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EVALUATION OF TOTAL GREENHOUSE GAS EMISSIONS OF COUNTRIES WITH TROPICAL CLIMATE

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ABSTRACT

Greenhouse gas emissions are the gases released into the atmosphere, directly or indirectly, as a result of different types of production and consumption processes. The use of fossil fuels, deforestation, agricultural practices, industrial processes and the livestock sector are human-induced actions that increase greenhouse gas emissions. Since greenhouse gases hold heat in the atmosphere, they increase the temperature and cause global warming and climate change with the effect of greenhouse gases. In this study, total greenhouse gas emissions values of eight countries with tropical climate (Brazil, Nigeria, Venezuela, Colombia, Sudan, Bolivia and Chad) were investigated. It has been observed that among these countries, especially those with developed industries, have higher total greenhouse gas emission values. Among these countries, the highest total greenhouse gas emission value is approximately 1.5 billion tons in Brazil.

1. INTRODUCTION

The rays from the sun pass through the atmosphere filtered. And they heat the earth. Heat loss in the earth is prevented by the atmosphere. The ability of the atmosphere to transmit and retain heat is called the greenhouse effect. Greenhouse gas emissions arise as a result of both natural processes and production and consumption processes. Greenhouse gas emissions in the atmosphere increase their atmospheric concentrations and, as a result, warm the climate. Compounds that have a greenhouse effect due to production and consumption processes and are accepted as greenhouse gases in the Kyoto protocol; Carbon dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Hydrofluoride carbons (HFCs), Perfluorocarbons (PFCs), Sulfurhexa fluoride (SF6). Dones et al. have evaluated greenhouse gas emissions from fossil, nuclear and renewable energy systems [1]. Kennedy and others have investigated why greenhouse gas emissions vary in different cities. They evaluated the effects of geophysical and technical factors on greenhouse gas emissions in ten global cities (Bangkok, Barcelona, Cape Town, Denver, Geneva, London, Los Angeles, New York, Prague and Toronto) [2]. Mohammed et al. examined the relationship between Hungary's greenhouse gas emissions and economic growth between 1985 and 2018. Their results showed that the industrial sector contributed 72% to Hungary's total greenhouse gas emissions [3]. Sharma et al. examined improvements in greenhouse gas inventory estimation. Its results highlighted strengths, current shortcomings, and challenges to improve inventory [4].

In this study, the total greenhouse gas emission values of countries with a tropical climate were compared. Some suggestions have been presented to reduce the total greenhouse gas emission values.

2. COUNTRIES WITH TROPICAL CLIMATE

In countries with a tropical climate, an average temperature of 18 ^{o}C is seen throughout the year due to the effects of the climate. It is possible to see this type of climate in countries located between 10 ^{o}C north and 20 ^{o}C south of the equator line. Common features of countries with tropical climate are as follows;

- The vegetation is defined as savannah.
- While the summer season is rainy, the winter season is dry and it rains regularly.

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- The rainiest months are August and July.
- The highest temperature values during the year are reached in May.

Fig. 1 shows the tropical countries in the world [5]. Tropical countries are Bolivia, Brazil, Venezuela, Sudan, Chad, Nigeria, Mauritania and Colombia.

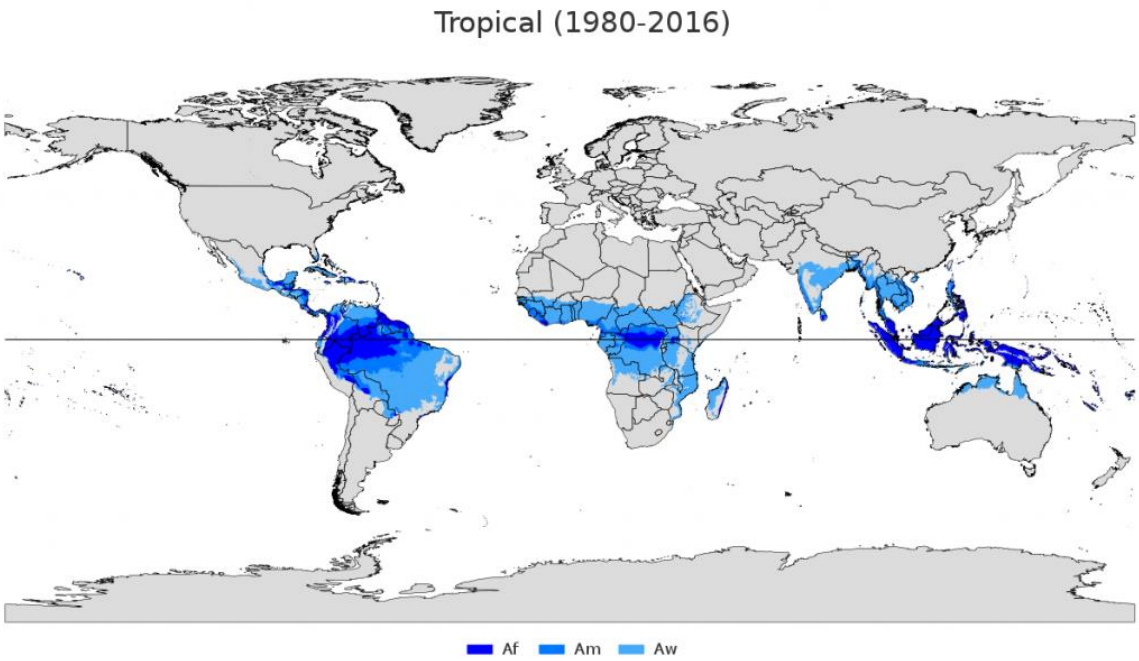

Fig 1. Map of tropical climate zone [5]

2.1. Bolivia

Bolivia, which has a surface area of 1,098,581 km2, has a population of 11.2 million (2018). Bolivia is surrounded by Brazil, Peru, Argentina, Chile and Paraguay. Its climate varies across the country. A humid tropical climate is observed especially in the eastern parts. Bolivia's export products are Petroleum gases, zinc, gold, soybeans, lead, tin, precious metal ores, coconut and cashew nuts. Especially, 60% of the world's total reserves of lithium, which is the main raw material of batteries, are located in Bolivia. The installation of the country's largest photovoltaic solar farm has recently come to an end. It is planned to produce 60 MW of electricity in this facility. Bolivia's renewable energy capacity has reached 150 MW [6].

2.2. Brazil

Brazil has an area of 8,547,400 km2 and a population of 209,205,000 (IMF, 2018) million. Brazil is the tenth largest energy consumer in the world and the largest energy consumer in South America. Brazil is also the region's most important oil and gas producer and the world's second-largest ethanol producer. Brazil is the world's 15th largest oil producer. With 13.2 billion barrels of oil reserves, Brazil is the country with the largest oil reserves after Venezuela. In addition, Brazil has 364.2 billion m3 of natural gas reserves. Hydroelectric generation constitutes 83% of the total electricity production. 4% of Brazilian electricity production comes from nuclear energy. In the production of ethanol fuel used as biofuel, Brazil is defined as the world's "superpower" and is the world's largest ethanol exporter. Ethanol fuel is produced from sugarcane, so Brazil is the world's largest sugarcane producer [6].

2.3. Venezuela

Venezuela has an area of 912,050 km2 and a population of 29.1 million. It is surrounded by Brazil, Colombia and Guyana. The country generally has a tropical climate, but at higher elevations, there is a more temperate climate. Exports are crude oil and petroleum products, aluminium, bauxite, iron, minerals and chemicals. Venezuela ranks first in the world with approximately 303 billion 200 million barrels of proven oil reserves. Venezuela is one of the world's leading countries in terms of natural gas reserves. The country ranks seventh in the world with 6.4 trillion cubic meters of natural gas reserves [6].

2.4. Sudan

Sudan has an area of 1,861,484 km^2 and a population of 40.5 million (2017 estimate). Sudan's industry consists of cotton, textiles, cement, vegetable oils, sugar, soap, shoes, oil production and pharmaceuticals. The country, which cannot have heavy industry, has light industry production. The main products imported by Sudan are machinery equipment, chemical products, pharmaceuticals and textile products [6].

2.5. Chad

Chad has an area of 1,284.000 km^2 and a population of 12,075,985 (2017 data). Chad is a landlocked country in Central Africa bordered by Libya to the north, Niger, Nigeria and Cameroon to the west, the Central African Republic to the south, and Sudan to the east. Tropical climate prevails in the south of the country, and desert climate prevails in the north. Natural resources of petroleum, uranium, natron and kaolin are known. Chad can fully meet its own needs with the energy it produces. The total production of all facilities producing electrical energy is 215 million kWh and this is 108% of its value requirement. Therefore, excess energy is exported to other countries [6].

2.6. Nigeria

Nigeria has an area of 923,768 km2 and a population of 191 million (2017 estimate). Nigeria is located in West Africa, on the coast of the Gulf of Guinea, between Benin and Cameroon. The climate is equatorial in the south of the country, tropical in the middle and desert in the north. Natural gas, petroleum, tin, iron, coal, limestone, lead and zinc constitute the country's natural resources. Steel, coal, iron, motor vehicle assembly, tobacco products and oil refining form the country's industry. Nigeria, a member of OPEC, has a large iron and steel industry and a large construction sector. Oil and natural gas are the country's most important energy sources. Another major energy sources are hydropower. The installed power generation power in Nigeria is approximately 6000 MW [6].

2.7. Mauritania

Mauritania has an area of 1,030,700 km2 and a population of 4.4 million (2020). The country has a desert climate and the weather is hot, dry and dusty throughout the year. As a geographical location, Mauritania is bordered by the Atlantic Ocean to the west, Senegal to the southwest, Mali to the southeast and east, Algeria to the northeast, and Western Sahara to the north. Mineral fuels, machinery, ships and sea vehicles, iron and steel, electronic devices and dairy products constitute the import products. Renewable energies were not used in Mauritania until 2008. Today, renewable resources are financed from public funds. Wind energy stands out as an energy source that the country attaches importance to [6].

2.8. Colombia

Colombia has an area of 1,141,748 km2 and a population of 49.5 million (2018). The tropical climate is seen in the coastal parts of the country and valleys in the eastern regions, while a milder climate prevails in the higher parts. Geographically located in the northwest of South America, Colombia is surrounded by Brazil and Venezuela to the west, the Pacific Ocean to the east, Ecuador and Peru to the south, and Panama and the Caribbean Sea to the north. Petroleum, coal, emerald, coffee, flowers, nickel, banana, ready-made clothing, palm oil, passenger cars and petroleum oils are among the export products of the country. The country's economy is largely energy and mining. Colombia has rich coal reserves. It also has 1.6 billion barrels of oil, 110 billion m3 of natural gas reserves and is the continent's fourth-largest oil producer. The industrial sector of the country is also developed. Textile, ready-to-wear, automobile assembly and chemical industries are among these sectors. It ranks third in the world in coffee production. Colombia is shown as one of the world's ten superpowers in renewable energy production [6].

3. RESULTS

The total greenhouse gas emissions in countries with tropical climates are given below graphically. In Fig. 2, the total greenhouse gas emissions of Brazil between 1990 and 2018 are given. It is seen that the greenhouse gas emission value, which has been approximately 1.6 billion tons since 1990, has increased every year. In 2010, this value reached its highest value. The fact that Brazil is one of the world's largest oil producers has a large share in this increase.

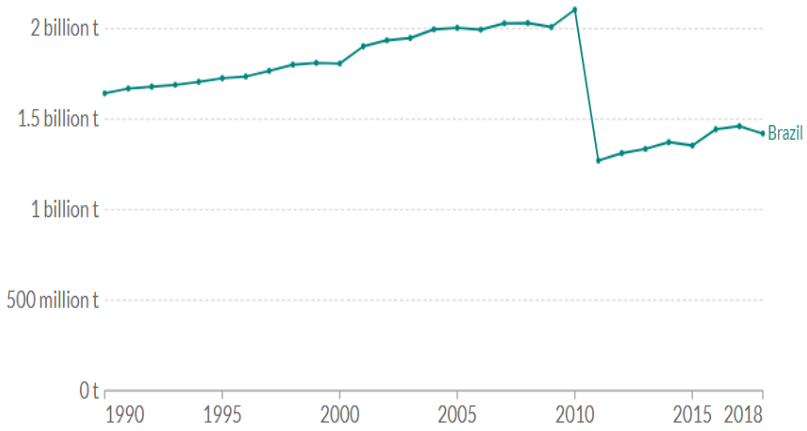

Fig 2. Total greenhouse gas emissions of Brazil [7]

In Fig. 3, the total greenhouse gas emission values of Bolivia are given. It is seen that in the last 30 years, Bolivia has had 110 million tons of greenhouse gas emissions. In recent years, Bolivia has given importance to renewable energy investments and supports the production and use of clean energy.

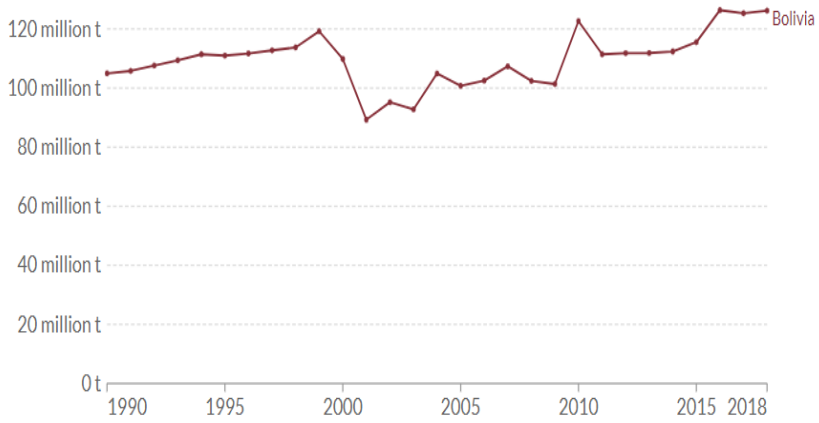

Fig 3. Total greenhouse gas emissions of Bolivia [7]

Greenhouse gas emissions of Venezuela are given in Fig. 4. It is seen that the greenhouse gas emission values in Venezuela are 300-350 million tons. Venezuela has the largest oil reserves in the world and its production processes have an important role in reaching these values.

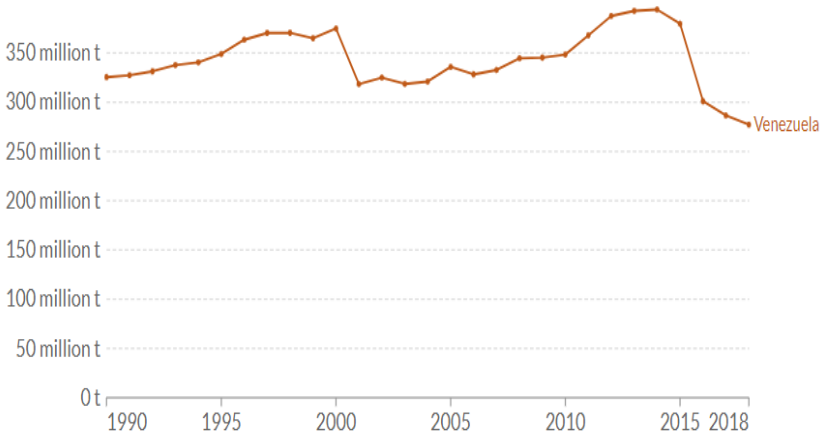

Fig 4. Total greenhouse gas emissions of Venezuela [7]

The total greenhouse gas emission values of Sudan between 1990 and 2018 are given in Fig. 5. The value, which was about 75 million tons in 1990, increased over time to over 120 million tons. The reason for this is the increase in population and production in the light industry.

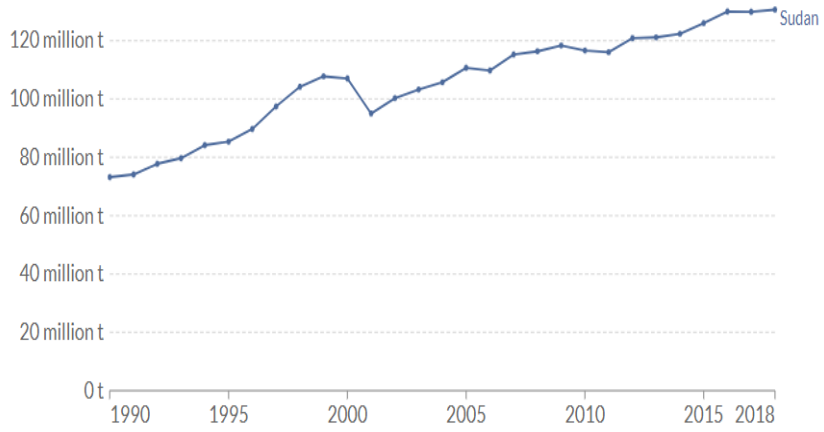

Fig 5. Total greenhouse gas emissions of Sudan [7]

Fig. 6 shows the total greenhouse gas emission values of Chad. It is seen that the greenhouse gas emission values, which were 22 million tons in 1990, exceeded 100 million tons until 2018. Chad meets its own needs with the energy it produces. It sells the excess energy it produces to neighbouring countries. Greenhouse gases emerging in this production process cause an increase in total greenhouse gas values.

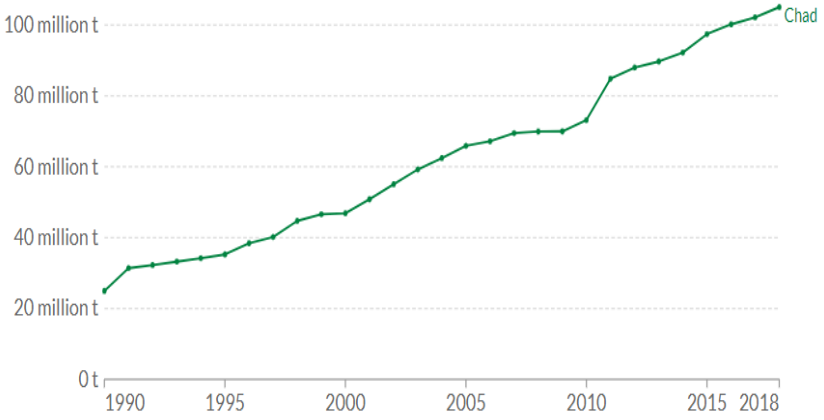

Fig 6. Total greenhouse gas emissions of Chad [7]

The total greenhouse gas emission values of Colombia are given in Fig. 7. It is seen that the average of the total greenhouse gas emission values in the last 30 years is approximately 250 million tons. It is noteworthy that the values remained approximately the same from 1990 to 2018. There has been no significant increase in emission values in the last 30 years. The reason for this is that the country has developed industry and is one of the countries with the largest renewable energy potential in the world. In particular, the use of renewable energy has played a role in reducing greenhouse gas emissions.

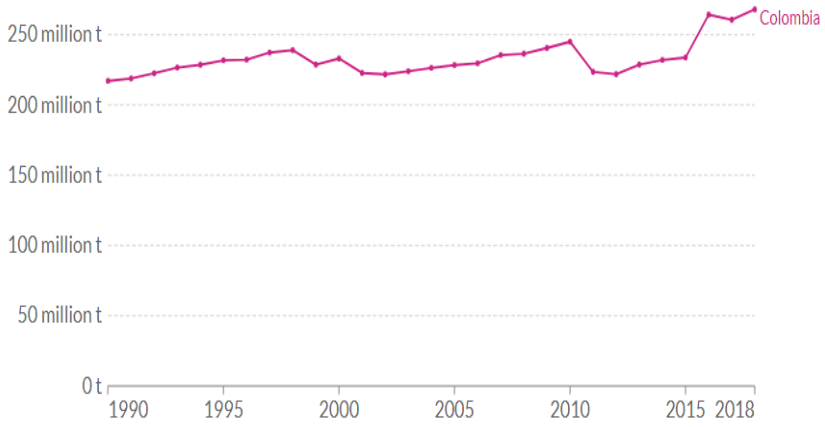

Fig 7. Total greenhouse gas emissions of Colombia [7]

The total greenhouse gas emission values of Mauritania between 1990 and 2018 are given in Fig. 8. It is seen that the emission values, which were 7 million tons in 1990, reached approximately 12 million tons in 2018. Mauritania is the least populated country among the countries with a tropical climate. Therefore, the total greenhouse gas emission values are also the least. Until recently, the use of renewable energy in the country was close to zero. In recent years, the tendency to use clean energy has increased. With the completion of these processes, it is expected that greenhouse gas emissions will first be stable and then decrease.

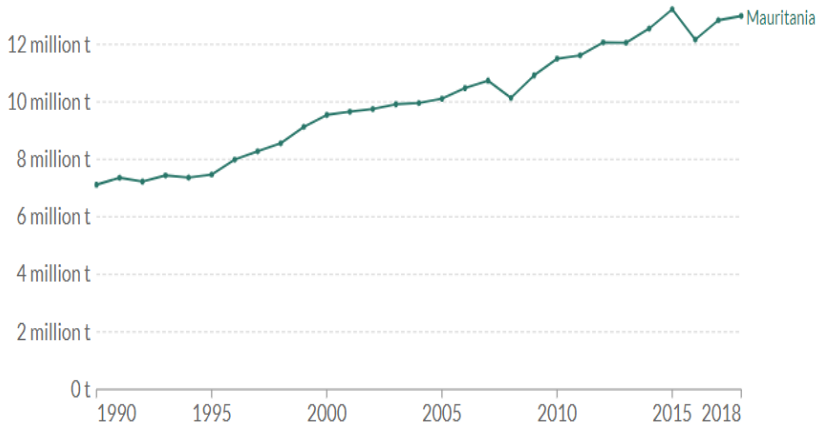

Fig 8. Total greenhouse gas emissions of Mauritania [7]

Fig. 9 shows Nigeria's total greenhouse gas emission values. The emission value, which was 250 million tons in 1990, reached 350 million tons in 2018. Nigeria is a tropical climate country with the largest population after Brazil. The iron and steel industry and production processes in Nigeria are the main reasons for the increase in emission values.

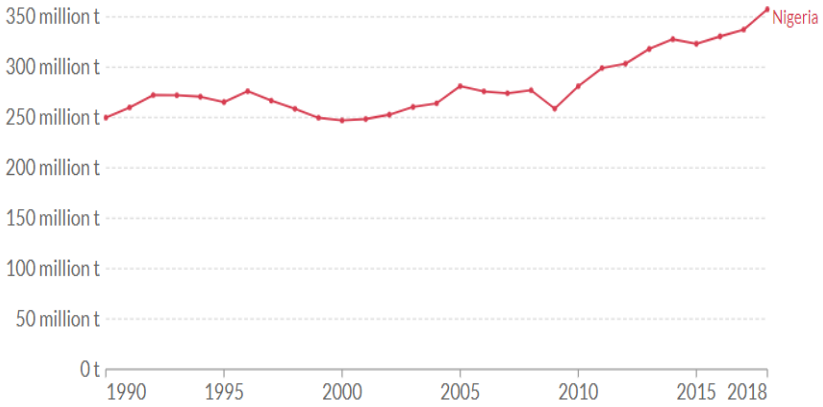

Fig 9. Total greenhouse gas emissions of Nigeria [7]

The total greenhouse gas emission values of all tropical climate countries are given in Fig. 10 as logarithmic. With approximately 2 billion tons of greenhouse gas emissions, Brazil is the country with the highest value among all these countries. Then, Nigeria, Venezuela, Colombia, Sudan, Bolivia, Chad and Mauritania are ranked respectively.

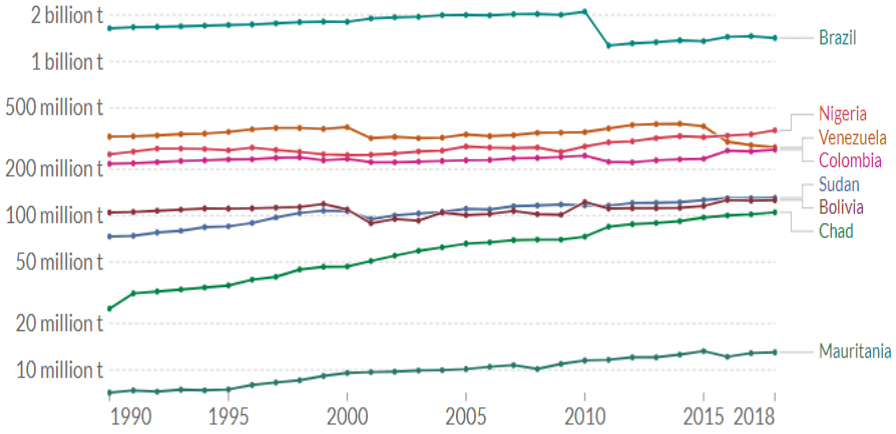

Fig 10. Total greenhouse gas emissions of countries with tropical climate [7]

4. CONCLUSIONS

In this study, the total greenhouse gas emissions of eight countries with tropical climate (Brazil, Nigeria, Venezuela, Colombia, Sudan, Bolivia and Chad) were evaluated. Among these countries, it has been observed that especially those with developed industries have higher greenhouse gas emissions. In addition, it is clear that the increase in the per capita carbon footprint causes higher greenhouse gas emissions in countries with a high population. It is possible to reduce total greenhouse gas emissions with several measures to be taken.

Measures can be taken to reduce greenhouse gas emissions, such as;

- Greenhouse gas emissions should be limited in energy production processes,
- The use of hybrid electric and electric vehicles for transportation, especially in densely populated countries,
- Using energy recycling systems,
- Thermal insulation of systems and buildings,
- Using devices and systems with high energy efficiency,
- Terminating the use of fossil fuels over time and giving importance to the use of alternative fuels instead.

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