Greenhouse Gas Impact of Food
Deliberate Dining at Duke University

Spring 2020 ENVIRON 245 Project Brief

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Background

‣ Studies estimate that 37% of greenhouse gas (GHG) emissions worldwide are from the food system, and food production is responsible for 25% of all GHG emissions.[1,2]

‣ Food type matters most: Meat and dairy production alone produce 14.5% of worldwide GHG emissions, more than the entire transportation sector combined.[3] Replacing **meat** with **plant-based** foods also reduces greenhouse gas emissions more than reducing transport emissions, packaging materials, or waste.[4] Most greenhouse gas emissions stem from on-farm practices (manure management, CH_4 released after digestion in livestock, and land use change).

‣ Emissions released during food production, transport, and waste are not measured by Duke Dining or included in the Duke Climate Action Plan. The complex life cycles of food make emissions indirect and difficult to track.

Research Question

‣ *How can Duke measure **greenhouse gas emissions** from Marketplace menus/Duke purchasing data through the lens of food sources (plant vs. animal), production methods, and other factors?*
‣ *How can Duke **communicate** this information to encourage **behavioral change** in Duke students, specifically in first-years?*

Significance

If **students** understand how **food choices** on-campus contribute to **climate change**, they might be encouraged to make **conscious decisions** to reduce their food-based emissions.

Objectives

‣ Recommend food emissions **calculator(s)** that Duke Dining can use to track and communicate food emissions

‣ Suggest pilot programs to incentivize first-years to make sustainable food choices

Deliberate Dining

Client:

Marcus Carson
Assistant Director of Sustainability and Quality Control of Duke Dining

Sustainability: A Three Pronged Approach

Environmental
Deliberate Dining campaigns can push Duke students to **reduce their diet-related greenhouse gas emissions** and combat climate change.

Economic
The **budget of Marketplace and students** must be considered with a project that aims to change the types of food purchased, and purchasing behavior could impact the **local community**.

Social
Any project designed to change dining behavior in Duke students must target and respect cultural norms and personal and religious values. Duke Dining cooks and staff should also be included in curating sustainable menu items.

BEHAVIOR CHANGE
Literature review gauged validity of certain methods and their relevance to behavior change in regards to food consumption and sustainable decision-making. Student interviews offered insight into first-year habits in Marketplace.

MARKETPLACE OBSERVATION AND INTERVIEWS
29 customers were observed and 10 first-years were interviewed during lunch hours at Marketplace.
Observations included meat vs. vegetarian options and popular meals and venues. The interview questions were designed to gauge popular meal choices and Marketplace venues, favorite protein sources, most important criteria when choosing food (i.e. health, convenience, taste, etc.), impact of activity on food choices, perception of the GHG impact of food choices, knowledge of/willingness to use carbon calculators.

CARBON CALCULATOR DATA COLLECTION AND ANALYSIS:
Carbon calculators were discovered with Google searches for GHG emissions calculations specifically for food. An Excel matrix was created to analyze specific calculator features and rank their utility, credibility, and ease of use for the client and for Duke students.
The following features were analyzed and used to create a point system to rank the calculators:
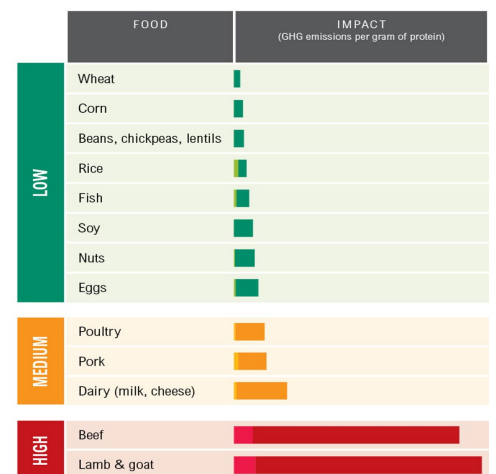
- Produce specificity (1-3 pts)
- **Livestock specificity (2-6 pts)**
- Poultry specificity (1-3 pts)
- Seafood specificity (1-3 pts)
- **Dairy specificity (1-4 pts)**
- Beverage specificity (1-3 pts)
- Multi-ingredient food items considered? (+0/+3)
- # of livestock special labels (ex. grassfed)
- Upstream emissions considered (+0/+1)
- Downstream emissions considered (+0/+1)
- Transportation emissions considered (+0/+1)
- # of GHG emissions reported
- # of GHG in initial calculations
- Dated entry and data accumulation over time? (0-2 pts)
- Cost-analysis features? (+0/+3)
- Data entry ease of use (1-5 pts)
- Report format ease of use (1-5 pts)

These categories explain the points given to each calculator as shown on the findings page. Bolded categories are weighted higher due to higher emissions from those food sources.

FIRST-YEAR FOCUS
First-years haven't developed permanent campus eating habits. They can share behavior changes with peers as they progress through Duke.

Protein Scorecard

FOOD	IMPACT (GHG emissions per gram of protein)
LOW Wheat	
Corn	
Beans, chickpeas, lentils	
Rice	
Fish	
Soy	
Nuts	
Eggs	
MEDIUM Poultry	
Pork	
Dairy (milk, cheese)	
HIGH Beef	
Lamb & goat	

Lighter shade shows emissions from agricultural production, darker shade shows emissions from land-u

NUTRITION
Each food category in the Protein Scorecard* was annotated with the average grams of protein per typical serving size at Duke. Duke Dining's NetNutrition tool was used for most annotations, and USDA's FoodData Central was used when NetNutrition lacked the desired data. The goal was to determine whether a Duke first-year eating all their meals on campus could feasibly eat only low-emission foods (coded green on the Protein Scorecard) or even only plant-based foods while meeting minimum daily protein requirements.

Sources: GlobAgri-WRR model developed by CIRAD, Princeton University, INRA, and WRI. www.wri.org/proteinscorecard

Findings

OBSERVATION/ INTERVIEWS: BEHAVIOR

Out of n=10 Duke first-years from the exploratory study:

▸ 1 makes an effort to decrease animal product consumption for environmental reasons.

▸ 8 do not make food choices based on *emissions* impact.

▸ 5 do consider *other* environmental impacts of food (i.e. waste).

▸ 3 list price as a top priority when making food choices.

▸ 8 list health/balance as a top priority when making food choices.

▸ **7** mentioned that they consider protein when making food choices.

▸ 8 build meals with a carbohydrate, protein, and vegetable serving. (Although they view foods like rice and grains as carbohydrates separate from protein sources like meat and seafood, they may not be aware that plant-based sources of carbohydrates can also be protein-rich.)

▸ 8 preferred or mentioned Durham Market.

▸ 7 preferred or mentioned deli venue.

▸ 4 preferred or mentioned 1892 Grille.

▸ 6 are open to learning about GHG emissions using a Duke menu-specific calculator.

▸ 3 indicated that a stoplight poster would be more effective for behavior change than a QR code/link to a food emissions calculator.

LITERATURE REVIEW: BEHAVIOR CHANGE

▸ Social pressure & physical incentives are effective ways to foster behavior change.

▸ Visual cues and reminders are proven to nudge people to make certain decisions.

▸ Loss aversion is a strong driver- informing people about the loss of wildlife and the destruction of the planet could led them to eat sustainably.

NUTRITION

▸ Duke first-years may be over-consuming protein.

How Much Protein Do You Need?

The average daily adult protein requirement is **56g** for a man and **46g** for a woman but many people consume much more than they need.

REQUIREMENT	OVERCONSUMPTION

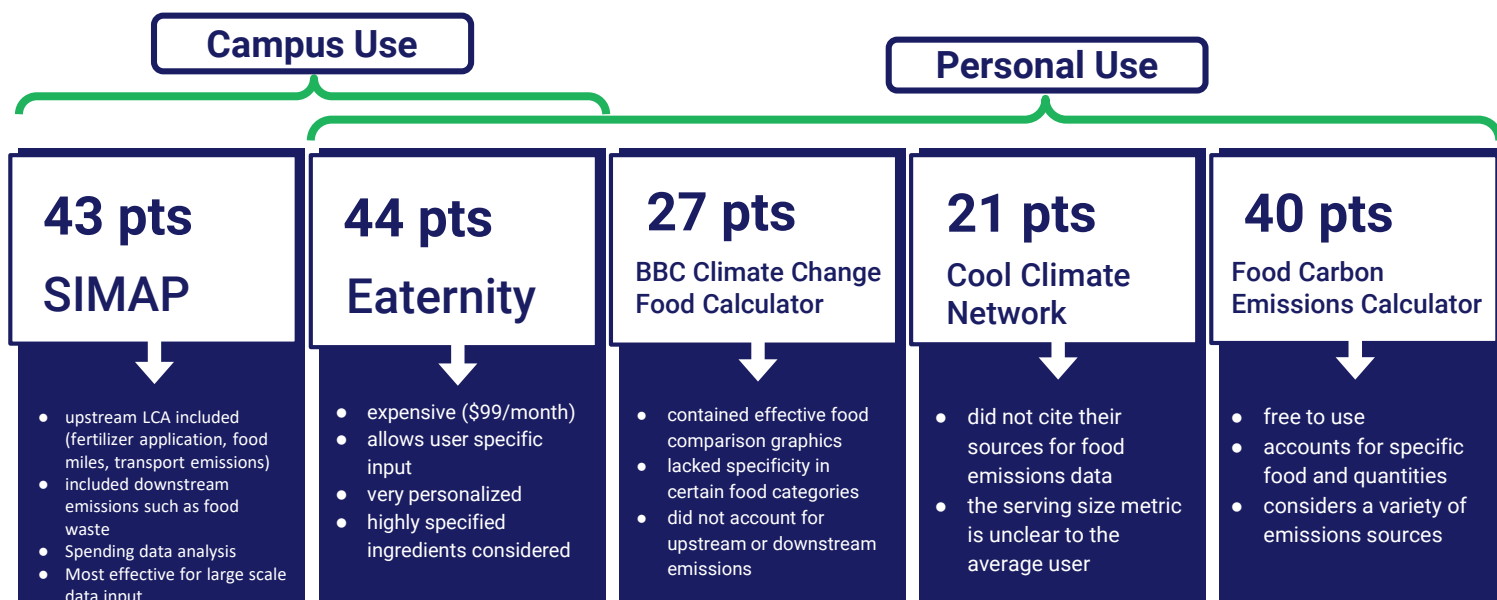0g   average daily adult protein requirement 51g   average US daily protein consumption 83g

▸ Although plant foods are often lower in protein than animal-based sources, they can meet protein requirements if combined with protein-rich carbohydrates. Processed plant-based meat substitutes are even more protein rich and have similar protein content relative to their meat counterparts.

▸ It is feasible for first-years to obtain enough protein on a low-emissions and even a plant-based diet at Duke.

Carbon Calculator Point Allocation and Features Through Matrix Analysis

▸ Different calculators make emission calculations at varying scopes.

▸ The most holistic and thorough calculators capture emissions impacts of entire food life cycles (LCA): transportation, livestock and agricultural practices, packaging/marketing, and waste.

▸ To capture the importance of food type, poultry and meat specificity, and price input categories are weighted most heavily (for campus use).

▸ Format and metrics were considered to gauge target audience.

▸ Most online carbon calculators for food are geared toward general consumers and small data sets.

Campus Use

Personal Use

43 pts
SIMAP
- upstream LCA included (fertilizer application, food miles, transport emissions)
- included downstream emissions such as food waste
- Spending data analysis
- Most effective for large scale data input

44 pts
Eaternity
- expensive ($99/month)
- allows user specific input
- very personalized
- highly specified ingredients considered

27 pts
BBC Climate Change Food Calculator
- contained effective food comparison graphics
- lacked specificity in certain food categories
- did not account for upstream or downstream emissions

21 pts
Cool Climate Network
- did not cite their sources for food emissions data
- the serving size metric is unclear to the average user

40 pts
Food Carbon Emissions Calculator
- free to use
- accounts for specific food and quantities
- considers a variety of emissions sources

Sources: GlobAgri-WRR model developed by CIRAD, Princeton University, INRA, and WRI. www.wri.org/proteinscorecard

Calculator Recommendations & Conclusions

For Campus Metrics	**SIMAP**	✓ long-term data comparisons ✓ expenses ✓ upstream production, transport, waste factored in
For Developing a Stoplight System	**Eaternity**	✓ emissions by recipe/designed for menus ✓ upstream production, transport, waste + **water footprint** X pay to use
For Student Use	**Food Emissions Carbon Calculator**	✓ free to use ✓ upstream production, transportation, waste factored in X requires input of weight and food miles

Pilot Program for Behavior Change

While these recommendations *measure* campus emissions, Duke must use these tools to *reduce* campus food emissions. For example, the implementation of a **"stoplight" system** integrating health and GHG measures would emphasize the GHG impact of meat production and enable students to make immediate sustainable food choices.

SAMPLE STOPLIGHT POSTER
MARKETPLACE, 1892 GRILLE

BEEF PATTY
- 25 g protein (49% DV)
- 272 calories
- "z" kg CO_2E
* Like driving a car for 5 miles.

CHICKEN TENDERS
- 22 g protein (43% DV)
- 300 calories
- "y" kg CO_2E
* Like driving a car a half mile.

IMPOSSIBLE BURGER
- 19 g protein (37% DV)
- 240 calories
- "x" kg CO_2E

Next Steps

❏ Gather additional survey data on first-years using revised questions to gauge habits, values, and impact of emission information tools
❏ Encourage Duke Dining to use SIMAP and/or Eaternity to calculate Marketplace emissions
  ❏ collaborate with computer science experts to create a Duke Dining-specific food emissions calculator
  ❏ Use *student preference data* to optimize the report format/units (GHG/macronutrient, GHG/total weight, etc.)
❏ Target Durham Market, deli station, and 1892 Grille for pilot stoplight poster (see pictured)
❏ Incentivize Duke first-years to use the Food Carbon Emissions Calculator to calculate individual emissions

Acknowledgements

Bleed Blue. Live Green.
I SUPPORT **Sustainable Duke**
sustainability.duke.edu