

What's Driving the Vegan Trend?

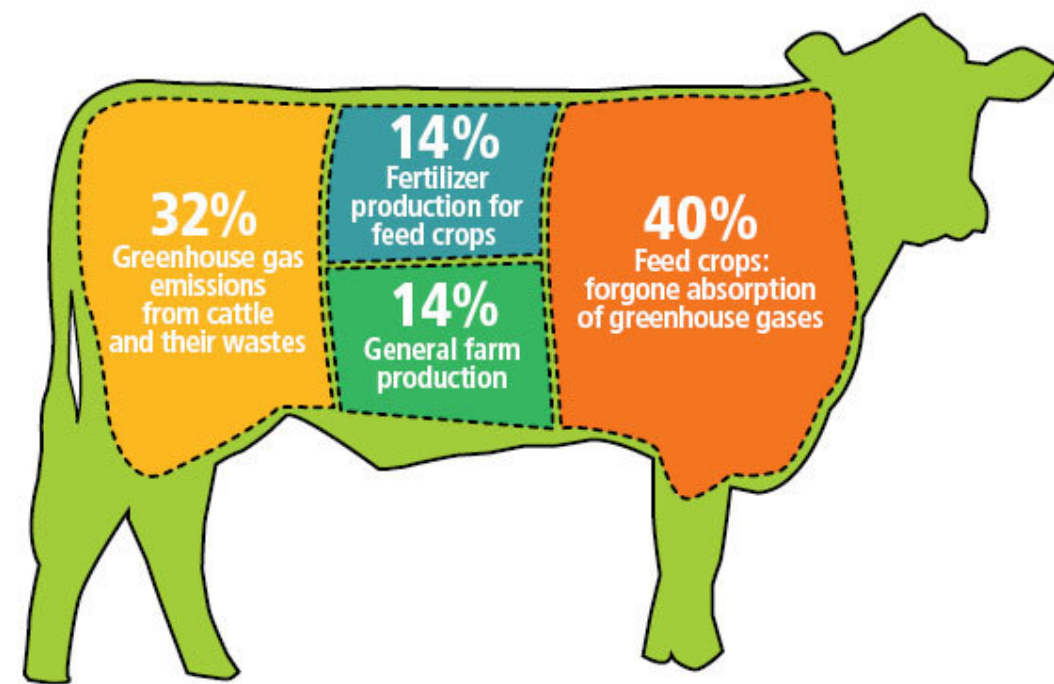
DH 100 Theory and Methods, Summer 2021 | Instructor: Adam Anderson | Student: Seunghye Jeon | 2021. 06. 27

Introduction:

Humans are omnivores, and animal meat provides many nutrients that humans need that are not available in plant sources (Bhat 2010, 125). According to Bhat, “[m]eat is specifically valuable as a source of omega-3 fatty acids, vitamin B12, protein and highly bioavailable iron (Bhat 2010, 125).” Therefore, meat is a significant food source for human which helps to keep better physical and mental health, and the demand for the meat is keep increasing. However, the increased meat production and consumption also have some adverse effects on the environment and human health. Since the environmental problems caused by the meat production is coming up as an issue nowadays, many people are trying to organize their diet with plant-based ingredients instead of animal meat. In this project, I would like to identify the effect of meat consumption to the environment and human health and the current trend of vegetarianism.

Questions to Explore:

- 1) How does the meat production affect the environment?
- 2) How does the meat consumption affect the human health?
- 3) What is current trend and movement of the vegetarianism?



Datasets:

- 1) Environment Impact of Food Production (csv file)
- 2) WORLD DATA by country (csv files)
- 3) Vegetarian and Vegan Restaurants (csv file)

Description of Method and Analysis:

1) Data Gathering:

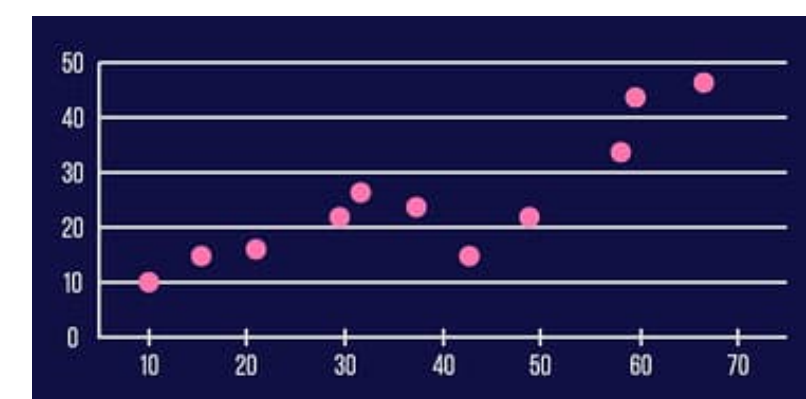
Gather the relevant datasets from the Kaggle

2) Data Processing / Cleaning / Filtering:

Process the data to make them fit the purpose of exploration questions utilizing Pandas in Jupyter Notebook. Join the datasets that are relevant and drop the columns from the datasets that are not necessary for this project.

3) Data Visualization:

Create the visualization based on the processed data. Bar Plot can be used to visualize how the meat production affects the various aspects of environment and show the distribution of vegetarian and vegan restaurants. Scatter Plot can also be used to compare the meat consumption and health status of people in each country. Scatter Plot helps us to identify the correlation between the meat consumption and the human health. The overall visualization of the data can help us to understand the large-scale data at a glance.



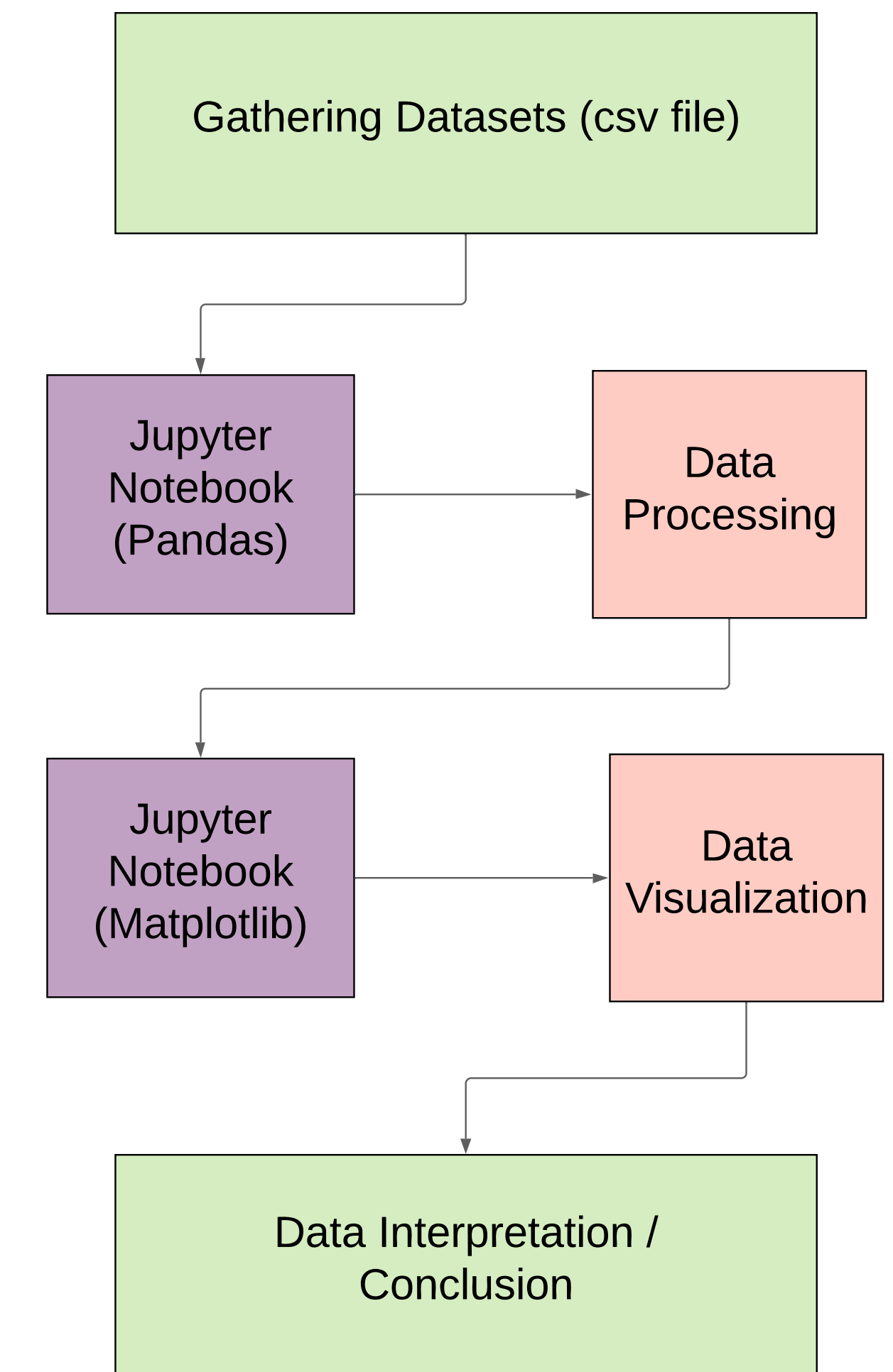
4) Data Interpretation / Conclusion:

With the data cleaned and visualized, it is possible to draw the conclusion of the project.

Link to Jupyter Notebook: <https://drive.google.com/file/d/19ZBWZjqTPE7TFk77b9NdKCJLvBK1TDm0/view?usp=sharing>

Hypothesis:

The hypothesis I have for this project is that meat production and consumption causes adverse effect to the environment and the human health. Many people are recognizing these adverse effects so that current trend of vegetarianism is rising. However, since there are some nutrients that we can gather from meats, we should consider the way we can continue sustainable diet with healthy and environmental-friendly ingredients.



Works Cited:

- 1) Bhat, Zuhair Fayaz, and Hina Fayaz. "Prospectus of Cultured Meat—Advancing Meat Alternatives." *Journal of Food Science and Technology* 48, no. 2 (2010): 125–40. <https://doi.org/10.1007/s13197-010-0198-7>.
- 2) van der Weele, Cor, Peter Feindt, Atze Jan van der Goot, Barbara van Mierlo, and Martinus van Boekel. "Meat Alternatives: an Integrative Comparison." *Trends in Food Science & Technology* 88 (2019): 505–12. <https://doi.org/10.1016/j.tifs.2019.04.018>.
- 3) Vivek. "Environment Impact of Food Production." Kaggle (2020). <https://www.kaggle.com/selfvivek/environment-impact-of-food-production>
- 4) Daniboy370. "WORLD DATA by country (2020)." Kaggle (2020) <https://www.kaggle.com/daniboy370/world-data-by-country-2020>
- 5) Datafiniti. "Vegetarian and Vegan Restaurants." Kaggle (2018) <https://www.kaggle.com/datafiniti/vegetarian-vegan-restaurants>
- 6) <https://proveg.com/wp-content/uploads/2018/04/Foodplate.jpg>
- 7) <https://ecologise.in/wp-content/uploads/2015/12/meat.jpg>
- 8) <https://www.configuratori.com/wp-content/uploads/2020/10/DataVisualization.jpg>
- 9) <https://mk0insideclimats3pe4.kinstacdn.com/wp-content/uploads/2019/10/ag-climate-livestock-methane-emissions-infographic-1058px-1024x581.png>

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Environment Impact of Food Production Dataset:

This dataset contains the various information such as total emissions, land use per kilogram, and freshwater withdrawals per kilogram based on the food product.

	Food product	Land use change	Animal Feed	Farm	Processing	Transport	Packaging	Retail	Total_emiissions	Eutrophying emissions per 1000kcal (gPb, eq per 1000kcal)	Eutrophying emissions per kilogram (gPb, eq per kilogram)	Eutrophying emissions per 100g protein (gPb, eq per 100 grams protein)	Freshwater withdrawals per 1000kcal (liters per 1000kcal)	Freshwater withdrawals per 100g protein (liters per 100g protein)	Freshwater withdrawals per kilogram (liters per kilogram)	Greenhouse gas emissions per 100g protein (kg CO2-e)
0	Wheat & Rye (Bread)	0.1	0.0	0.8	0.2	0.1	0.1	0.1	1.4	0.000000	0.00	0.000000	0.000000	0.000000	0.0	0
1	Maize (Meal)	0.3	0.0	0.5	0.1	0.1	0.1	0.0	1.1	0.000000	0.00	0.000000	0.000000	0.000000	0.0	0
2	Barley (Beer)	0.0	0.0	0.2	0.1	0.0	0.5	0.3	1.1	0.000000	0.00	0.000000	0.000000	0.000000	0.0	0
3	Oatmeal	0.0	0.0	1.4	0.0	0.1	0.1	0.0	1.6	4.281357	11.23	8.638462	183.911552	371.076923	482.4	0
4	Rice	0.0	0.0	3.6	0.1	0.1	0.1	0.1	4.0	9.514379	35.07	49.394366	609.983722	3166.760563	2248.4	1
5	Potatoes	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.3	4.754098	3.48	20.470588	80.737705	347.647059	59.1	0
6	Cassava	0.6	0.0	0.2	0.0	0.1	0.0	0.0	0.9	0.708419	0.69	7.666667	0.000000	0.000000	0.0	1
7	Cane Sugar	1.2	0.0	0.5	0.0	0.8	0.1	0.0	2.6	4.820513	16.92	0.000000	176.66667	0.000000	620.1	0
8	Beet Sugar	0.0	0.0	0.5	0.2	0.6	0.1	0.0	1.4	1.541311	5.41	0.000000	62.022792	0.000000	217.7	0
9	Other Pulses	0.0	0.0	1.1	0.0	0.1	0.4	0.0	1.6	5.008798	17.08	7.977581	0.000000	203.503036	435.7	0
10	Peas	0.0	0.0	0.7	0.0	0.1	0.0	0.0	0.8	2.173410	7.52	3.384338	0.000000	178.487849	396.6	0

Interpretation of Dataset:

In this part, I utilized the "Environment Impact of Food Production" dataset to compare the various environmental impact occurred by the food production.

I created three visualizations with the dataset: Food Production and the Total Emissions, Food Production and the Land Use Per Kilogram, and Food Production and the Freshwater Withdrawals Per Kilogram. In the visualization, skyblue color bar indicates the plant based food and the orange color bar indicates the meat based food.

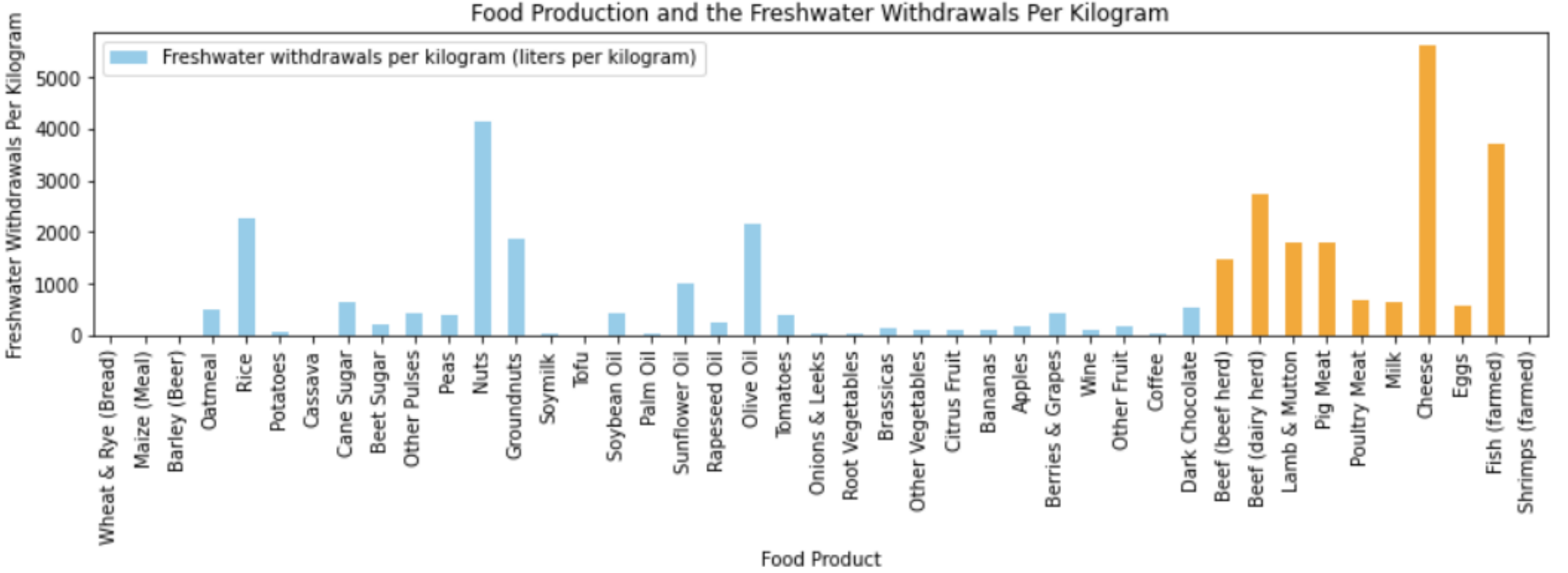
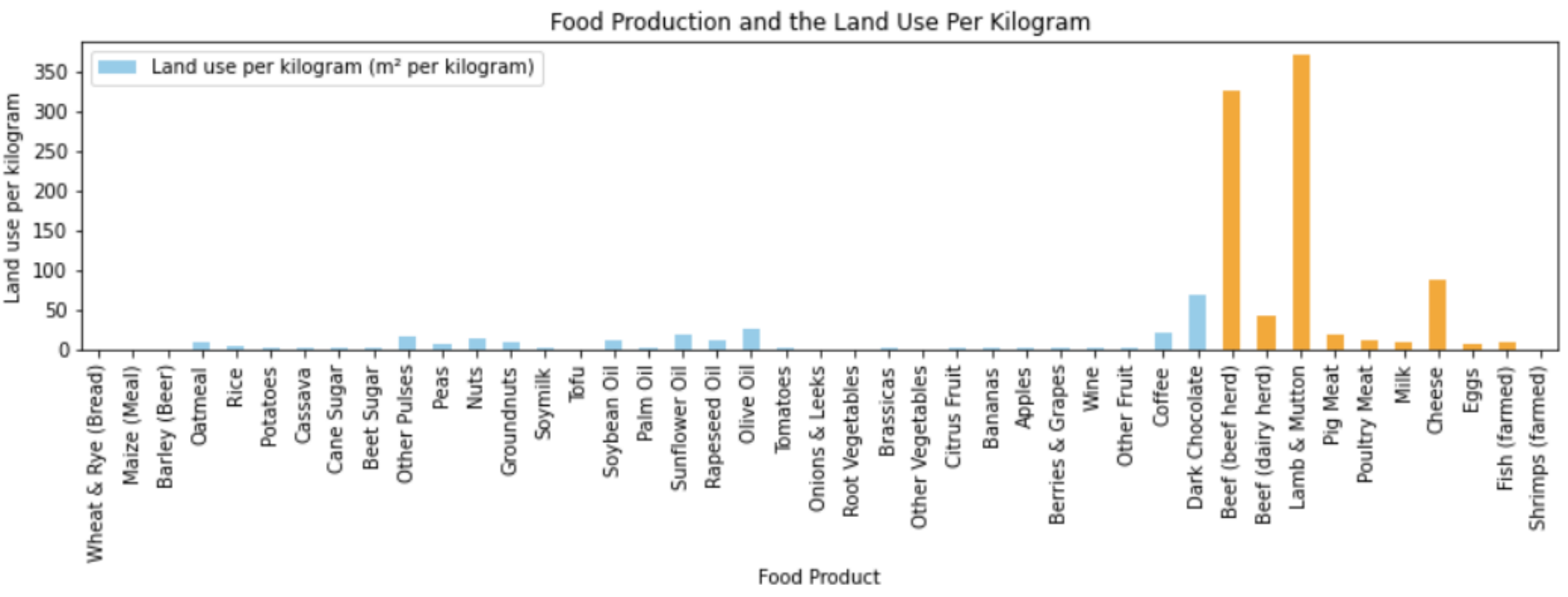
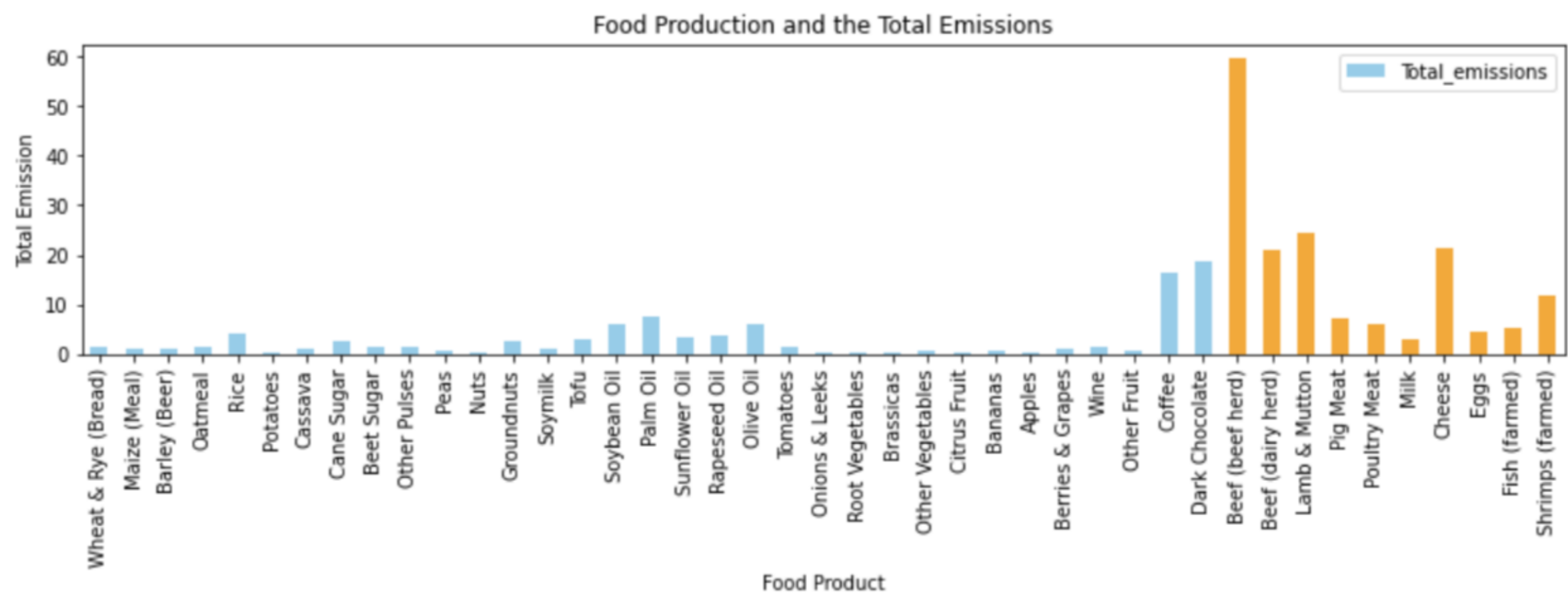
The first visualization shows the total emission of greenhouse gas in the food production. The total emission is significantly higher for meat products, especially for beef, compare to the plant products.

The second visualization shows the land use per kilogram based on the food product. The land use is also higher for meat products, especially for beef and lamb, compare to the plant products.

The last visualization shows the freshwater withdrawals per kilogram based on the food product. Cheese production causes the highest amount of freshwater withdrawl per kilogram followed by nuts and fish.

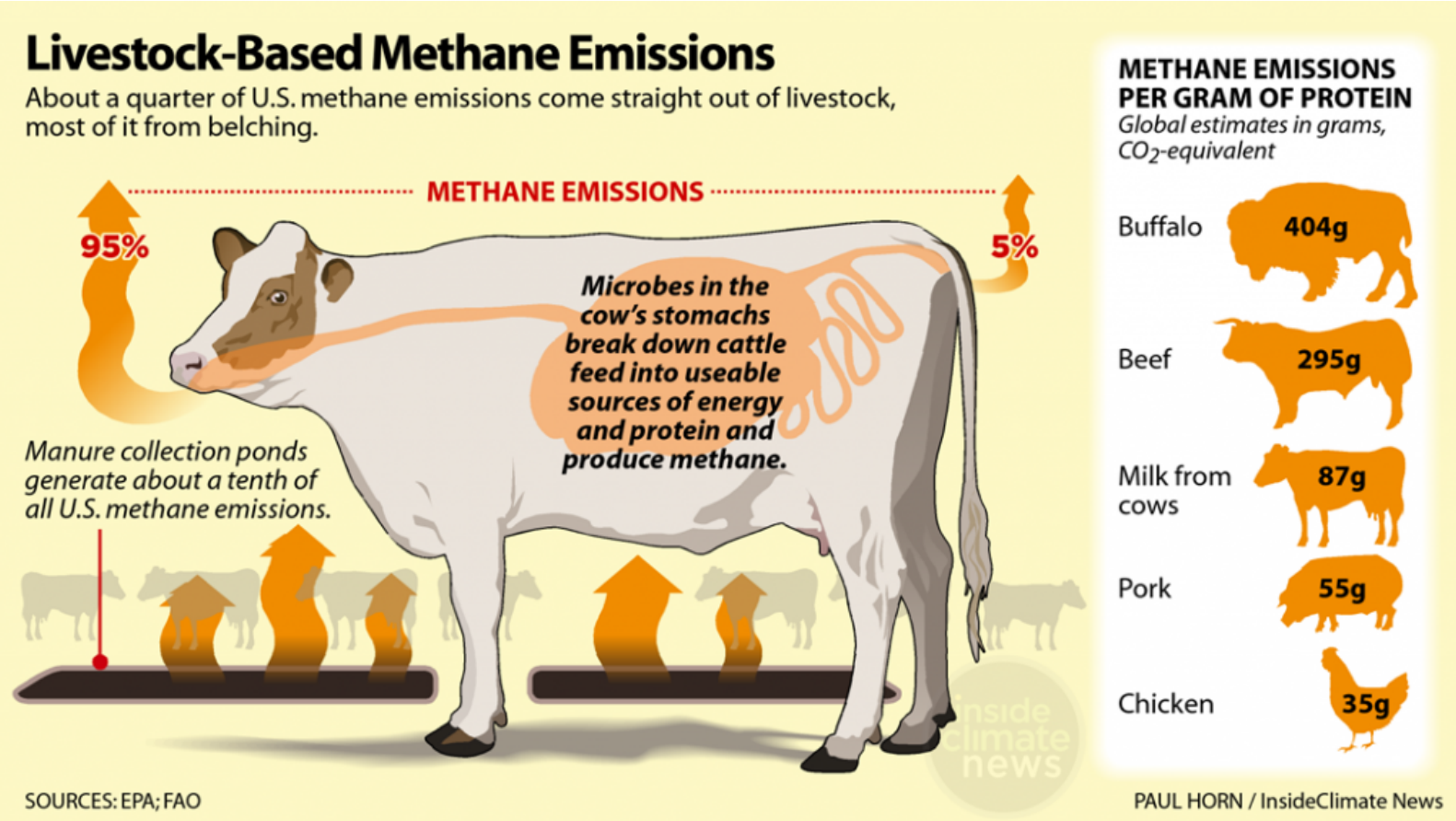
Tools and Methods:

For the interpretation of this dataset, I utilized the pandas in Jupyter Notebook. First of all, I imported the csv file and replaced N/A columns to '0' value to prevent the error when creating the visualization. Then, I utilized matplotlib to create the bar plot and designated skyblue color for the bars with plant based food products and orange color for the bars with meat based food products to make it easier to compare between plant and meat based food products at a glance.



Environment Impact of Meat Production:

The increased meat production and consumption have several adverse effects on the environment. According to Weele, “the increasing production and consumption of meat at global scale has triggered environmental concerns about land and water requirements, pollution and greenhouse gas emissions and biodiversity loss (Weele 2019, 505).” To raise the livestock for the meat production, 30% of land surface is used and 70% of the fresh water is used for food production (Bhat 2010, 126). Most of the land surfaces are used to raise crops to feed animals (Bhat 2010, 126). Moreover, meat production is responsible for the environmental pollution and greenhouse gas emissions. The meat production process emits the large amounts of nitrogen and phosphorus (Bhat 2010, 126). “[T]he emission of acidifying substances, biocides, and copper from meat protein food production is also higher than that from soybean-based protein food production, especially the emission of copper, which is over 100 times higher (He 2020, 2641).” The ruminants, such as cattle and sheep, emit huge amounts of methane gas, so that the greenhouse emissions are particularly high. Also, the pesticides used for the food and meat production contaminates the water (Bhat 2010, 126). Pollution is not only limited to air and water, but also soil. Soil is contaminated by the chemicals which contain metals, and ammonia emission triggers the acid rain (Bhat 2010, 126). In addition, the antibiotics used for the animal growth can cause the antimicrobial drug-resistant diseases (Bhat 2010, 126). The problem is that even with the current livestock scale, environmental problems are serious, and considering the increasing meat consumption in the future, there might be more severe environmental problems that could happen.



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WORLD DATA by country Dataset:

This dataset contains the various csv files including meat consumption, life expectancy, GDP per capita, and urbanization rate of each country.

Tools and Methods:

For the interpretation of WORLD DATA by country dataset, I utilized the pandas in Jupyter Notebook. First of all, I imported the csv files and merged the files to identify the correlation and to create the visualization. Then, I utilized matplotlib to create the scatter plot and seaborn to create the regression line to visualize the correlation. For the interpretation of Vegetarian and Vegan Restaurants dataset, I utilized the pandas in Jupyter Notebook. I imported the dataset and cleaned and ordered the dataset to make it easier to visualize. Then, I utilized matplotlib to create the bar plot about top 10 cuisines in vegan restaurants.

Human Health Impact of Meat Consumption:

In this part, I first utilized the "Meat Consumption," and "Life Expectancy" datasets to identify the human health impact of meat consumption. I used life expectancy dataset since I thought life expectancy could represent the human health status. I joined two datasets and created scatter plot with regression line to identify the correlation between the meat consumption and the life expectancy. My hypothesis was the country with more meat consumption will have shorter life expectancy. However, contrary to the hypothesis, the country with more meat consumption had higher life expectancy. However, since the life expectancy is influenced by various factors, this correlation alone does not show the correlation between the meat consumption and life expectancy. To make sure that life expectancy is influenced by various factors other than meat consumption, I created two other visualization that shows the correlation between GDP per capita and life expectancy and urbanization rate and life expectancy. The direct effect of meat consumption on human health could not be determined from the analysis of this dataset. However, according to the analysis of environmental impact of meat production earlier, we found that the meat production causes environmental pollution and this might cause an adverse effect on human health as well.

Current Trend and Movement of Vegetarianism:

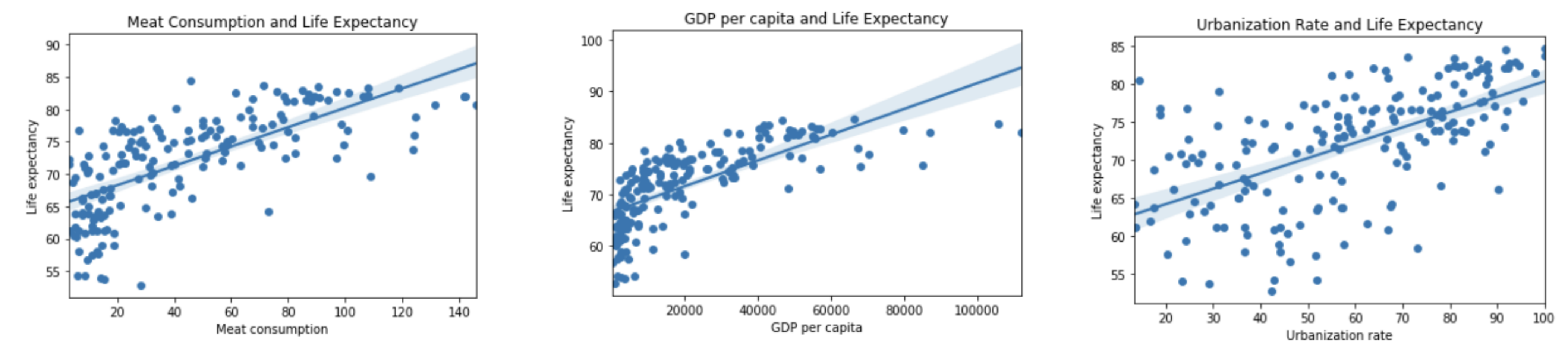
In this part, I utilized the "Vegetarian and Vegan Restaurants" dataset and identified the type of vegan restaurants in US. There were more than hundred kinds of cuisines and I sorted top ten cuisines for the visualization. Among the vegan restaurants, Indian Restaurants were the most number of vegan restaurants, followed by Chinese Restaurants and Smoothies and Juices.

	Country	Meat consumption	ISO-code
0	Afghanistan	17.3	AFG
1	Algeria	18.3	DZA
2	American Samoa	24.9	ASM
3	Angola	19.0	AGO
4	Antigua and Barbuda	56.0	ATG
...
182	Vietnam	28.6	VNM
183	Virgin Islands	6.6	VIR
184	Yemen	14.7	YEM
185	Zambia	11.9	ZMB
186	Zimbabwe	15.2	ZWE

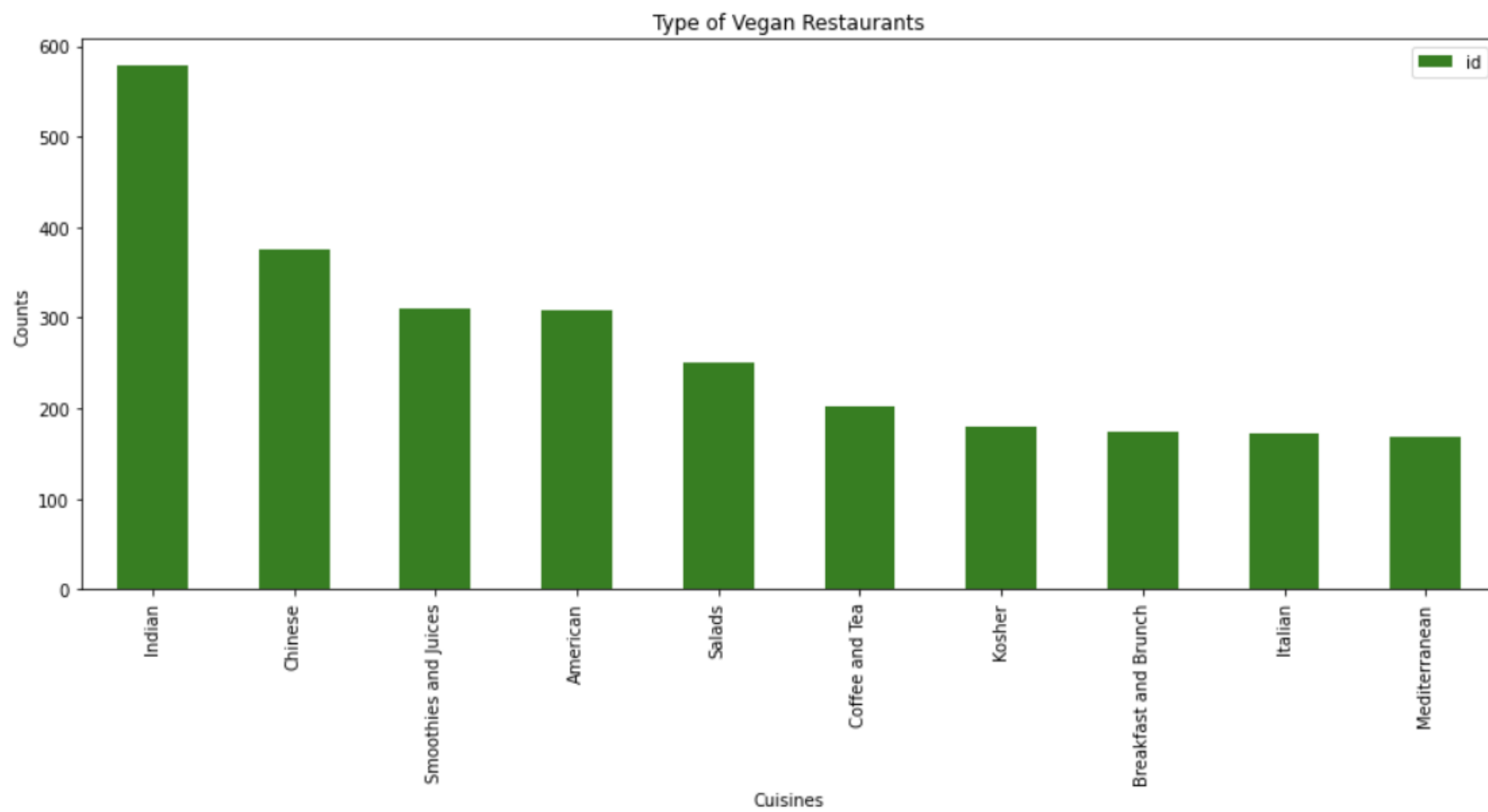
	Country	Life expectancy	ISO-code
0	Afghanistan	64.5	AFG
1	Algeria	76.7	DZA
2	Andorra	81.8	AND
3	Angola	60.8	AGO
4	Antigua and Barbuda	76.9	ATG
...
180	Venezuela	72.1	VEN
181	Vietnam	75.3	VNM
182	Yemen	66.1	YEM
183	Zambia	63.5	ZMB
184	Zimbabwe	61.2	ZWE

	Country	GDP per capita	ISO-code
0	Afghanistan	2182.0	AFG
1	Albania	14866.0	ALB
2	Algeria	16091.0	DZA
3	Angola	6763.0	AGO
4	Antigua and Barbuda	30593.0	ATG
...
186	Venezuela	16055.0	VEN
187	Vietnam	8677.0	VNM
188	Yemen	2312.0	YEM
189	Zambia	4174.0	ZMB
190	Zimbabwe	2778.0	ZWE

	Country	Urbanization rate	ISO-code
0	Monaco	100.0	MCO
1	Nauru	100.0	NRU
2	Singapore	100.0	SGP
3	Anguilla	100.0	AIA
4	Bermuda	100.0	BMU
...
213	Niger	16.6	NER
214	Liechtenstein	14.4	LIE
215	Burundi	13.7	BDI
216	Papua New Guinea	13.3	PNG
217	Montserrat	9.1	MSR



	id	dateAdded	dateUpdated	address	categories	primaryCategories	city	claimed	country	cuisines	desc
0	AVwd3yXEkuFWRAb59-sH	2016-04-22T02:47:48Z	2018-09-10T21:00:49Z	1045 San Pablo Ave	Restaurant,Asian/Pacific,Cafe,Vegetarian / Veg...	Accommodation & Food Services	Albany		US	Thai,Asian/Pacific,Vegetarian	
1	AVwd3yXEkuFWRAb59-sH	2016-04-22T02:47:48Z	2018-09-10T21:00:49Z	1045 San Pablo Ave	Restaurant,Asian/Pacific,Cafe,Vegetarian / Veg...	Accommodation & Food Services	Albany		US	Thai,Asian/Pacific,Vegetarian	
2	AVwd3yXEkuFWRAb59-sH	2016-04-22T02:47:48Z	2018-09-10T21:00:49Z	1045 San Pablo Ave	Restaurant,Asian/Pacific,Cafe,Vegetarian / Veg...	Accommodation & Food Services	Albany		US	Thai,Asian/Pacific,Vegetarian	
3	AVwd3yXEkuFWRAb59-sH	2016-04-22T02:47:48Z	2018-09-10T21:00:49Z	1045 San Pablo Ave	Restaurant,Asian/Pacific,Cafe,Vegetarian / Veg...	Accommodation & Food Services	Albany		US	Thai,Asian/Pacific,Vegetarian	
4	AVwd3yXEkuFWRAb59-sH	2016-04-22T02:47:48Z	2018-09-10T21:00:49Z	1045 San Pablo Ave	Restaurant,Asian/Pacific,Cafe,Vegetarian / Veg...	Accommodation & Food Services	Albany		US	Thai,Asian/Pacific,Vegetarian	
...
9995	AVwd88IK_7pvs4fz-tol	2016-03-28T05:35:40Z	2018-01-09T08:01:08Z	1335 W Thomas Rd	Vegetarian / Vegan Restaurant,Restaurant,Medic...	Accommodation & Food Services	Phoenix		US	Mediterranean,Vegetarian,Persian,Middle Eastern	
9996	AVwd88IK_7pvs4fz-tol	2016-03-28T05:35:40Z	2018-01-09T08:01:08Z	1335 W Thomas Rd	Vegetarian / Vegan Restaurant,Restaurant,Medic...	Accommodation & Food Services	Phoenix		US	Mediterranean,Vegetarian,Persian,Middle Eastern	



Vegetarian and Vegan Restaurants Dataset:

This dataset contains the various information of vegetarian and vegan restaurants located in United States including location, address, category, cuisine, etc.

Overall Analysis and Conclusion:

According to the data analysis, interpretation, and visualization, I could identify that the production of meat have adverse impacts on the environment. Even though, the dataset did not show the direct effect of meat consumption on human health, it was able to make an assumption that the environmental pollution driven by the meat production can affect negatively to human health. Also, by analyzing the top ten cuisines of vegan restaurants, Indian restaurants were the ones with the largest proportion.

It is time for us to consider about the future food system. In the past, plant-based menus have been recognized as the menus which only aimed at some vegetarians and were only sold in the vegetarian restaurants. However, nowadays, there are many plant-based meat alternatives that are similar to the actual meat in taste and texture. It would be nice to try a plant-based diet for the environment and health.