# “Carbon Footprint Across Nations: An In-Depth Analysis of Key Indicator in Climate Change”

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GitHub: Carbon Footprint Across Nations

## Abstract

Climate change is one of the most pressing issues confronting the world today, and carbon dioxide (CO2), the most significant greenhouse gas (GHG), contributes significantly to it. It is emitted to the atmosphere by a variety of human activities, including the use of fossil fuels, deforestation, and industrial processes. In order to assess the situation and implement the necessary measures, it is crucial to comprehend the indicators of CO2 emissions and how they are evolving over time. By utilising World Bank climate change data, this report intends to investigate and analyse the statistical properties and trends of indicators such as urban population, renewable energy consumption, forest area, and arable land across various countries. This analysis found both positive and negative correlations between the indicators, which also revealed that they varied among countirs and years. To comprehend the nature of these correlations more completely, the underlying causes that underlie them have also been analysed.

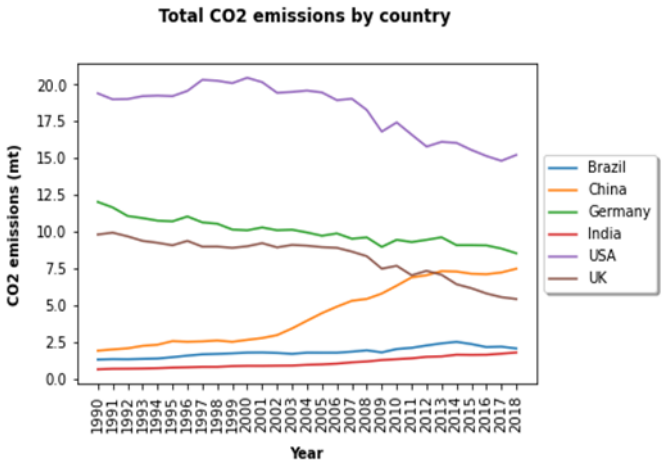


*Figure 1 : CO2 emission over time*

Figure 1 illustrates the total CO2 emissions of six different countries over the last 28 years. The CO2 emissions in the United States are much larger and have been essentially steady since 2000, with a modest downward trend in recent years. There is a minor downward trend in emissions over time in Germany and the United Kingdom; although there are still some spikes and falls, this trend is generally downward. This implies that those countries may be actively putting into practise environmental regulations or programmes that aid in decreasing their carbon emissions. Compared to the other countries, CO2 emissions in China have considerably increased, as seen by the upward trend after 2000 and highlighted by the expanding effects of urbanisation shown in Figure 2.

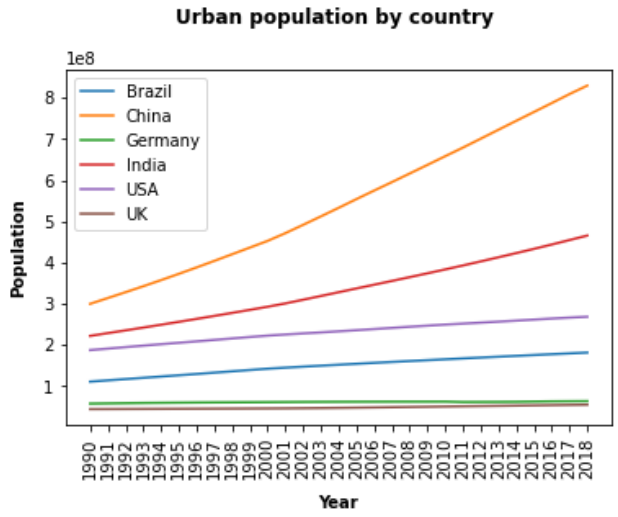


*Figure 2: Urban population growth over time*

Figure 2 shows that the proportion of people living in cities has steadily increased over the last few decades. In comparison to the other countries, China and India experienced the most rapid growth, and China's urbanisation rate is much higher than India's, with a steeper slope in the trend line. This suggests that urbanisation in China is accelerating faster than in India. China has experienced unprecedented urbanisation, with millions of people migrating from rural areas to cities in search of economic opportunities and a better quality of life. However, this rapid urbanisation has come at a cost, as the country's CO2 emissions have increased significantly.

As illustrated in Figure 1, China's CO2 emissions per capita have risen sharply since the late 1990s, with a significant portion of this increase attributed to increased energy consumption and urban transportation emissions. Figure 2, which depicts the trend of China's urban population over the same time period, shows how these two trends are inextricably linked.

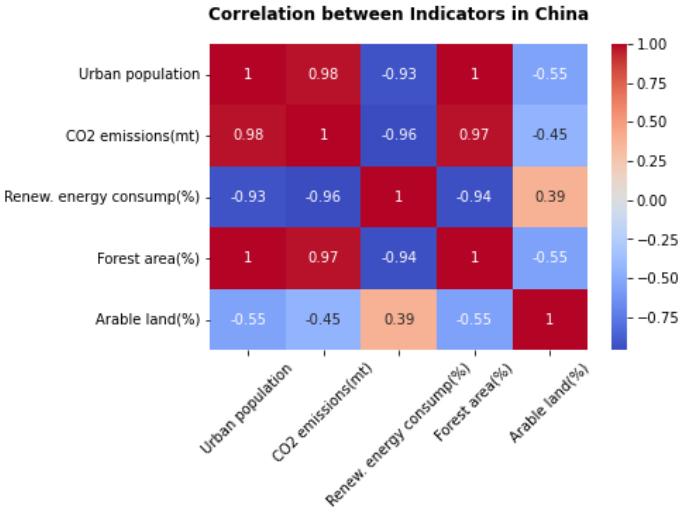


*Figure 3: Correlation between indicators in China*

The above heatmap of the correlation between indicators in China shows a quite strong positive relationship between CO2 emissions and urban population, with a correlation coefficient of 0.98, which confirms the relationship between the two indicators. According to this correlation, the country's increased CO2 emissions are significantly correlated with its growing urbanisation.

As shown in Figure 3, renewable energy consumption and CO2 emissions are negatively correlated with a correlation of -0.93. This indicates that China can drastically lower its carbon footprint and minimise the negative effects of urbanisation on the environment by investing in renewable energy sources.

Figure 4 shows the consumption of renewable energy as a percentage of overall energy consumption over time for different countries. It has been observed that India consumed the most renewable energy relative to its total energy consumption, and that this proportion has slightly declined over time. Similarly, China has also experienced a downward trend, which implies that the increase in CO2 emissions is due to the country's declining utilisation of renewable energy sources. Also, this suggests that the two factors have a very high negative correlation.

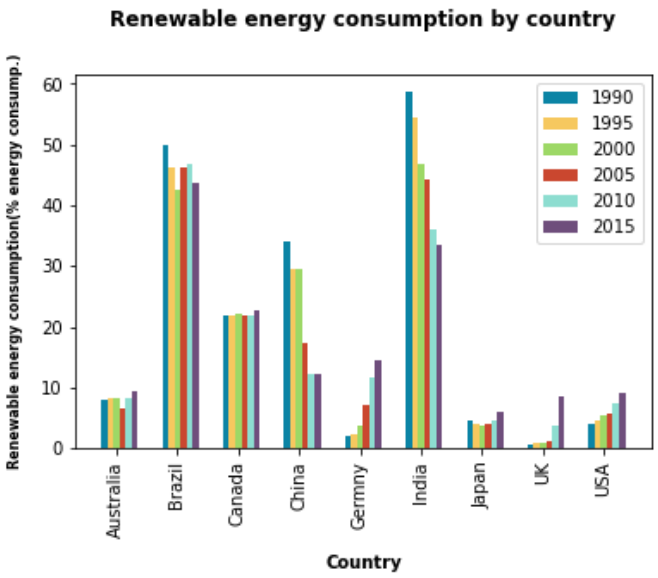


*Figure 4: Renewable energy consumption over time*

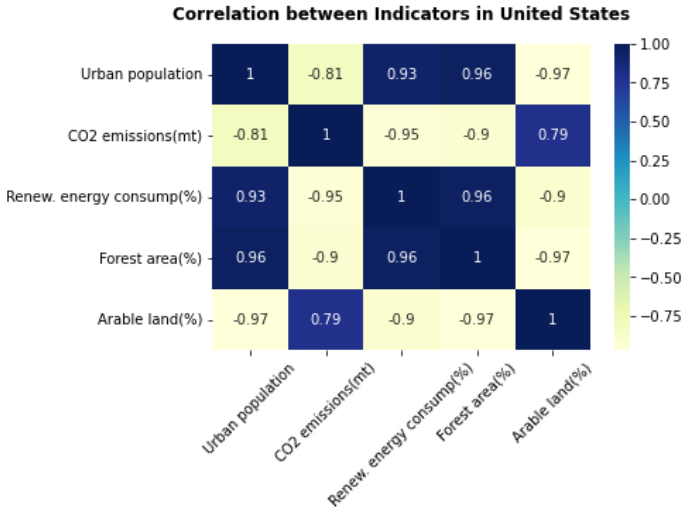


*Figure 5: Correlation between indicators in USA*

In Figure 5 above, the consumption of renewable energy in the United States is shown to be closely related to its CO2 emissions. Figures 4 and 1 show that during the past few decades, the United States has steadily increased its use of renewable energy while reducing its CO2 emissions, which confirms the correlation between those two indicators. As the use of renewable energy sources continues to decrease in China, the country has seen a increase in CO2 emissions over the past few years. This indicates a strong negative correlation between the two factors.

An important factor to consider in environmental conservation is the relationship between CO2 emissions and the volume of forest area. The heatmap (Fig. 5) demonstrates a strong negative relationship between CO2 emissions and the percentage of forest area in the United States. As shown in Figure 6, the forest area of the USA is gradually increasing, demonstrating that the country's efforts to protect its forests have contributed to a decrease in CO2 emissions.

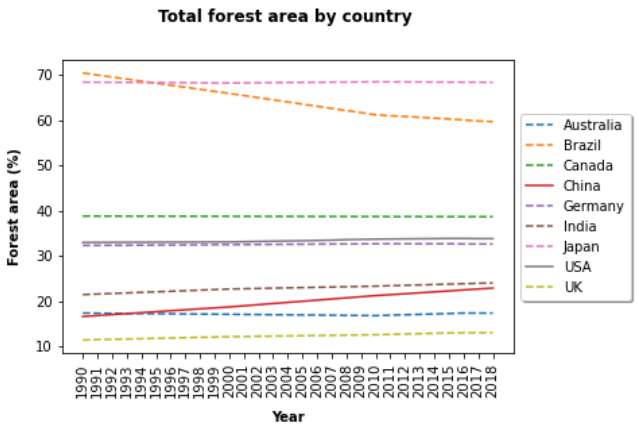


*Figure 6: Forest area growth over time*

Figure 7 illustrates that, while the amount of arable land in the United States is slightly decreasing, it is slightly rising in China. With their contrasting trends in CO2 emissions, it can be seen that China's CO2 emissions have increased despite an increase in arable land, which may be attributed to other factors like industrialization. While there has been a minor drop in CO2 emissions and the amount of arable land, the United States has seen the opposite. Intriguingly, the correlation heat maps of the two countries in Figs. 3 and 5 demonstrate that the United States shows positive relationships between CO2 emissions and arable land, while China shows a negative relationship. This implies that the relationship between CO2 emissions and arable land may be influenced by several factors that are at play differently in the two countries.

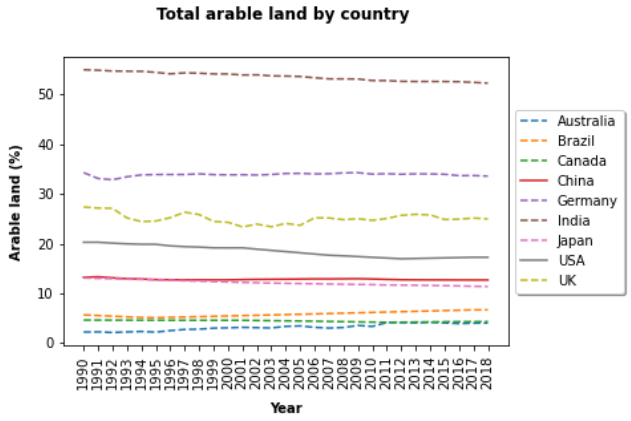


*Figure 7: Arable land growth over time*

In conclusion, this statistical analysis has provided insights into the indicators and causes of CO2 emissions across different countries. According to the findings, urbanisation, renewable energy consumption, forest area and arable land are all substantially correlated with CO2 emissions levels. The finding of this study emphasis to reducing CO2 emissions requires the implementation of laws that support clean energy sources and sustainable development, such as energy efficiency and renewable energy initiatives.