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DATA-DRIVEN SUSTAINABLE FOOD PURCHASING

SPRING 2014

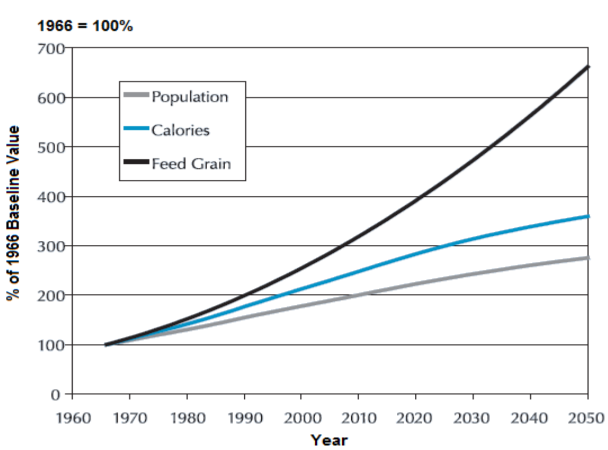
Project Goal

The goal of this project is to provide Google, the project client, with a data-driven method for assessing and reducing the environmental impacts of providing food for its employee food program. Measuring the program's environmental impacts enables Google to implement a sustainability strategy to better manage its environmental footprint, specifically global warming impact and water consumption.

Problem Statement

Agricultural practices are a significant source of greenhouse gas emissions and water consumption, accounting for an estimated 8% of greenhouse gas emissions and 80% of water use in the United States. Globally, relative impacts of agriculture on the environment are even greater. The increase in world food demand driven by rising global population (*Figure 1*) will have important social and environmental implications. In the interest of preserving natural resources, sustainable solutions can be implemented to reduce environmental impacts and meet food demand.

Figure 1.
World Population & Food Demand



Source: http://www.card.iastate.edu/

Objectives

Google is committed to mitigating environmental impacts throughout its operations with a data-driven approach. This project aims to help the client to improve its food purchasing by quantifying the climate change impacts and water consumption of the food program's supply chain. To meet this objective, we developed the following strategy:

- Quantify the global warming impact and water consumption of Google's recent food purchases to identify and rank the most impactful food categories.

- Analyze the contributions of various agricultural practices to the impacts of individual food items, so the procurement team can selectively source from more environmentally friendly food producers.

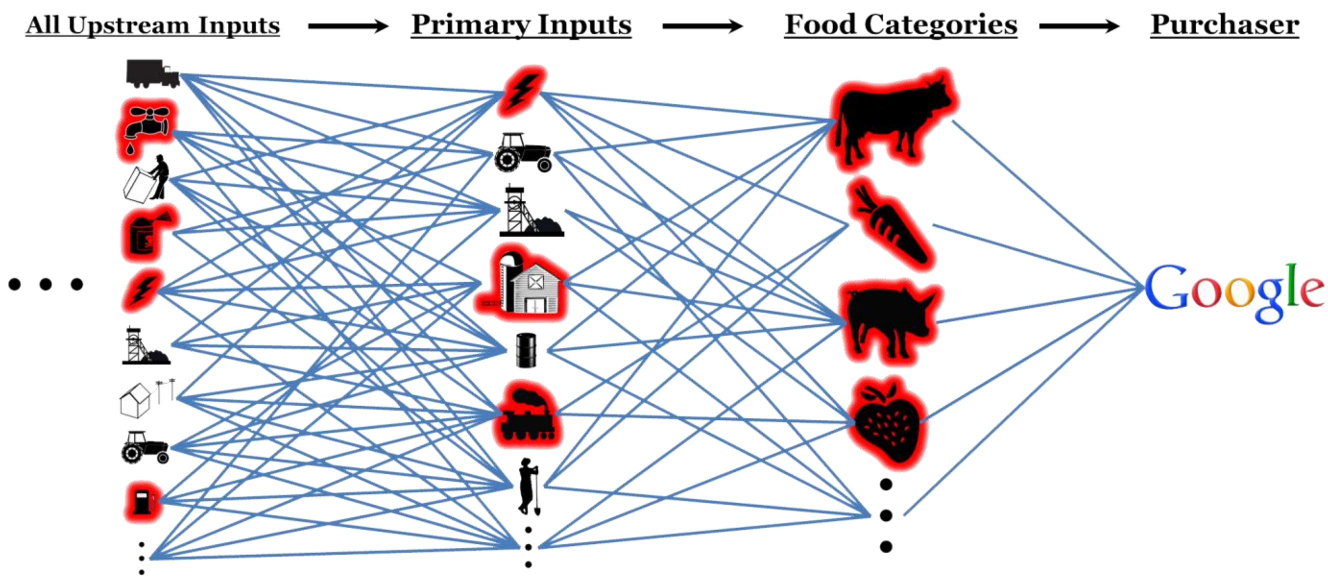
- Calculate water supply and demand differences among states to develop a regionalized model for identifying water consumption equivalents.

Approach

Google's food supply chain embodies a complex network of purchasing interactions. Food items are sourced from distributors that buy from numerous producers, each of which requires a variety of material and energy inputs for their products. See *Figure* 2 for an illustration of interactions within and across the supply chain.

A comprehensive approach to assessing the food program's supply chain is necessary to improve its sourcing. The group's chosen method, life cycle assessment, quantifies the impacts of food items by considering all processes in a product's life cycle.

Figure 2. **Food Supply Chain Visualization**



Supply chain hotspots are identified in red.

Input-Output Life Cycle Assessment

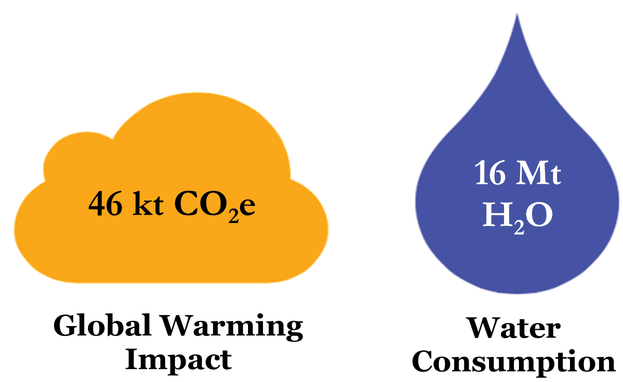
Google purchases a large volume of food from across the U.S. The nature of the data lends itself to analysis through a specific process called input-output life cycle assessment. This process allows the user to screen large data sets to quantify environmental impacts through a product's life cycle based on how much money was spent on that product.

In input-output life cycle assessment, the environmental impact of a product is calculated by multiplying purchase dollars spent on an item by an indicator result specific to that item. Indicator results are variables that represent relative harmfulness of an industrial process and are expressed in units of impact per dollar. Impact factors are developed by combining two types of data: (1) a map of economic flows for an entire economy and (2) nationwide averages for environmental impacts of industrial processes.

Total Environmental Impacts

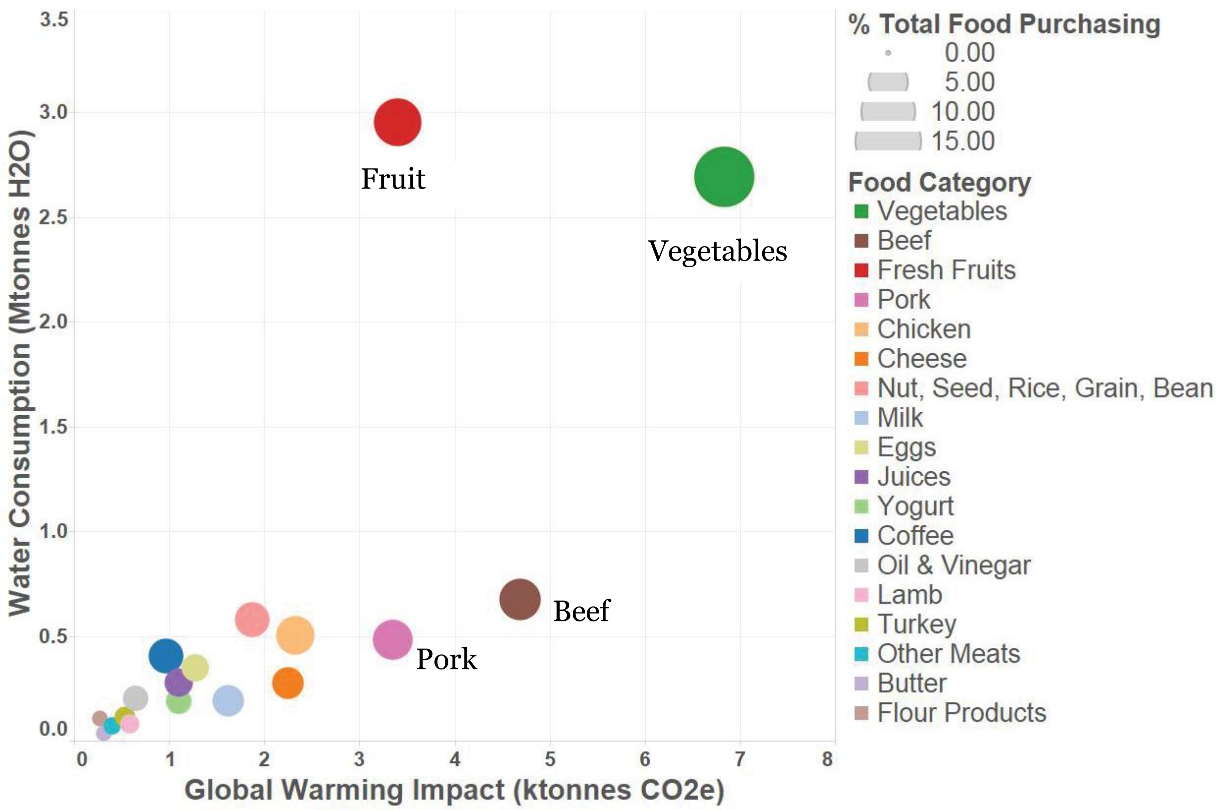
Total food purchasing global warming impacts and water consumption were quantified for Google's Mountain View headquarters using input-output life cycle assessment. Annual global warming impact and water consumption were calculated to be approximately 45.9 kt CO2 equivalent and 16.1 Mt H2O, respectively (*Figure 3*).

Figure 3.
Baseline Environmental Impacts of Google's Food Program



The baseline quantification of impacts provides the client with an understanding of global warming emissions and water consumption for its food program. These impact values can be used as a starting point to measure the effectiveness of future mitigation efforts.

Figure 4. **Water Consumption & Global Warming Impact**

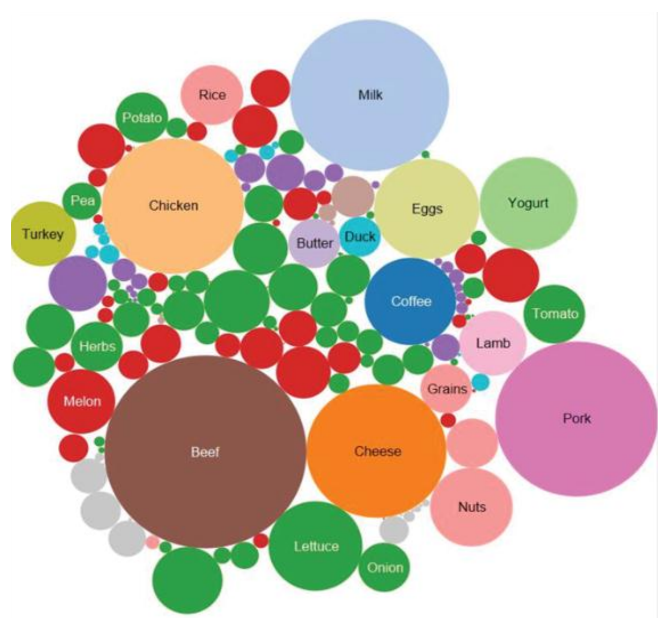


Category-Specific Impacts

Figure 4 shows the total water consumption of each food category and its total global warming impact. The results misleadingly indicate that vegetables and fruits are more impactful than animal products. It is important to understand that these results are based total amount spent. Fruits and vegetables are highly aggregated categories, and Google spends large amounts on them relative to other foods. As a result, the impacts of these food categories are overstated relative to animal products, which are single food item categories.

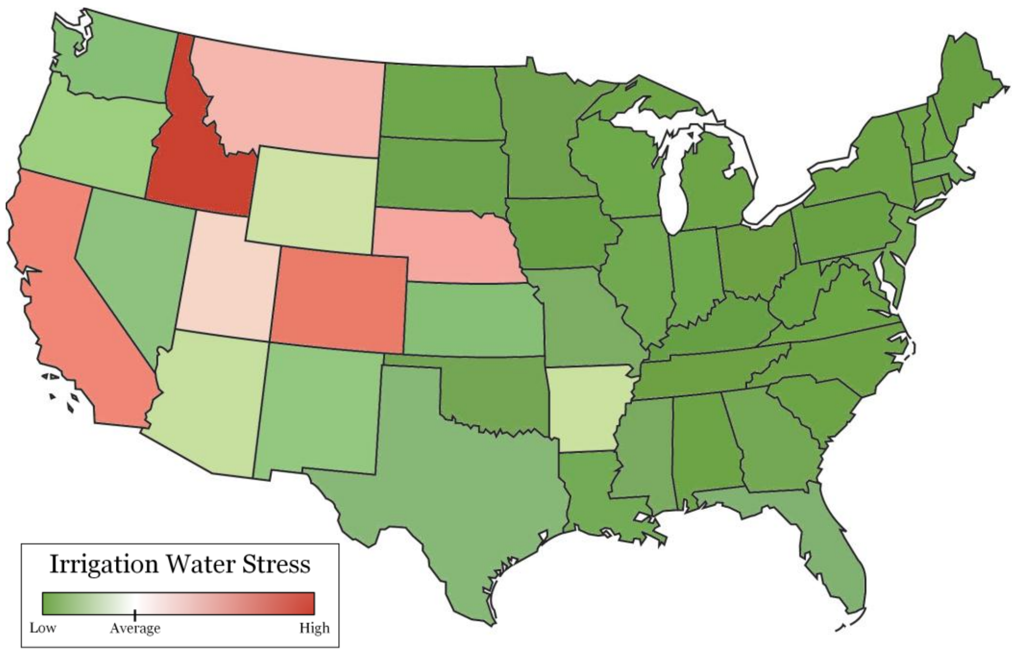
When all food categories are disaggregated into individual food items, as shown in *figure 5,* animal products like beef, pork, and chicken are found to be the most impactful food categories. Comparing individual food categories, such as melons, lettuce, and beef to one another helps to illustrate relative global warming impacts of food categories.

Figure 5.
Comparison of Global Warming Impact of Individual Food Items



Size of bubble represents relative impact of each food item.

Figure 6. **U.S. Irrigation Water Stress**



Regional Water Stress

The amount of water consumed is less important than the regional availability of water. In other words, a gallon of water used in Arizona does not have the same impact as a gallon of water in Maine. A water stress index was developed to compare water stress across states in order to regionalize the value of water consumption. Irrigation water stress for each state was derived from the relative difference in water availability and extraction, modified by the proportion of water used for irrigation. *Figure 6* indicates the variation in water stress across states. This index serves as a tool that the client can use to selectively source between suppliers to reduce the impact of water consumption by choosing products from less stressed states.

Discussion of Findings

The overall results reveal several insights. First, the relative impact of individual food items decreases quickly, illustrating that a minority of the food items account for the majority of global warming impact and water consumption. This demonstrates that mitigation efforts applied to a few top items will result in proportionally large decreases in carbon and water footprints. For example, animal products account for at least five out of the top ten items in both the overall food category and individual food item analysis for both global warming and water consumption impact. This information directs Google to prioritize animal products for impact mitigation strategies and further research. Looking at production more broadly, this analysis identifies the most significant production processes recurring across food categories that can be addressed to more effectively reduce environmental impacts.

Acknowledgements

Bren School: Sangwon Suh, Associate Professor; David Tilman, Professor; Gary Libecap, Professor, Yi Yang, PhD Candidate; Eric Edwards, PhD Candidate; Aubrey Dugger, PhD Candidate

Bon Appetit Management Company: Helene York, Director of Purchasing Strategy; Joe Dominguez, Director of Purchasing; Charlie Liao, Purchasing Specialist

IERS LLC: Shivira Tomar, Senior Analyst