A comparison of greenhouse gases released by the production and transportation of food

Tracy Timmins, PhD student, York University, Faculty of Environmental Studies

INTRODUCTION

- Animal agriculture emits 14.5 - 18 % of the world's total greenhouse gases (GHGs), more than the all transportation (Gerber, 2013; IPCC, 2014; Steinfeld et al., 2006).
- **How do production-phase GHG emissions compare to those produced during the transportation of foods in North America?**
- I examine peer-reviewed literature, government reports and other sources to address this question.

ENERGY IN PRODUCTION

- Fossil fuels are used directly in food production to run farm machinery, for labour and irrigation, and to grow feed crops.
- Eshel & Martin (2006) compared the energy efficiency of different foods in the USA. See Fig. 1.

Fig. 1. Energy efficiency of food production

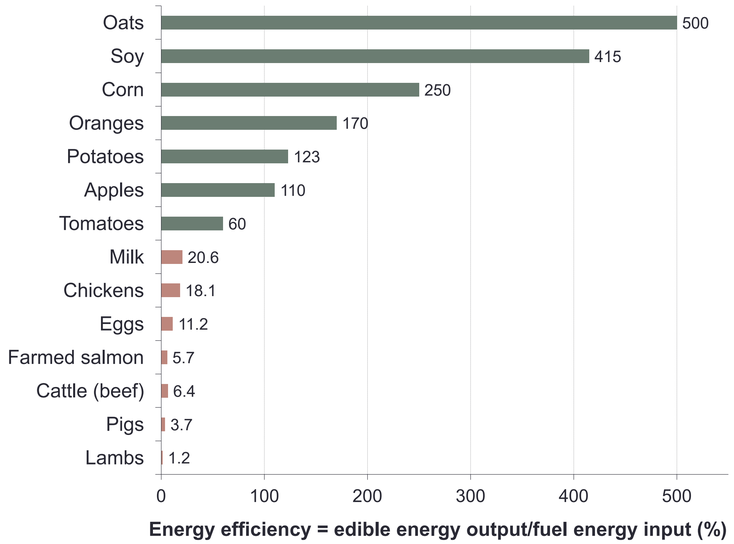

Fig. 1 source: Adapted from Table 2 in Eshel & Martin (2006) and Pimentel & Pimentel (1996)

Note to Fig. 1: Input fuel includes energy used to grow feed crops. It does not include fuel used to produce nitrogen fertilizer—a major consumer of fossil fuels.

- **In general, producing animal products results in a net loss of edible energy, while producing plant-based foods results in a net gain.**

GHGS FROM PRODUCTION

- The following GHG's are released in the production of food:
  - CO_2: fossil fuel use, land clearing
  - Methane (CH_4): digestion (enteric fermentation) of ruminants, manure
  - Nitrous oxide (N_2O): fertilizer application, manure
- Eshel & Martin (2006) estimated the quantity of GHGs released by different diets relative to a vegan diet. See Fig. 2.

Fig. 2. GHG emissions above a vegan diet

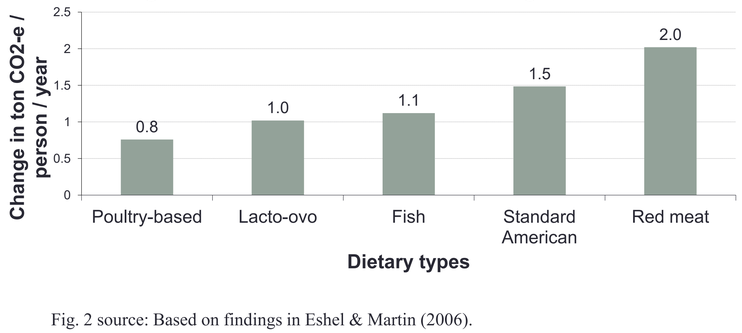

Fig. 2 source: Based on findings in Eshel & Martin (2006).

Note about Fig. 2: All diets contain equal calories and all obtain ~28 % of calories from animal products (vegan diet = 0 calories from animal products).

- The values depicted are *underestimates as* N_2O released from fertilization was not included in calculations.
- Nitrogen fertilization is important as it contributes 74 % of the USA's N_2O emissions (Eshel & Martin, 2006).
- Most of the fertilizer is used on feed crops in the USA. Farmed animals eat 7x as much grain as humans (Pimental & Pimental, 2003).

TOTAL LIFE-CYCLE GHGS

- Weber & Matthews (2008) estimate GHG emissions of different food groups in the USA over their entire life-cycle. See Fig. 3
- **"Transportation as a whole represents only 11% of life-cycle GHG emissions, and final delivery from producer to retail contributes only 4%"** (p. 3511).
- Delivery-stage transportation is responsible for 1 % of red meat's emissions and 11 % of fruits/veg's.
- Fruits/veg rely the most on trucks for final delivery—trucks are more polluting than ships or trains.

Fig. 3. GHG emissions from total life-cycle

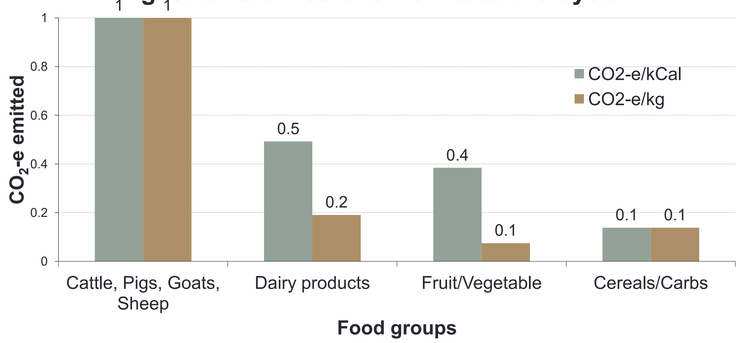

Fig. 3 source: Based on findings in Weber & Matthews (2008).

Notes about Fig. 3:

- GHG estimates given as a proportion of red meat's (cattle, pigs, goats, sheep) emissions.
- Estimates measured as CO_2-equivalents per kilo-calorie and per kilogram food produced.
- The chicken/eggs/fish category was excluded from Fig. 3 because non-cereal/non-carb crops were included in estimates. Category is inconsistent.

CANADA'S SITUATION

- In 2015, agriculture accounted for 28% of CH_4 and 71% of N_2O emissions in Canada (EC, 2015).
- Main sources of agricultural GHG are digestion (42%) and fertilizer application (22 %) (EC, 2015).
- In 2002-3, 55 % of nitrogen fertilizer was applied to feed crops and pastures in Canada (Steinfeld et al., 2006, p. 87).
- Forage & pasture continues to be the biggest crop by area and volume today (Bonnefield, 2016).

CONCLUSIONS

- Food production, particularly of animal products (digestion & feed crops), is the biggest source of food-related GHGs.
- **In comparison to shifting towards plant-based foods, a focus on local foods will do little to reduce GHG emissions.**

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