

ASSIGNMENT -1

How is Brazil addressing the problem of climate change?

Geography:

Brazil is the largest country of South America, occupying roughly half of its total area. It is located in the eastern part of South America. Both the equator and tropic of the Capricorn line passes through Brazil. It has a 7,491 kilometres long eastern coastlines along the Atlantic Ocean. Brazil has six major ecosystems: the Amazon Rainforest, which occupies 60% of Brazil's territory; the Pantanal, a tropical wetland system; the Cerrado, a savanna system and source of Brazil's largest river system; The Caatinga, a dry savanna of northeast, The Atlantic Forest, that extends along coastline from northeast to south and The Pampas, the fertile lowlands of south [1]. The Amazon Basin, home to the world's largest tropical rainforest, acts as a massive carbon sink and hosts a vast variety of species. The forests in Brazil cover 59.3% of its land area, agriculture land covers approximately 28.6% of land area (2021) [2].

The climate of Brazil is very diverse. North and centre regions have frequent rainfall and higher temperature. Southern Brazil has humid subtropical temperature. The average mean temperature is 25.44°C [3].

Brazil is rich in natural resources, such as gold, bauxite, platinum, iron ore, rare earth elements, tin, petroleum, uranium and hydropower. However, these resources are under threat due to deforestation caused by agricultural expansion, development and mining activities. Deforestation also threatens both biodiversity and the country's role in combating global climate change [2].

Demography:

Brazil's population, approximately 216.4 million, is the largest in South America, and is growing at a rate of 0.61%. The population is mostly concentrated along the Atlantic coast. 87.8% of the total population lives in the urban area. Annual rate of urbanisation is 0.87% (2020-25 est.). The rapid urbanisation in Brazil has created challenges such as overcrowded cities, deforestation, environmental degradation etc. The population of Brazil is relatively young, with a median age of 35.1 years [2]. The average age of Brazil is increasing and will get relatively constant till 2100 [4].

Brazil's total GDP was 2.17 trillion US\$ in 2023 and GDP per capita was 10,043.6 US\$. GDP is growing at an annual rate of 2.9%. It is considered an upper middle-income country [1]. However, the economic inequality is very high in Brazil. According to Oxfam International, it will take approximately 75 years for Brazil to reach the United States' current level of income equality [5]

Impacts of Climate Change

1) Change in Temperature

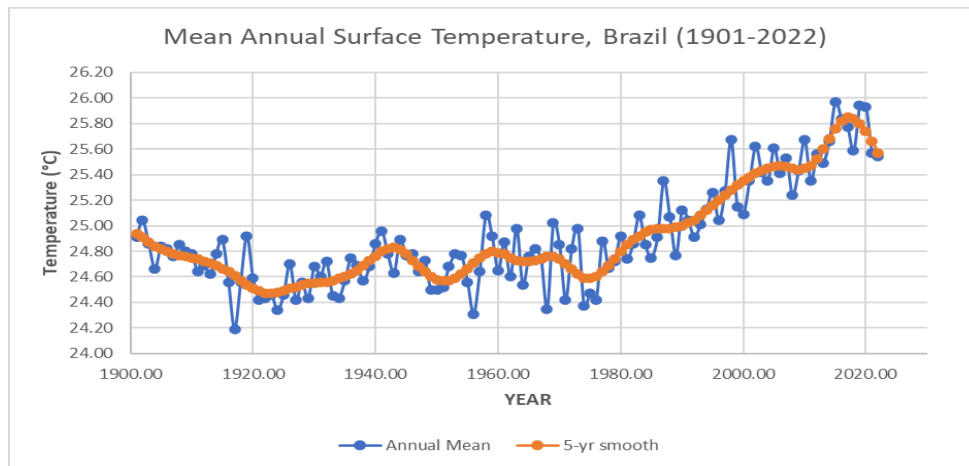


Figure 1: Mean Annual Surface Temperature of Brazil from 1901-2022 [6]

Brazil has experienced an increase in the mean annual temperature from 24.83°C in the decade 1901-1910 to 25.71°C in 2010-2020 [6]. This increase in temperature trend can be observed in Figure 1, to have started from the late 1970s.

2) Change in precipitation

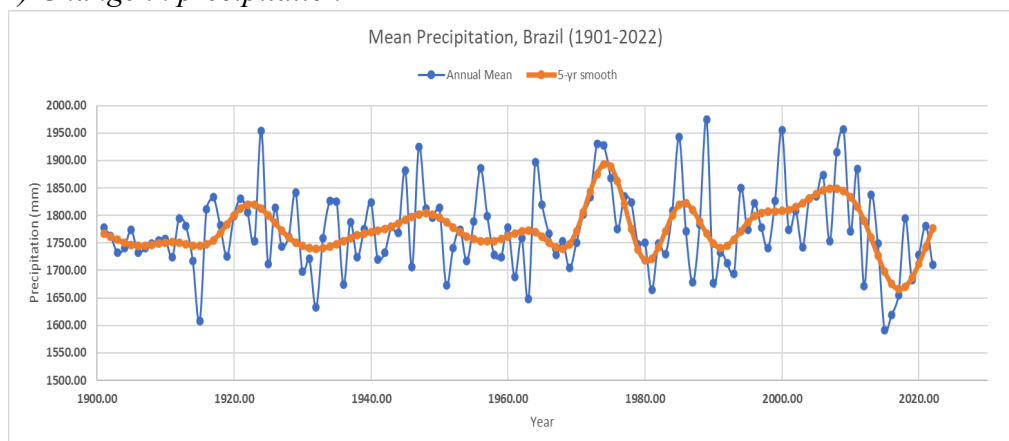
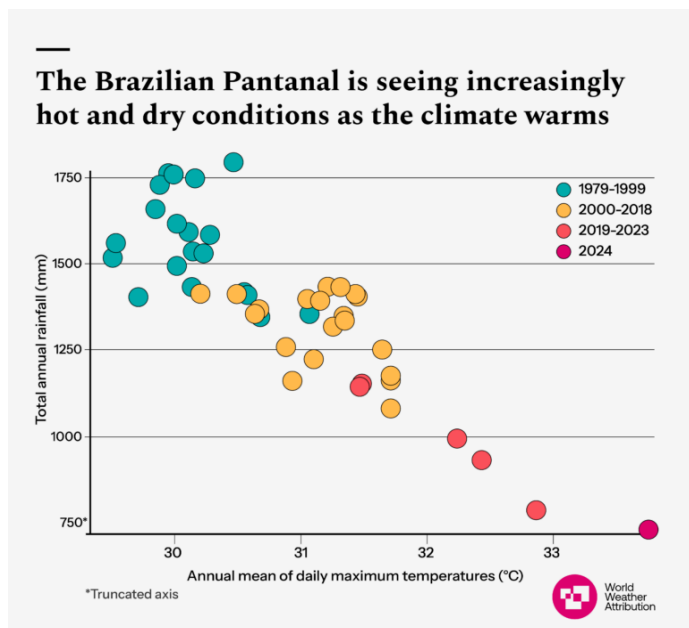


Figure 2: Mean precipitation of Brazil from 1901-2022 [6]

The overall trend of precipitation did not show any sharp incline or decline in the amount of precipitation, yet it is evident from Figure 2 that since the 1970s, the occurrence of extreme precipitation events has increased. Over the last 3 decades, there has been a 5% increase in rainfall observed in the tropical wet region that covers most of the Amazon [7, p. 8].

3) Intensified Pantanal Fires

The Pantanal wetlands of the country experience a fire season usually from July with the highest frequency of occurrence between August and September [8]. Unusually, as observed by the National Institute for Space Research (INPE) of Brazil, Pantanal experienced intensified fires from early in June [9]. A study done by the World Weather Attribution shows how there has been a drying trend that is leading to such extreme fire events [10].



Energy intensity

In recent years, there has been an increase in the energy intensity of Brazil. Between 2010 and 2022, there was a slight increase from 3.5 to 3.6 GJ per thousand USD. [15] because of higher energy consumption in energy-intensive sectors like industry, transportation, and agriculture. In 2021, the energy intensity was approximately 1.15 kWh per dollar as compared to the world average of 1.32 kWh per dollar. [16] This relatively lower energy intensity shows Brazil's efficiency in energy use while comparing with the rest of the world.

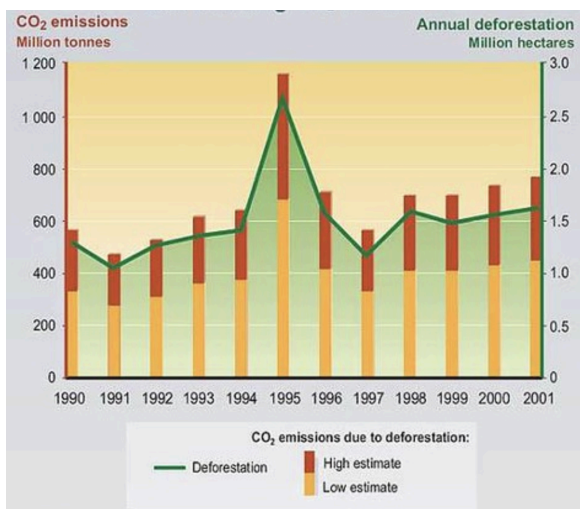
When we compare Brazil to other emerging economies, Brazil presents a mixed picture in carbon and energy intensities. While the high dependence on renewables helps in reducing carbon intensity, the recent increase in energy intensity indicates challenges in maintaining efficiency.

Brazil's Net Zero Roadmap

As part of its commitments under the Paris Agreement, Brazil has pledged to achieve net zero emissions by 2050. This commitment is part of Brazil's broader Nationally Determined Contribution (NDC), which outlines the country's climate action plan.[17]

Key Components of Brazil's Net Zero Strategy:

1. Deforestation and Land Use: Brazil's primary source of GHG emissions is deforestation,



particularly in the Amazon. The IPCC has emphasised the importance of protecting and restoring forests as a vital strategy for both mitigating climate change and maintaining biodiversity. Brazil has committed to ending illegal deforestation by 2030, a crucial step toward its net zero goal. The government launched PPCDAm (Plan for Prevention and Control of Deforestation in the Amazon) in 2004 which resulted in a remarkable 83% decline in deforestation till 2012. The new 5th phase of the plan will aim at ending deforestation by 2030 [18].

Figure 4: Annual deforestation in the Amazon and resulting CO₂ emissions

Additionally, Brazil aims to restore and reforest 12 million hectares of forests by 2030, which will help absorb CO₂ from the atmosphere.

2. Energy Transition: Although Brazil already has a relatively low-carbon energy mix, with over 45% of its energy coming from renewables, the country plans to expand its use of renewable energy further. This includes increasing the share of wind, solar, and biomass in its energy matrix.

3. Industry and Transport: Brazil is also focusing on reducing emissions from industry and transport, sectors that are traditionally challenging to decarbonize. The country aims to improve energy efficiency, promote the use of biofuels, and invest in green technologies. The implementation of the National Biofuel Policy (RenovBio) is one such example of a policy established in 2017 to achieve the goal of lowering carbon intensity in transport fuel [19].

Challenges and Opportunities

Brazil's net zero roadmap is ambitious but faces significant challenges, including political, economic, and social factors. Enforcement of anti-deforestation laws, investment in green infrastructure, and ensuring a just transition for communities dependent on high-emission industries are critical to the success of Brazil's climate strategy. Moreover, the IPCC has warned that time is running out, and immediate, robust action is required to meet the 2050 target globally.

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