

# Global Temperature Trends and Impact of CO<sub>2</sub> and Deforestation on Temperature Change

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**Q1) Project Description:** Climate change is one of the biggest threats in modern times, severely impacting Earth's ecosystem. After a careful literature survey, we identified that CO<sub>2</sub> and deforestation are two major factors impacting climate change. In this project, we plan to analyze temperature change for the last 250+ years and to investigate effects of two factors globally using machine learning (ML) and interactive visualization.

**Objective:** To predict the temperature change and impact of CO<sub>2</sub> emissions and deforestation for the next few decades based on historical datasets.

**Datasets:** 1) Global Temperatures, 2) CO<sub>2</sub> Emission, and 3) Deforestation

**Q2)** [3] **a.** This paper investigates global climate change by calculating the temporal latitudinal shift. **b.** According to [3], 77% of the cities will experience climate change by 2050, so our model can be compared to it. **c.** There is no further analysis whether there are other factors which may affect the climate shift such as CO<sub>2</sub>, deforestation etc.

[13] **a.** Like [3], this study characterizes the climate shift based on temperature data for Europe. **b.** According to [13], the climate shift was forecast with 84% accuracy, and the southward velocity has risen recently. Our results can be compared by [13]. **c.** The climate shift is studied only for the Europe region and cannot be generalized globally.

[15] **a.** This article quantifies the impact of deforestation on climate change for different climates. **b.** We can investigate if deforestation shows different behaviors in different climates as shown in [15]. **c.** Due to the lack of data, this paper cannot conclude the impacts of CO<sub>2</sub> emission on climate change.

[4] **a.** The paper explains how forests help in cooling down surfaces by providing suitable conditions for rainfall. **b.** This supports our hypothesis that forests have an impact on surface temperatures. **c.** The paper does not quantify the effect of forests on temperature.

[9] **a.** The paper explains how climate induced temperature increase impacts ecosystems. **b.** Additional insights from current work will help in developing solutions to mitigate climate change.

**c.** The paper does not quantify the effect of CO<sub>2</sub> emissions or forestation on climate change.

[7] **a.** The paper illustrates prediction of CO<sub>2</sub> emissions in India using different models and univariate time series analysis. **b.** The prediction approach can be extended to forecast CO<sub>2</sub> emissions for world countries. **c.** The paper limited CO<sub>2</sub> emissions prediction to India.

[14] **a.** This paper illustrates different ways to properly manage the forest ecosystem, adapt to the changes, and mitigate the impact of climate change. **b.** It explains the correlation between climate change and forests. We can refer to the forest impact models for our project. **c.** The paper is mainly qualitative but our project will focus on use of data to create impactful visualizations.

[2] **a.** This study examines the most significant factors for increase in CO<sub>2</sub> emission in developing ASEAN region countries. **b.** The paper helps to understand the factors that influence CO<sub>2</sub> emission which impacts the climate. **c.** The scope is only limited to ASEAN countries.

[1] **a.** The paper explains the impact of deforestation on the rise in temperature. **b.** It shows the approach to predict deforestation impact on climate change which is one of our objectives. **c.** The study is limited to the Amazon. We want to analyze the impact of deforestation on temperatures globally.

[18] **a.** The chapter describes the impact of CO<sub>2</sub> emission on climate change. **b.** One of the predicted impacts of CO<sub>2</sub> emission is the increasing of temperature in coastal area by 2C. This can be used as a compare factor in the project. **c.** This chapter only provides general information on the relationship between CO<sub>2</sub> emission and temperature. We will go to more detail analysis with visualization.

[5] **a.** This paper focuses on forecasting CO<sub>2</sub> emissions in Iran from a set of predictors. **b.** The research shows the usage of multiple regression models on forecasting CO<sub>2</sub> emissions level. **c.** The paper only focuses on forecasting CO<sub>2</sub> emission in Iran.

[12] **a.** This paper focuses on analyzing the relationship between deforestation and forestation on

surface temperature. **b.** It suggests that deforestation may increase the temperature and forestation may decrease the temperature, which supports our project’s objective. **c.** This paper focuses only on predicting the future impact of forestation and deforestation in Brazil.

[8] **a.** This study focused on China, the largest CO<sub>2</sub> emitter, and broke data into three regions based on certain factors. **b.** It is helpful to see how they broke up the country into different regions; we can use this when looking at classifying cities. **c.** One way to improve is to use regional CO<sub>2</sub> emissions as they vary greatly across the country.

[6] **a.** The dynamic global vegetation model predicted biomass carbon from 2020 to 2100, factoring in CO<sub>2</sub> fertilization, climate change, and wildfires. **b.** This information can help us when we look at deforestation and climate data to make predictions about climate change. **c.** One shortcoming is for an area of restoration, more carbon can be stored resulting in cooling, which is not shown in the model.

[17] **a.** The authors analyzed carbon emission literature available since 1981. **b.** This helped us get an understanding how past studies have regionally studied carbon emissions but identified missing aspects to study moving forward. **c.** The paper mentions missing ML for estimation and a comprehensive study of global carbon emissions in current work.

[11] **a.** This study evaluates trends in forest cover loss based on land surface temperatures in forested and deforested areas in Chiquitania. **b.** This study supports our hypothesis that deforestation causes increase in surface temperatures. **c.** The study does not cover the impact of deforestation in colder regions.

[16] **a.** This study reviews the impact of CO<sub>2</sub> emission in seven top transport CO<sub>2</sub> emitter countries by applying the logarithmic mean Divisia index (LDMI). **b.** LDMI method identifies the major contributors to CO<sub>2</sub> emission but it does not relate to temperature change. **c.** The paper does not review other sectors to analyze the effect of CO<sub>2</sub> emissions.

[10] **a.** The paper illustrates how emergence of big data and ML methods enables climate solution research to overcome generic recommendations, and it provides more specific solutions. **b.** This study aligns with our approach to use ML models to predict temperature change. **c.** The paper does not provide much insight on temperature change.

**Q3) Innovation:** In our project, we evaluate the impact of both factors on temperature trends globally with an interactive visualization tool.

The literature survey confirms regional effects of deforestation and CO<sub>2</sub> emission on temperature, so it should also be applicable globally. **Future Work:** Providing mitigation methods for temperature change.

**Q4)** It is critical for governments and authorities to educate and inform the public to take precautions towards climate change from now on. Hence, it is necessary to do data analysis and visualization continuously to attract public attention.

**Q5) Impact:** Since the climate change impact is global, this work can be used by governments for city planning to take precautions for food and water supply and social impacts. Furthermore, the authorities can identify vulnerabilities and develop a plan for adaptation and sustainability via knowledge transfer from different cities in similar climates.

**Measuring success:** The success of our work can be measured by comparing the accuracy of temperature prediction with existing studies. We visualize the global temperature trends whether they are explainable by deforestation and CO<sub>2</sub> emission data.

**Q6)** The risks associated with this project are: **1)** data processing challenges (missing data, data errors, normalization, etc.), **2)** having limited features, some of which if correlated might impact model training, **3)** the factors from different datasets can be interdependent despite lack of data.

**Q7)** Cost - N/A

**Q8)** Our project plan is shown in Figure 1.

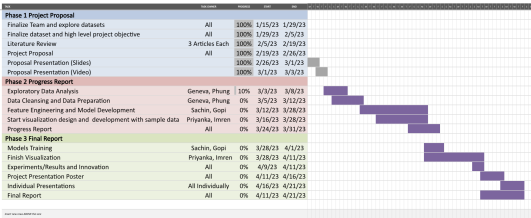


Figure 1: Project Plan

**Q9) Midterm:** Planning to finish the EDA/data preparation, model development, and conceptualize visual design.

**Final:** Final trained model to predict the temperature change and enhanced interactive visualization to show how the temperature changed in the past and how it will change in the future.

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