Nitrogen Tracking and Footprint Reduction Scenarios at EMU

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Introduction

Carbon tracking involves monitoring carbon gas outputs from different sources (yielding a "footprint") and is a necessary step to reducing carbon output. Carbon footprint reduction at all levels is important as carbon gasses greatly contribute to climate change. In the same vein, nitrogen tracking is the process of calculating and monitoring how much reactive nitrogen is produced by different sources (Fig. 1) and is equally helpful in constructing possible reduction scenarios.

Nitrogen in its stable, inert form does not cause harm, but in its reactive form contributes to various environmental impairments, such as precipitation acidification, eutrophication of bodies of water, and climate change. This reactive form is most notably found in synthetic fertilizers and contributes to eutrophication through runoff into watersheds.

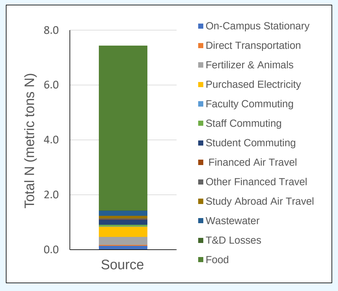

Fig. 1 Bar graph of total NFT (80% of NFT is due to food)

Nitrogen footprint tracking has been performed at EMU since 2015, and the baseline data used in this study is from fiscal year 2019 (Fig. 1). The largest contributor to EMU's N footprint is the food served in the dining hall. Beef, chicken, and pork cause the largest contribution (64.6%), despite being among the least foods served per weight (15.3%) (Fig.2).

Meat is responsible for the largest portion of nitrogen emissions due to the amount of grain livestock consume, as well as nitrogen emissions from manure. Since meat consumption is such a larger contributor, six scenarios involving reduction of meat consumption on EMU's campus were analyzed to determine overall impact on EMU's nitrogen footprint.

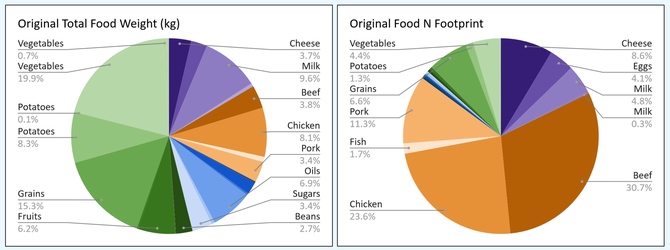

Fig. 2 Percentage of total weight of food served at EMU during 2019 by category (a) and percentage of total nitrogen footprint by food category (b).

Methods

Any successful reduction strategy is going to balance effectiveness with feasibility. A total of six scenarios were analyzed to determine their effectiveness at reducing total nitrogen while also offering a variety of options in terms of feasibility.

The first three scenarios all involved reducing beef and replacing it with the less nitrogen intensive pork and chicken. Beef consumption was reduced by 10, 20, and 30% respectively. In order to preserve the total amount of food being served, chicken and pork were each increased by half the amount that the beef was decreased, resulting in the same total food weight (Kg).

The second three scenarios modeled the amount of nitrogen reduced when total meat consumption (beef, chicken, and pork) was reduced by 10, 20 and 30% respectively and replaced with alternative food items. These total weight reductions were offset by increasing the total amount of beans served by 80% and vegetables by 20%.

Results

The 10-30% beef reduction scenarios led to a 1.9%, 3.9%, and a 6.0% decrease in total nitrogen respectively, while the 10-30% total meat reduction scenarios resulted in a 6.7%, 14.4%, and 23.3% nitrogen decrease respectively**.** A 30% beef reduction and a 20% total meat reduction were deemed the two scenarios that seemed the most reasonable for EMU to implement, while still resulting in a substantial reduction in nitrogen footprint (Fig. 3). All scenarios resulted in no decrease in the total amount of food served (Fig. 4). The beef reduction scenarios included increases in the amount of pork and chicken served, and the total meat reduction scenarios involved increases in beans and vegetables. Thus, the total nitrogen that is removed by reducing meat is replaced in part by nitrogen from the replacement food items. However, the overall footprint is still substantial. For example, a 20% reduction in beef results in a 3.9% reduction in total nitrogen despite beef only being 3.8% of the total food by weight served. And a 20% reduction in meat results in a 14.4% total nitrogen decrease despite total meat only contributing to 15.3% of the total food by weight served.

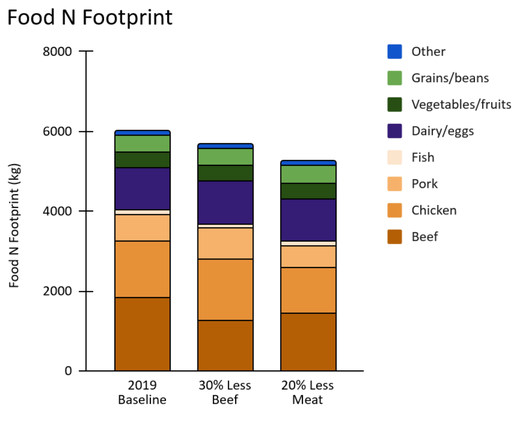

Figure 3. Two reduction scenarios compared with the FY 2019 nitrogen baseline.

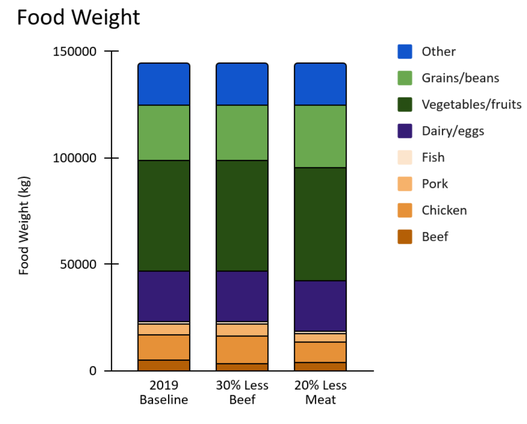

Figure 4. Food weight in two reduction scenarios in relation to FY 2019 weight baseline.

Discussion

The total nitrogen footprint for EMU during fiscal year (FY) 2019 (school year 2018-19) was six metric tons, and 80% of that total was contributed by food. In FY 2019, 22,184kg of meat (beef, chicken, pork), was purchased; however, meat contributes to 65% of our nitrogen footprint which is disproportionate, considering that it only makes up 15.3% of the total food weight purchased. Two scenarios were determined to be the most feasible to implement at EMU: the 30% beef reduction or the 20% total meat reduction. The 30% beef scenario was deemed reasonable because it would preserve the total amount of meat available in the dining hall while also contributing the most to nitrogen footprint mitigation. Among the total meat reduction scenarios, a 20% reduction would be the best to implement, as a 30% may be too drastic for the student body, but the 20% reduction still results in a 14.4% reduction our nitrogen footprint.

One idea used at other schools is having a single meatless day a week (e.g. Meatless Monday). If this was implemented once a week throughout both semesters at EMU, this would result in a total nitrogen reduction of 10%, a substantial proportion of the 14.4% reduction goal of the 20% meat reduction scenario.

Next Steps

Moving forward, implementation strategies need to be considered. A gradual increase in meat reduction could be a beneficial way to work towards footprint reduction without creating drastic changes that may result in a significant backlash from the student body. A starting point could be to implement a regular Meatless Monday type event that would result in a substantial part of any reduction goal. Many other schools already have such a policy. However, it may be more beneficial to work towards an overall meat reduction goal incrementally at each meal, thus not drawing as much attention toward the change in diet or forcing students to go a day without any meat, which may result in students avoiding the cafeteria on those days. As beef contributes the most to the food nitrogen footprint, it could also be beneficial to start by reducing beef only, as this would not decrease the total amount of meat being served and be a more palatable approach to students.

Another point to consider is that implementation by kitchen staff is not always possible as they work under a contract with a food service provider. In order to create more systemic change in this regard, working to have a meat reduction scenario written into that contract would be an efficient and effective top-down approach for implementation.