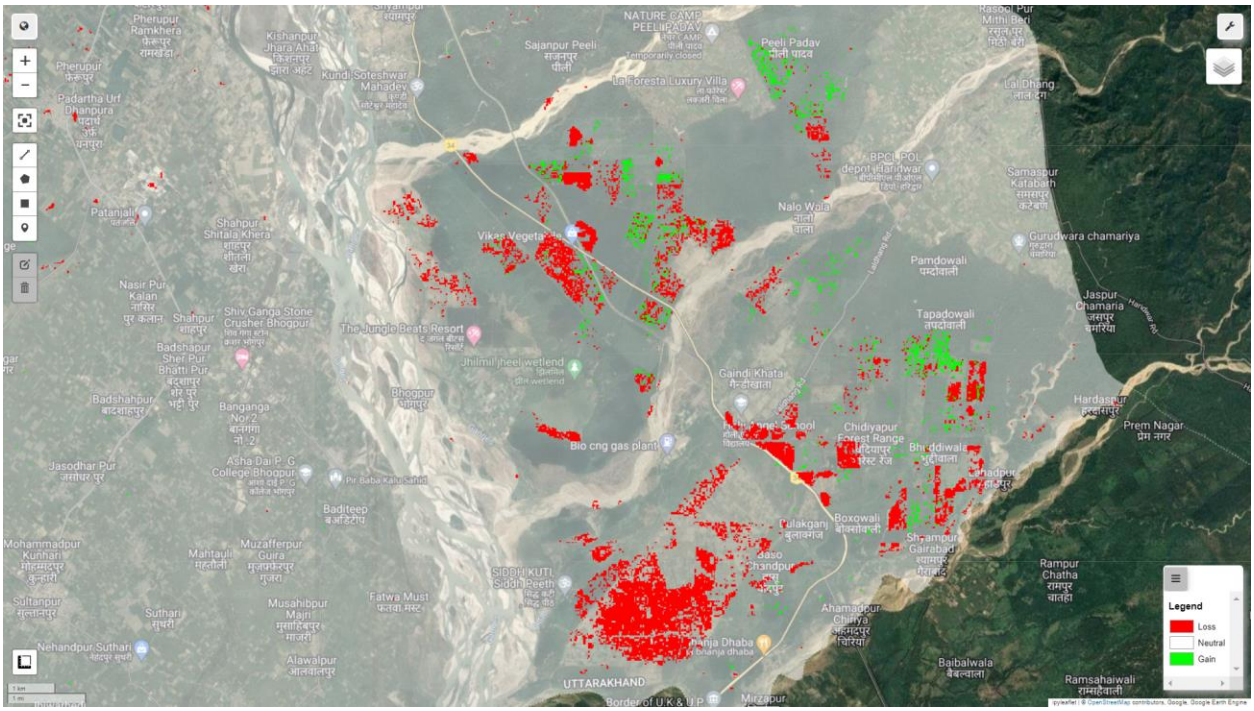
The calculation of net carbon sequestration involved two main components: afforestation and deforestation. Afforestation refers to the process of converting non-forested areas into forests, resulting in carbon sequestration. Deforestation, on the other hand, leads to carbon emissions as forested areas are cleared.

The net carbon sequestration map was derived by quantifying the carbon sequestration potential of afforestation and the carbon emissions resulting from deforestation. Positive values in the map indicate areas where carbon sequestration through afforestation exceeds carbon emissions from deforestation. Negative values denote areas where carbon emissions outweigh sequestration.

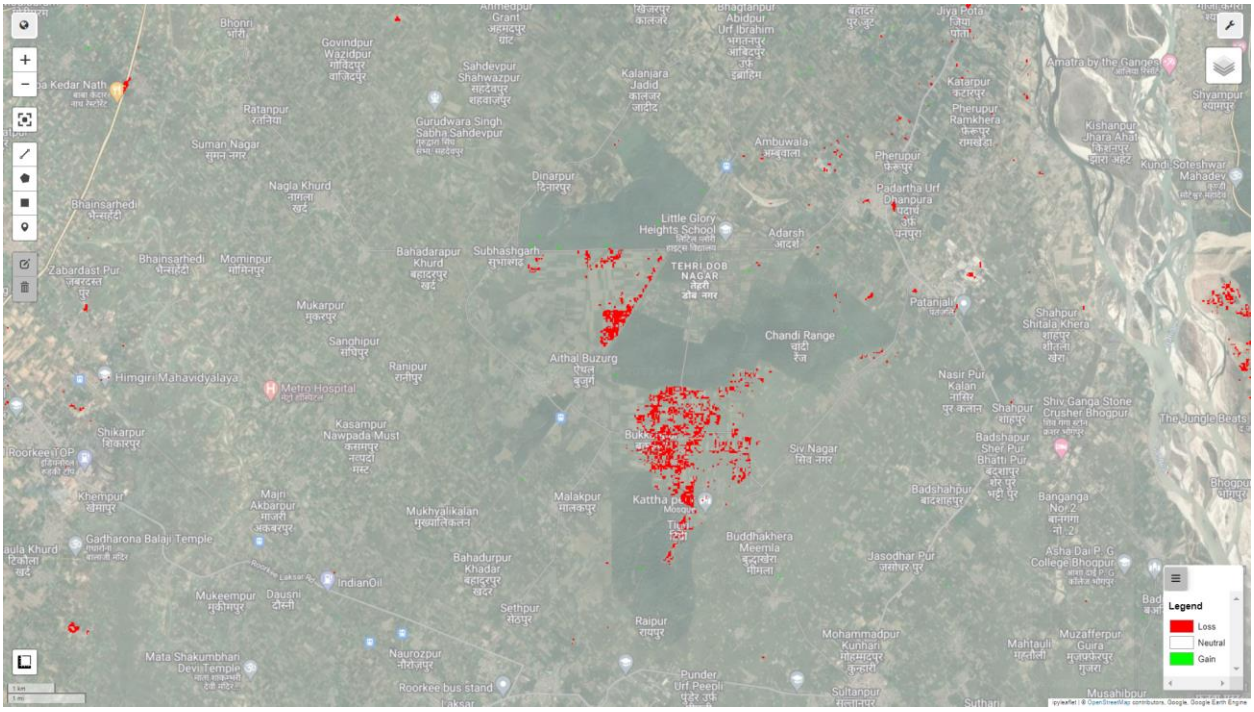
This analysis enables us to identify regions within the study area that contribute positively to carbon sequestration, contributing to climate change mitigation efforts, and areas where land use changes may have a negative impact on the carbon balance.



Net Carbon Sequestration Map



Net Carbon Sequestration Map: Zoom View



Net Carbon Sequestration Map: Zoom View

The analysis of the Uttarakhand region yielded the following results:

• **Total Carbon Sequestration**: The total carbon sequestration due to afforestation and deforestation was estimated to be 9355.76 metric tons.

• **Area of Afforestation**: The area undergoing afforestation was measured at 2691 square meters.

• **Area of Deforestation**: The area experiencing deforestation amounted to 16358.78 square meters.

• **Afforestation Rate**: The annual rate of afforestation was calculated to be 122.32 square meters per year.

• **Deforestation Rate**: The annual rate of deforestation was determined to be 743.58 square meters per year.

Conclusion

The results of this project provide valuable insights into the effects of deforestation and afforestation on carbon sequestration in the Uttarakhand region. The analysis underscores the importance of preserving and restoring forested areas to mitigate carbon emissions and enhance ecosystem services. These findings contribute to the understanding of the intricate relationship between land use changes, carbon sequestration, and environmental sustainability.

The utilization of geospatial technology, such as the Global Forest Change dataset, enables researchers and policymakers to make informed decisions regarding forest management and conservation strategies. By studying the dynamics of forest cover changes, people can work towards a more sustainable and resilient future.

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