A Comparative Study of Carbon Dioxide Emission of Most Popular Dishes in Top 10 Countries

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Abstract: **Significant demographic shifts are expected in several places of the world this century. These modifications may have an influence on energy consumption and greenhouse gas emissions. CO2 emission occurs throughout the life cycle of a food product. This research will undertake a comparative assessment of total carbon emissions created by the most popular foods in ten nations at all stages. This comparison seeks to classify countries based on their carbon dioxide emissions. As a result, the country with the most carbon-conscious dietary choices is identified. The countries were chosen based on the fact that they have huge and comparable population densities. Dishes were chosen based on consumption by the majority of the population of that particular country. A vast data set obtained from "Kaggle" and "Our World in Data" is to be used as our data set. Tools used for this data analysis project includes Excel combined with Python. We can further investigate how demographic change may affect global carbon dioxide emissions by demonstrating that slower population growth could produce the emissions reductions predicted to be needed by 2050 to avoid severe climate change using a food-production growth model that takes a variety of demographic factors into account.**

Index Terms: **Carbon emission; food products; countries; population size; analyses; reduction in emissions**

I. INTRODUCTION

Population expansion has been one of the drivers of emissions growth over the past few decades, according to statistical analysis of historical data [8]. This century is expected to see considerable demographic changes in many parts of the world. Even though these changes may have an impact on energy use and greenhouse gas emissions, they have either been overlooked or only partially or excessively simplified in emissions scenario evaluations.

The world's population is continuing to grow, and with it, the demand for food. As a result, the global food system is one of the major contributors to carbon emissions. The production, processing, transportation, and disposal of food all contribute to the release of greenhouse gases, which are responsible for climate change.

The way food is produced and consumed also has an impact on carbon emissions. The overconsumption of meat, dairy and processed foods, for example, can increase the carbon footprint of a diet. On the other hand, plant-based diets, which rely heavily on fruits and vegetables, have a lower carbon footprint. This is because the production of meat and dairy products requires more resources and results in more greenhouse gas emissions than the production of plant-based foods. Additionally, food transportation also contributes to carbon emissions. Eating locally sourced foods can significantly reduce the carbon emissions associated with transportation.

Overall, reducing carbon emissions due to food will require a multifaceted approach, including changes in food production, transportation, and consumption patterns. This can be achieved through policies and regulations, such as taxes on meat and dairy products, incentives for sustainable farming practices, and education campaigns promoting plant-based diets.

An analysed report is required for the implementation of carbon-reduction policies. Hence, to identify the most consumed foods in the top 10 populated countries and to estimate the carbon emissions caused by them, we conclude that these are the countries with carbon-conscious dietary patterns.

II. LITERATURE SURVEY

A study of how food consumption patterns contribute to climate change was done. It found that certain foods, such as beef and pork [6], have high greenhouse gas emissions due to production methods. In contrast, foods like vegetables and fruits have lower emissions.

India's agricultural sector has a significant impact on the environment, especially in terms of greenhouse gas (GHG) emissions from livestock and freshwater required for irrigation. Future efforts by agriculture to keep up with India's expanding population and shifting food habits are anticipated to increase these effects. India has a wide variety of food practices and hence varies in the GHG emissions and water use resulting from various dietary practices.[1] To examine the food habits of 10 different nations, we utilised a similar methodology.

Carbon emission occurs during various stages of the life cycle of food products. A study [7] of greenhouse gas (GHG) emissions from 24 Indian food items showed that animal food products (meat and milk) and rice cultivation mostly contributed to methane (CH_4) emission, while food products from crops contributed to the emission of nitrous oxide (N_2O). Emission of CO_2 occurred during farm operations, production of farm inputs, transport, processing and preparation of food. The GHG emission during the life cycle of cooked rice was 2.8 times the GHG emission during the life cycle of chapati, a product of wheat flour. Mutton emitted 11.9 times as much GHG as milk, 12.1 times fish, 12.9 times rice and 36.5 times chapati. As Indians mostly consume fresh foods produced locally, 87% of emissions came from food production followed by preparation (10%), processing (2%) and transportation (1%). For a balanced diet (vegetarian) an adult Indian man consumed 1165 g of food and emitted 723.7 g CO_2 eq. GHG d^{-1}. A non-vegetarian meal with mutton emitted GHG 1.8 times of a vegetarian meal, 1.5 times of a non-vegetarian meal with chicken and an ovo-vegetarian meal and 1.4 times a lactovegetarian meal. Change in food habits thus could offer a possibility for GHG mitigation.

A similar study [5] was done in the Netherlands to analyse the emissions of greenhouse gases produced by Dutch households in their food consumption. The authors found that certain types of food, specifically those from cattle farming and agriculture, were major sources of emissions. The study suggests that these findings can inform potential reductions in emissions by identifying which food products have higher emissions and their potential reduction options which is along similar lines to the study that is undertaken by us.

A study along the aforementioned lines was undertaken by Nigeria wherein a relationship between C02 emission, agricultural productivity and food security was tried to be established.A cyclic relationship nature was found– agriculture and food production cause Carbon Emissions. [2] Damage from the consumption of toxic emissions from CO_2 by the surrounding vegetation can affect the quality and aesthetic value of plants and reduce their economic value. When CO_2 sinks in the atmosphere, the resulting water can become harmful to vegetation and aquatic life.

Taking our neighbour Pakistan into account. Pakistan, with 2.5% of the world's population, is a food-insecure country. Vision 2050 of UNO emphasizes the doubling of world food production to achieve food security. [4] Pakistan requires effective policies to meet the targets of UN Vision 2050. Analysing the impact of some important factors on food production may be helpful to achieve sufficient food production in Pakistan. Pakistan is hence working on developing a model which increases food production to become a food-secure country without compromising on CO_2 and GreenHouse Gases Emission.

Hence, it can be suggested that changes to our diet such as eating more plant-based foods and choosing meat from animals that don't produce methane can help reduce emissions and mitigate climate change. It can hence be concluded that the way we consume food has an impact on the environment, and understanding this relationship is important.[6]

III. MATERIALS AND METHODS

A. Study Area

The population of the world has doubled since 1973. Of course, that expansion has not been evenly distributed, and the list of the nations with the largest population is still changing.

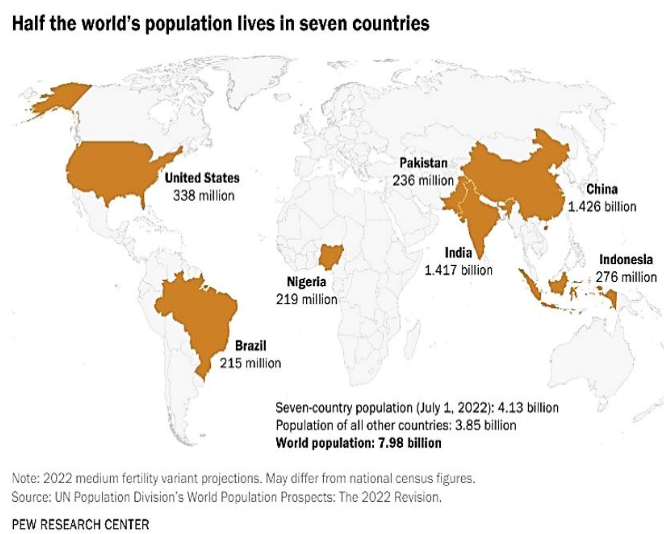

Fig. 1. Population of top seven-countries as of July 1, 2022

We examined which nations account for the largest portion of the **eight billion** people on the earth using the most recent data from the United Nations[1]. And more than half of all people live in just seven countries[2].

The below mentioned statistics demonstrate the stark disparity in growth for these countries, which are among the most populous on earth. Pakistan and Nigeria's populations nearly doubled in size whereas Germany's population increased by only 6% over the previous 50 years[1].

Country	Population (1973)	Rank (1973)	Population (2023)	Rank (2023)
China	881,652,084	1	1,425,671,353	2
India	596,107,487	2	1,428,627,666	1
United States	207,314,772	3	339,996,567	3
Russia	132,191,636	4	144,444,360	9
Indonesia	124,709,060	5	277,534,118	4
Japan	109,679,473	6	123,294,516	12
Brazil	103,666,906	7	216,422,450	7
Germany	78,667,473	8	83,294,634	19
Bangladesh	71,144,816	9	172,954,325	8
Pakistan	64,285,630	10	240,485,666	5
Nigeria	59,605,450	11	223,804,636	6
United Kingdom	56,166,630	12	67,736,798	21
Mexico	55,228,202	13	128,455,563	10

Fig. 2. Population growth comparison between 1973 to 2023

The world's population leader currently is China (1.426 billion), although India (1.417 billion) is predicted to overtake China in next year. China's population actually exceeds that of the entire continents of Europe (744 million) and the Americas (1.04 billion), and is almost equal to that of all the countries in Africa (1.427 billion) [2].

According to the Global Population and Environment Program of the nonprofit Sierra Club, "Population, global warming, and consumption patterns are intricately intertwined in their combined global environmental impact." The size of the population and the rate of population growth will become important factors in amplifying the effects of global warming as developing countries' share of emissions rises[3].Growing population contributes to enhancing environmental stress. For instance, the United States produces 25% of the world's CO2 despite having only 5% of the global population. However, while it is declining or stagnating in the majority of wealthy nations (with the exception of the United States due to immigration), population growth is accelerating in fast industrializing developing countries. By 2050, developing nations with rapid population growth (like China and India) will account for more than half of the world's CO2 emissions[3].

In recent years, the relationship between food consumption and the environment has drawn political and social attention. The environment is under more pressure as food consumption rises. Rarely has the evaluation of greenhouse gas (GHG) emission

been done in research on the environmental implications of food consumption; instead, the focus has typically been on energy use and waste creation. Carbon dioxide (CO2) is the most significant GHG derived from food consumption, followed by methane (CH4) and nitrous oxide (N2O) (Kramer et al., 1999)[4].

Therefore, the study area to be chosen for carbon emission due to food consumption is top 10 most populated countries i.e. China, India, United States, Indonesia, Pakistan, Nigeria, Brazil, Bangladesh, Russia, Mexico, contribute at least 50% of the global population, considering the most consumed dish per capita for one serving.

B. Data collection procedure

The primary data for this investigation has been prepared by using the vast amount of data present in the internet. We identified the most consumed/popular dish in each of the 10 selected countries. Using the standard recipes of those selected dishes, we noted down the amount of main ingredients each that are needed to make one standard serving for an adult.

TABLE I
MOST CONSUMED/POPULAR DISHES IN 10 COUNTRIES

Sr.no.	**Countries**	**Dishes**	**Source**
1	China	Yangzhou fried rice	China highlights
2	India	Vegetable curry, chapati	The spruce eats
3	United States	Burgers, fries	Micro b life
4	Indonesia	Nasi goreng	CNN
5	Pakistan	Pakistani nihari	FOOD52
6	Nigeria	Jollof rice	Will fly for food
7	Brazil	Feijoada with rice	Rainforest cruises
8	Bangladesh	Fish curry with rice	Together women rise
9	Russia	Pelmeni	trip savvy
10	Mexico	Tacos	Taste atlas

TABLE II

MAIN INGREDIENT OF EACH DISH

Sr.no	Dishes	Ingredients	Source
1	Yangzhou fried rice	Rice, prawns, egg, vegetables, oil, ham(pork)	https://www.madewithlau.com/recipes/yangzhoufried-rice
2	Vegetable curry, chapati	Wheat, vegetable, onion, tomato, potato, oil	https://www.bongeats.com/recipe/roti https://www.slurrp.com/recipes/mixed-veg-1611367030
3	Burgers, fries	Wheat, beef, tomato, onion, potatoes, cheese	https://www.slurrp.com/recipes/mixed-veg-1611367030
4	Nasi goreng	Rice, oil, chicken, eggs, onions,	https://www.recipetineats.com/nasi-gorengindonesian-fried-rice/
5	Pakistani nihari	Beef, oil, onions, wheat	https://samarascuisine.com/nihari-recipe/
6	Jollof rice	Rice, chicken, onion,	https://www.slurrp.com/recipes/jollof-rice-1623823191
7	Feijoada with rice	Onion, tomatoes, olive oil, rice, pork, beans	https://www.curiouscuisiniere.com/feijoadabrazilian-black-bean-stew/
8	Fish curry with rice	Rice, fish, radish, onion	https://www.slurrp.com/recipes/bangladesh-fishcurry-recipe-1622791817
9	Pelmeni	Wheat, eggs, beef, pork, onion	https://www.thekitchn.com/pelmeni-recipe-23058710
10	Tacos	Beef, tomatoes, wheat, cheese	https://www.bettycrocker.com/recipes/easy-beeftacos/426c261d-b2eb-4e22-9cba-0066f3335591

TABLE III

PORTION SIZE OF INGREDIENTS PER CAPITA (1 serving)

Sr.no	**Dishes**	Ingredients (per kg)					
1	Yangzhou fried rice	**Rice**	**Prawns**	**Eggs**	**Vegetables**	**Oil**	**Ham(pork)**
		0.06167	0.0227	0.0224	0.0226	0.009	0.0283
2	Vegetable curry, chapati	**Wheat**	**Vegetable**	**Onions**	**Tomato**	**Potato**	**Oil**

		0.08	0.214	0.075	0.075	0.075	0.0075
3	Burgers, Fries	**Wheat**	**Beef**	**Tomato**	**Onions**	**Potatoes**	**Cheese**
		0.105	0.151195945	0.02918	0.02918	0.0850486	0.04
4	Nasi Goreng	**Rice**	**Oil**	**Chicken**	**Eggs**	**Onions**	
		0.135	0.0085	0.0375	0.005	0.075	
5	Pakistani nihari	**Beef**	**Oil**	**Onions**	**Wheat**		
		0.1135	0.0283	0.0625	0.0071		
6	Jollof Rice	**Rice**	**Chicken**	**Onions**			
		0.05625	0.0435	0.078599053			
7	Feijoada with rice	**Onions**	**Tomato**	**Olive oil**	**Rice**	**Pork**	**Beans**
		0.03144	0.0085	0.0143	0.167	0.0567	0.0453592
8	Fish curry with rice	**Rice**	**Fish**	**Radish**	**Onions**		
		0.4	0.075	0.075	0.00017		
9	Pelmeni	**Wheat**	**Eggs**	**Beef**	**Pork**	**Onions**	
		0.0375	0.0005	0.011339	0.011339	0.014174	
10	Tacos	**Beef**	**Tomato**	**Wheat**	**Cheese**		
		0.045	0.0226796	0.04166667	0.0113398		

We used a standard data set from Kaggle named Food_Product_Emission from EDGAR. EDGAR is the Emission Database for Global Atmospheric Research and EDGAR-FOOD is a global emission inventory of GHGs from food systems. This data set consists of information on CO_2 per kg produced by the most common food. Each food product is listed with global average GHG emissions from each stage of the food value chain from Land, Farm, Animal feed, Processing, Transport, Packaging, up to retail. (Note that it excludes the global average GHG emissions for Consumer or Waste stages of global food systems.)

TABLE IV
EDGAR DATASET OF FOOD EMISSIONS

Food product	Land Use Change	Feed	Farm	Processing	Transport	Packaging	Retail	Total from Land to Retail	Total Global Average GHG Emissions per kg	Unit of GHG Emissions

Apples	-0.029	0	0.225	0.004	0.096	0.044	0.017	0.357	0.43	kg CO2e per kg food produced
Bananas	-0.025	0	0.266	0.059	0.292	0.065	0.021	0.678	0.86	kg CO2e per kg food produced
Barley	0.009	0	0.176	0.128	0.035	0.497	0.264	1.109	1.18	kg CO2e per kg food produced
Beef (beef herd)	16.278	1.878	39.388	1.269	0.346	0.247	0.164	59.57	99.48	kg CO2e per kg food produced
Beef (dairy herd)	0.906	2.508	15.689	1.108	0.424	0.268	0.182	21.085	33.3	kg CO2e per kg food produced
Beet Sugar	0	0	0.536	0.242	0.629	0.09	0.039	1.536	1.81	kg CO2e per kg food produced
Berries & Grapes	0.025	0	0.722	0	0.238	0.212	0.017	1.214	1.53	kg CO2e per kg food produced
Brassicas	0.002	0	0.278	0	0.095	0.045	0.017	0.437	0.51	kg CO2e per kg food produced
Cane Sugar	1.247	0	0.485	0.037	0.784	0.083	0.036	2.672	3.2	kg CO2e per kg food produced
Cassava	0.589	0	0.22	0	0.094	0.045	0.039	0.987	1.32	kg CO2e per kg food produced
Cheese	4.455	2.346	13.059	0.738	0.138	0.172	0.332	21.24	23.88	kg CO2e per kg food produced
Citrus Fruit	-0.146	0	0.307	0	0.094	0.045	0.017	0.317	0.39	kg CO2e per kg food produced
Coffee	3.688	0	10.386	0.592	0.13	1.63	0.051	16.477	28.53	kg CO2e per kg food produced
Dark Chocolate	14.308	0	3.706	0.185	0.061	0.4	0.021	18.681	46.65	kg CO2e per kg food produced

Eggs	0.709	2.2	1.317	0	0.084	0.161	0.036	4.507	4.67	kg CO2e per kg food produced
Fish (farmed)	0.534	0.819	3.598	0.02	0.111	0.061	0.04	5.183	13.63	kg CO2e per kg food produced

Groundnuts	0.439	0	1.425	0.372	0.12	0.099	0.042	2.497	3.23	kg CO2e per kg food produced
Lamb & Mutton	0.468	2.37	19.508	1.111	0.49	0.251	0.217	24.415	39.72	kg CO2e per kg food produced
Maize	0.315	0	0.475	0.052	0.06	0.06	0.026	0.988	1.7	kg CO2e per kg food produced
Milk	0.495	0.236	1.458	0.149	0.09	0.097	0.256	2.781	3.15	kg CO2e per kg food produced
Nuts	-2.052	0	2.126	0.032	0.067	0.078	0.027	0.278	0.43	kg CO2e per kg food produced
Oatmeal	0.001	0	1.37	0.042	0.067	0.066	0.029	1.575	2.48	kg CO2e per kg food produced
Olive Oil	-0.377	0	4.272	0.66	0.482	0.861	0.046	5.944	5.42	kg CO2e per kg food produced
Onions & Leeks	0.005	0	0.211	0	0.095	0.045	0.039	0.395	0.5	kg CO2e per kg food produced
Other Fruit	0.126	0	0.369	0.015	0.182	0.042	0.016	0.75	1.05	kg CO2e per kg food produced
Other Pulses	0.033	0	1.089	0	0.096	0.353	0.039	1.61	1.79	kg CO2e per kg food produced
Vegetables	0.001	0	0.174	0.06	0.164	0.041	0.015	0.455	0.53	kg CO2e per kg food produced

Palm Oil	3.096	0	2.107	1.264	0.208	0.886	0.044	7.605	7.32	kg CO2e per kg food produced
Peas	0	0	0.717	0	0.095	0.045	0.039	0.896	0.98	kg CO2e per kg food produced
Pig Meat	1.535	2.94	1.694	0.284	0.343	0.296	0.19	7.282	12.31	kg CO2e per kg food produced
Potatoes	-0.001	0	0.193	0	0.094	0.045	0.039	0.37	0.46	kg CO2e per kg food produced
Poultry Meat	2.54	1.775	0.672	0.44	0.276	0.212	0.177	6.092	9.87	kg CO2e per kg food produced
Rapeseed Oil	0.212	0	2.343	0.193	0.19	0.844	0.046	3.828	3.77	kg CO2e per kg food produced
Rice	-0.022	0	3.553	0.065	0.096	0.084	0.063	3.839	4.45	kg CO2e per kg food produced
Root Vegetables	0.013	0	0.154	0	0.114	0.045	0.039	0.365	0.43	kg CO2e per kg food produced
Shrimps (farmed)	0.206	2.51	8.379	0	0.206	0.334	0.219	11.854	26.87	kg CO2e per kg food produced
Soybean Oil	3.096	0	1.519	0.311	0.299	0.849	0.043	6.117	6.32	kg CO2e per kg food produced
Soymilk	0.18	0	0.093	0.163	0.11	0.098	0.27	0.914	0.98	kg CO2e per kg food produced
Sunflower Oil	0.133	0	2.148	0.229	0.201	0.853	0.043	3.607	3.6	kg CO2e per kg food produced
Tofu	0.958	0	0.495	0.794	0.177	0.177	0.27	2.871	3.16	kg CO2e per kg food produced
Tomatoes	0.372	0	0.704	0.012	0.177	0.145	0.017	1.427	2.09	kg CO2e per kg food produced

Wheat	0.1	0	0.847	0.217	0.129	0.09	0.058	1.441	1.57	kg CO2e per kg food produced
Wine	-0.061	0	0.626	0.139	0.093	0.749	0.039	1.585	1.79	kg CO2e per kg food produced

C.Data analysis approach

Data for the study were generated and analysed in Microsoft Excel using distribution tables with simple measurements and introspectively using mathematical models for the computation of carbon emission of food consumption. Visualization is done using python programming.

We used Regression plots to compare population and CO2 emissions, regression plots can show the correlation between the two variables, allowing us to gain insight into the correlation between population size and environmental impact. By plotting population against CO2 emissions, we can observe countries with high or low population growth and the corresponding impact on emissions. For example, we can observe that countries with larger populations tend to have higher emissions and vice versa.

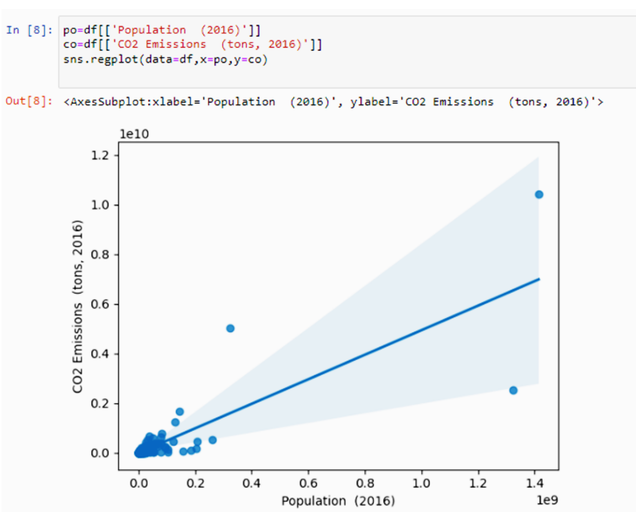

Fig. 3. Regression plot between population and CO2 Emission

We used a correlation heat map which is a useful tool for understanding the relationships between data points and variables. It visually displays a matrix of values that indicate how closely related two variables are. For example, by plotting population, CO2 emissions, share of the world, and per capita data points, it's possible to quickly see which data points are highly or even moderately correlated with each other. By exploring these correlations, it becomes easier to identify relationships and trends in the data and make more informed decisions. Ultimately, correlation heat maps help us gain a better understanding of our data and use it more effectively to make better decisions.

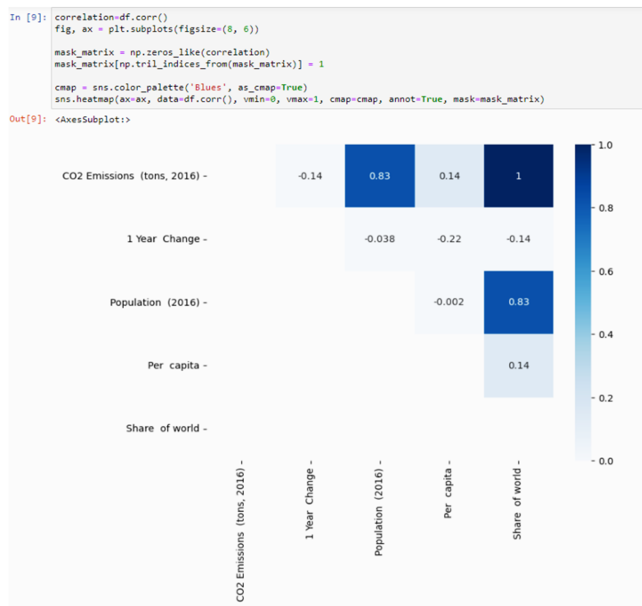

Fig. 4. Heatmap of Correlation

Finally, r square analysis used to explore the relationship between population and CO2 emissions data. The results from the analysis showed that the two variables had a moderately high correlation i.e 0.6807, indicating that population growth could be a contributing factor to the increase in CO2 emissions. This suggests that population growth should be considered when developing strategies to reduce emissions. This analysis was done in the python programming language using NumPy library.

```
In [10]: model=LinearRegression()
         X,y=po,co
         model.fit(X,y)
         r_squared=model.score(X,y)
         print(r_squared)

         0.6807411587971082
```

Fig. 5. R-squared analysis

D. Estimation of carbon emission

From the empirical survey through various websites, the main ingredients of the dishes have been determined. To estimate the weight of each ingredient the standard recipes are taken into consideration, accounting the portion size to be per capita. The weights were converted into kilograms for the suitable calculation of CO_2 emission per kg food items. Computation of CO_2 emission initiated by multiplying the total global average(mean) GHG with the weights of each item and furthermore taking the summation of the derived values for each of the dishes which concludes the carbon emission for the particular dish of the country.

Therefore, the equation sits as follows:

CO_2 per kg per capita = $\sum$ (weights of ingredient or food items * total global mean GHG)

IV. RESULTS

This figure shows CO2 emissions of all the food products used in the most popular dishes of the 10 countries, i.e., India, USA, China, Bangladesh, Mexico, Russia, Indonesia, Pakistan, Nigeria, and Brazil. Here we can see that animal-based food products such as beef, cheese, chicken, and seafood (including prawns) have a higher carbon footprint compared to plant-based foods. This is mainly due to the emissions from raising and transporting the animals, as well as the process of producing animal-based products. Livestock farming is a major source of greenhouse gas emissions, including methane from enteric fermentation in ruminants and manure and nitrous oxide from manure and fertilizers.

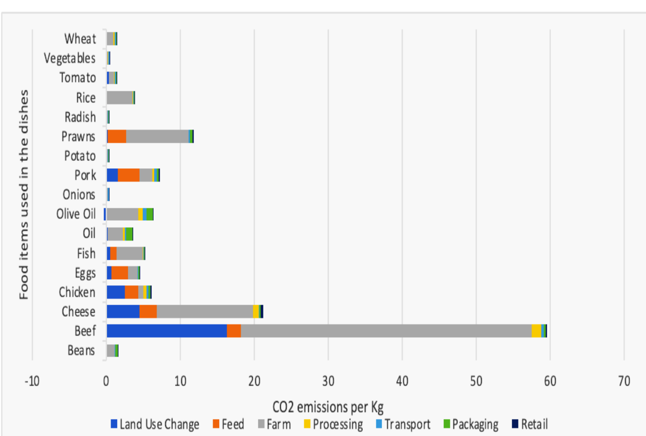

Fig. 6. CO2 emission of the dish used in the most popular dish of 10 Countries.

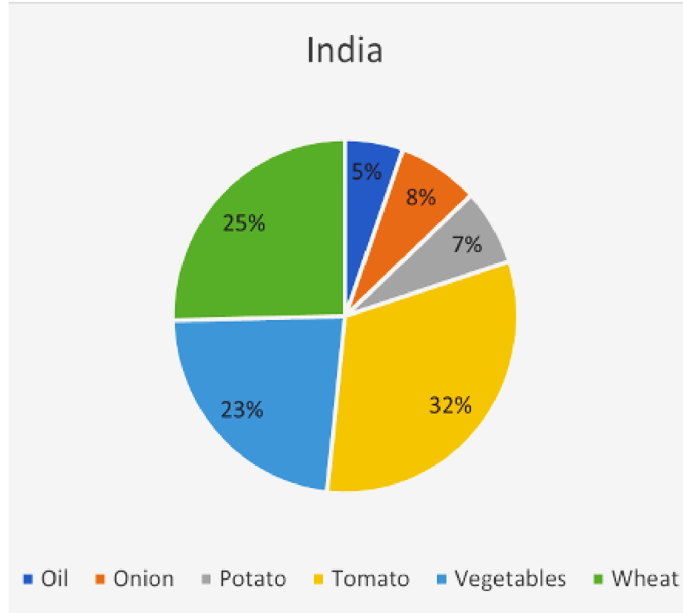

Fig. 7. CO2 emission of the ingredients used in the most popular dish (Vegetable Curry, Chapati) in India.

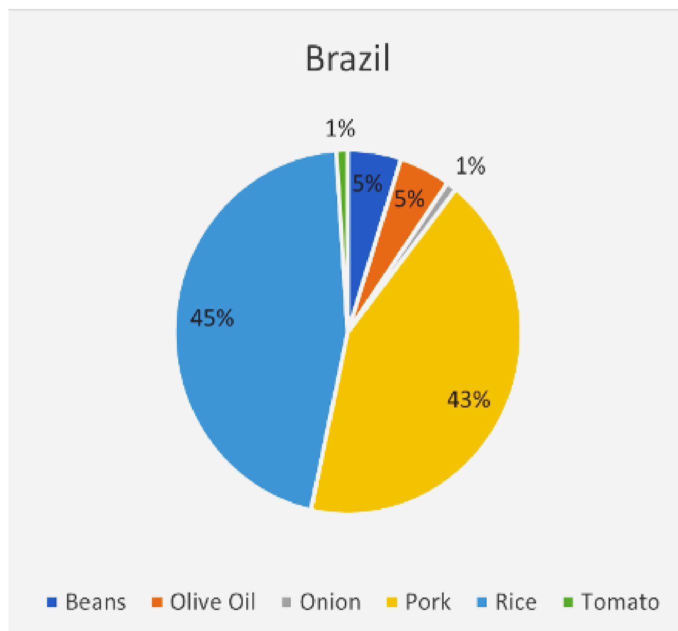

Fig. 8. CO2 emission of the ingredients used in the most popular dish (Feijoada with rice) in Brazil.

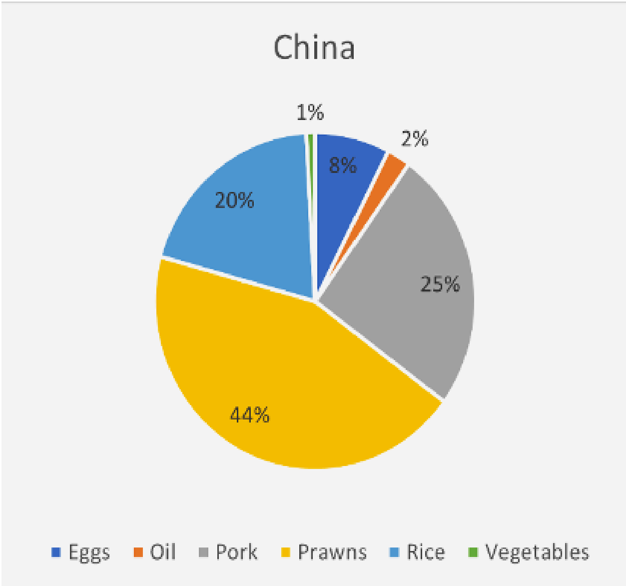

Fig. 9. CO2 emission of the ingredients used in the most popular dish (Yangzhou fried rice) in China.

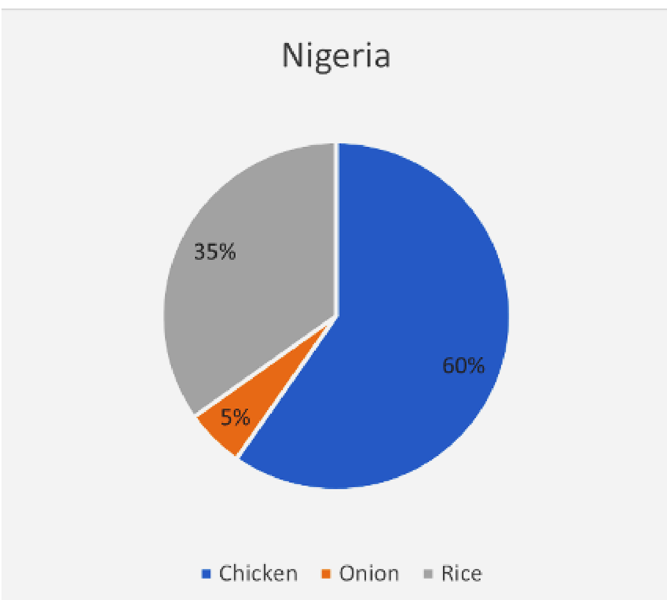

Fig. 10. CO2 emission of the ingredients used in the most popular dish (Jollof Rice) in Nigeria.

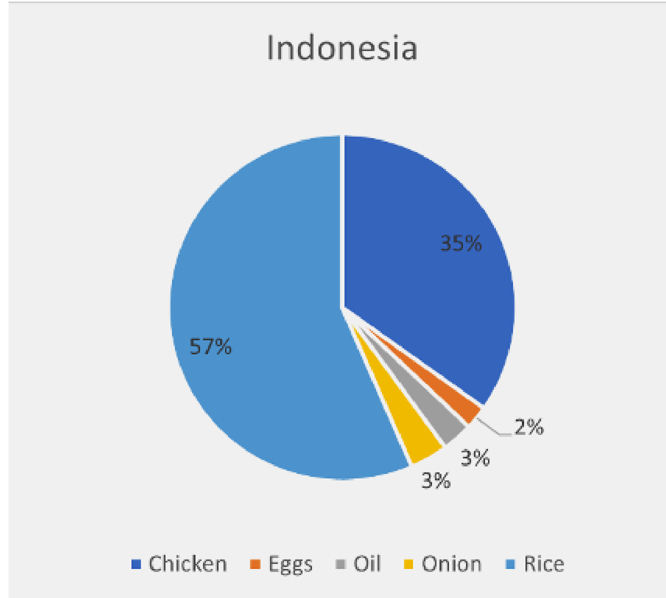

Fig. 11. CO2 emission of the ingredients used in the most popular dish (Nasi Goreng) in Indonesia.

In the Nigerian dish Jollof Rice, the weight of rice is almost the same, but the emission caused by chicken is almost double. The same trend is seen in the Indonesian dish Nasi Goreng. In dishes like Jollof Rice and Nasi Goreng, which typically include both rice and chicken, the emissions from the chicken component of the dish can be significant. As mentioned earlier, animal-based foods like chicken have a higher carbon footprint compared to plant-based foods like rice. This is due to the emissions from raising and transporting the animals, as well as the process of producing animal-based products. In these dishes, even if the weight of rice and chicken is similar, the emissions from the chicken component can still be much higher.

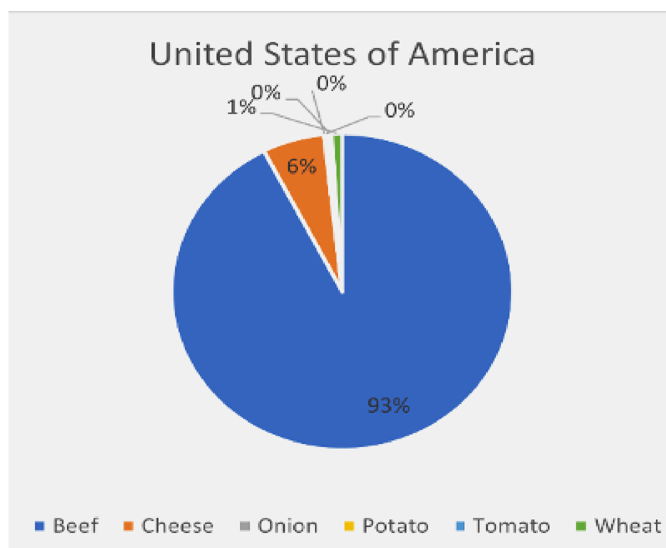

Fig. 12. CO2 emission of the ingredients used in the most popular dish (Burger, fries) in the USA.

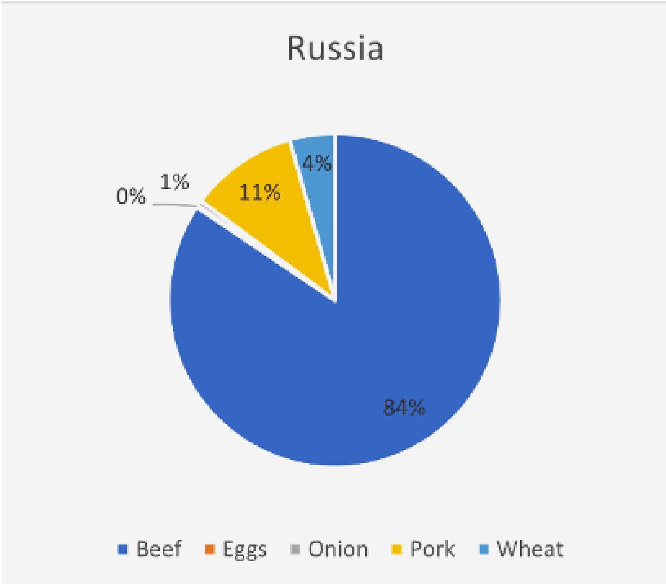

Fig. 13. CO2 emission of the ingredients used in the most popular dish (Pelmeni) in Russia.

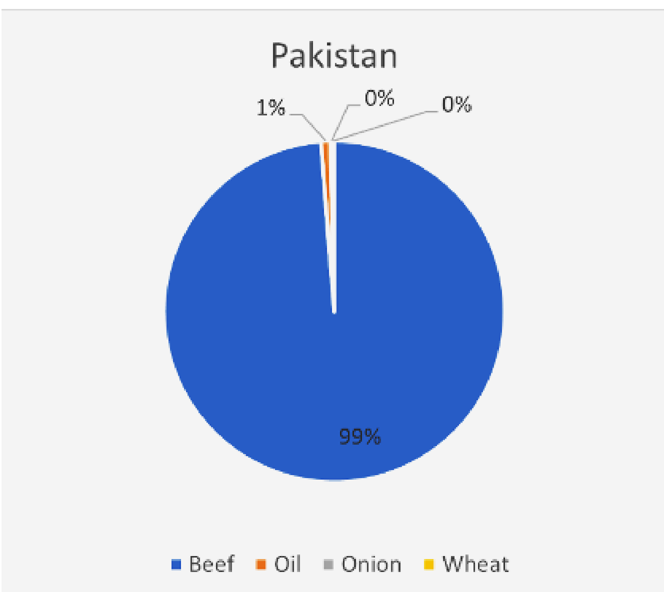

Fig. 14. CO2 emission of the ingredients used in the most popular dish (Pakistani Nihari) in Pakistan.

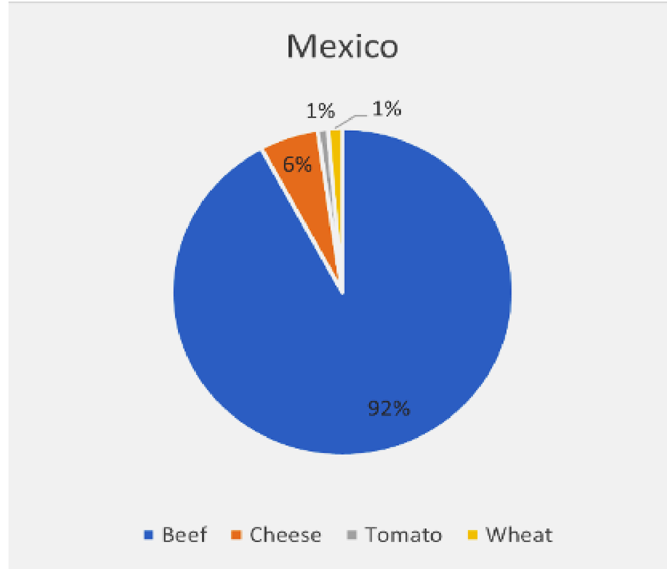

Fig. 15. CO2 emission of the ingredients used in the most popular dish (Tacos) in Mexico.

The plots above show how Beef takes over the entire region. The life cycle of beef production, including the growing of feed crops, raising and maintaining the cows, transporting them to slaughter, processing and packaging the meat, and transporting it to retailers and consumers, results in significant emissions of greenhouse gases. The primary sources of emissions are enteric fermentation in cows, manure management, and land use.

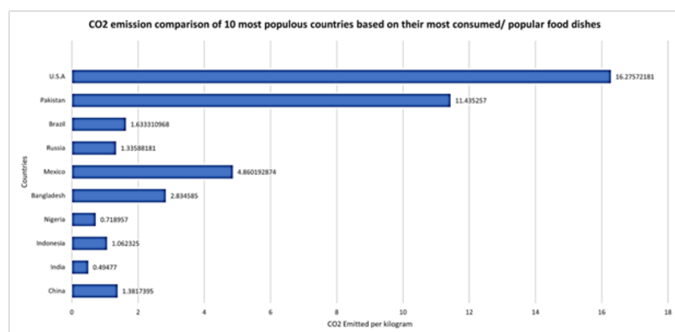

Fig. 16. Comparison of CO2 emission of the most popular dish per capita of 10 countries.

The United States, Pakistan, Brazil, and Mexico all have relatively high per capita beef consumption rates, and the production of beef in these countries can contribute to significant emissions of greenhouse gases. India and Nigeria, which have relatively high populations, also traditionally follow a mostly vegetarian diet. This can contribute to lower emissions of greenhouse gases compared to countries with high meat consumption. The production of plant-based foods typically results in lower emissions compared to animal-based foods, due to the fact that animals require more resources, such as water and feed. In brief, the countries with high per capita beef consumption, such as the United States, Pakistan, Brazil, and Mexico, contribute to significant emissions of greenhouse gases due to the resources required to produce the beef. India and Nigeria, on the other hand, have traditionally followed a mostly vegetarian diet, which can contribute to lower emissions of greenhouse gases. The production of plant-based foods typically results in lower emissions compared to animal-based foods due to the resources required to produce the food. In conclusion, reducing meat consumption and switching to a plant-based diet can be an effective way to lower greenhouse gas emissions and combat climate change.

V. CONCLUSION

The amount of carbon emissions can be significantly influenced by dietary habits. In comparison to plant-based diets, a diet high in meat, especially red and processed meat, tends to have a higher carbon footprint. A nation's high carbon footprint can have a variety of detrimental repercussions on the environment, the economy, and public health. A diet that favours seasonal and local foods can assist to increase food security by reducing reliance on imported food and strengthening local food systems. We may further analyse how demographic change may impact carbon dioxide emissions globally by demonstrating that slower population growth could lead to the emission reductions that are predicted to be required by 2050 to prevent severe climate change. This can be accomplished by applying a food-production growth model that considers a number of demographic parameters.

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