Food's footprint (For the teacher)

In this activity you will use scientific data to evaluate which of the analysed animal-based options has the lowest carbon footprint in Greenland.

Duration: 90 minutes

Learning outcomes

Scan the QR code

Materials

- Tables to complete the activity (Handout 1)
- Graph (Handout 2)
- Material for writing and drawing

GUARDNA cards

Species Cards
- Bearded seal
- Harp seal
- Hooded seal
- Ringed seal

Stakeholder Cards
- Consumers
- Hunters
- Scientists

Uses Cards
- Food

Threats Cards
- Climate change

Background

The choices we make regarding our food consumption and how they are produced have significant implications for both our health and the environment. From growing and processing to transportation, distribution, preparation, consumption, and disposal, each stage of the food's life cycle generates greenhouse gases, contributing to climate change. Our carbon footprint, this is, the amount of greenhouse gases like carbon dioxide and methane that are generated by our actions, is heavily influenced by our food-related activities, with approximately one-third of human-caused greenhouse gas emissions linked to food production.

The climate impact (this is, the carbon footprint) of food can be quantified in terms of its greenhouse gas emissions intensity, measured in kilograms of carbon dioxide equivalents (kg CO_2e) per kilogram of food (kg of food). Animal-based foods are generally associated with the highest greenhouse gas emissions – but do all animal-based food alternatives contribute to the same extent? What are other factors in the food production chain that contribute to greenhouse gas emissions?

Preparation

1. Pair the students. This exercise can also be done individually, but we encourage grouping students to encourage discussion.
2. Print Handouts 1 and 2.

Procedure

In this activity, students will calculate the carbon footprint of various animal-based food alternatives consumed in Nuuk, Greenland. The alternatives include poultry and pork transported from Denmark by boat or plane, and locally hunted seal (hunted either near or far from the city). Students will assess greenhouse gas emissions from different phases of production and transportation, from the farm or field to the consumer.

Handout 1 contains all the necessary tables to complete the activity and Handout 2 includes a graph for plotting the final results.

Student will start the activity by calculating the emissions from transporting pork and poultry from Denmark to Greenland by both boat and plane, using the data in Tables 1, 2 and 3. The provided data in Table 4 includes greenhouse gas emissions from pork and poultry production (farming and the cultivation of food for feeding these animals), and emissions from hunting seals including fuel for the trip and ammunition (data from Ziegler et al., 2021), that students will use to calculate the total greenhouse gas emissions from the production and transport of animal-based food alternatives in Greenland. Finally, students will compare these emissions by plotting the data on a graph.

1. Start by calculating the greenhouse gas emissions from transporting 1 kg of poultry or pork from a farm in Aalborg (Denmark) to the port in Nuuk (Greenland). Use the information in Data Table 1 to complete Table 2. Pay attention to the units!
2. Fill the "Total emissions from transport from Aalborg to Nuuk by boat" in Table 2.
3. Repeat steps 1 and 2, but this time use the Table 3 to calculate the transport of poultry and pork by plane.
4. Copy your results into Table 4 and plot them on a stacked bar chart (Handout 2) for each food alternative. Use different colours to represent each component (production, shipping, fuel, etc.) of the total greenhouse gas emissions.

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Follow-up discussion

- **What is the animal-based alternative with the lowest carbon footprint in Greenland? Do you think the same food alternative will have such a low carbon footprint all over the North Atlantic?**

  Locally hunted seal has the lowest carbon footprint in Greenland. The foods with the lowest carbon footprint differ from place to place. In Greenland, where there is little possibility to grow a lot of vegetables and fruits or to raise pig or chicken, everything besides locally hunted animals needs to be imported, thus increasing its footprint. Instead in many areas of continental Europe, where you can grow fruits and vegetables, and raise different animals, the carbon footprint resulting from the production and transport of the goods will look different. The question of sustainability and carbon footprint is a complicated one and does not have "one size fits all" solution. When trying to find the best food alternative for your region, it is important to consider many different factors.

- **Why does the shipping of food by boat contribute so little to the greenhouse gas emissions? Discuss about the two different ways of transport (boat vs. plane) and what are the differences when it comes to transporting big amounts of food (remember that the emissions are calculated by kg of food!)**

  Shipping by boat allows for massive amounts of food and other goods to be transported at the same time. Much more than planes allow for. That is why the carbon footprint originated from the boats is so low. Because the emission is calculated per kg of food, and shipping containers by boat allow thousands of tonnes of food to be transported at the same time, the final calculation per kilograms is quite low. The planes allow for a quick transportation, but their carrying capacity is a lot lower than boat transportation so it emits more greenhouse gases. You can have a look to Doll et al. (2020) for an example of the greenhouse gas emissions generated from different ways of transport.

- **Is sustainability only a matter of the carbon footprint? Explore the concepts of sustainable food systems and carbon-tunnel vision.**

  We often hear about the carbon footprint when it comes to sustainability, and while it is definitely important, the issue is far more complex than just reducing carbon emissions. Focusing too much on carbon can lead to what's called carbon-tunnel vision, where we concentrate on CO_2 reduction as the only measure of sustainability and overlook other crucial environmental, social, and economic aspects of the problem. Greenhouse gas emissions are just one part of the sustainable food systems puzzle.

  When it comes to food, sustainable food systems (SFS) encompass economic, environmental, and social impacts of the entire food system. According to the Food and Agriculture organisation a SFS is:

  > *"A food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised. This means that:*
  >
  > - *It is profitable throughout (economic sustainability);*
  > - *It has broad-based benefits for society (social sustainability); and*
  > - *It has a positive or neutral impact on the natural environment (environmental sustainability)."* (FAO, 2018, p.1)

  This means that for a food system, product or activity to be truly sustainable, it needs to meet multiple criteria. Sustainable practices should ensure safe and profitable work environments, not only for producers but also for the surrounding communities. They must minimise negative impacts on the environment and benefit both workers and nearby communities.

  Understanding sustainability requires recognising its inherent complexity. Many factors must align for an initiative to be genuinely sustainable, and solutions that work in one region may have unintended negative impacts in another. The goal should be to assess these diverse factors comprehensively and implement local solutions that deliver positive change across the entire system—economically, socially, and environmentally.

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Extension

- **Adapt your food choice to where you are.** As you learnt in the activity, transportation by boat makes up only a minor fraction of the carbon footprint associated with each animal-based food alternative. While eating local and seasonal foods is generally healthier and more sustainable, the type of food you consume has a greater impact on your carbon footprint. Factors such as land and water usage, as well as farming practices, are the have a significant impact in the carbon footprint. In continental Europe, eating less red meat and dairy, or opting for alternatives like chicken, pork, or plant-based options, can substantially decrease your footprint. Remember, it is essential to adapt these recommendations to your local context like you just saw in the example!
- **Cut your food waste.** When food is wasted, it is not just the food itself that is lost, but also the energy, land, water, and fertiliser used throughout its production, packaging, and transportation. By minimising waste, you not only save money but also reduce greenhouse gas emissions and contribute to conserving resources for future generations. Purchase only what you need, avoid letting food expire, and do not hesitate to use those slightly browning bananas sitting in your kitchen.

References

Doll, C., Brauer, C., Köhler, J., & Scholten, P., (2020). Methodology for GHG Efficiency of Transport Modes (Framework Service Contract EEA/ACC/18/001/LOT 1). Fraunhofer ISI 2020. https://cedelft.eu/wp-content/uploads/sites/2/2021/05/CE_Delft_200258_Methodology_GHG_Efficiency_Transport_Modes.pdf

FAO (2018). Sustainable food systems Concept and framework (No. CA2079EN/1/10.18). - Food and Agriculture Organisation of the United Nations. https://openknowledge.fao.org/server/api/core/bitstreams/b620989c-407b-4caf-a152-f790f55fec71/content

Ziegler, F., Nilsson, K., Levermann, N., Dorph, M., Lyberth, B., Jessen, A. A., & Desportes, G. (2021). Local Seal or Imported Meat? Sustainability Evaluation of Food Choices in Greenland, Based on Life Cycle Assessment. Foods, 10(6), 1194. https://doi.org/10.3390/foods10061194

Food's footprint (Handout 1 - For the teacher)

In this activity you will use scientific data to evaluate which of the analysed animal-based options has the lowest carbon footprint in Greenland.

Table 1. Greenhouse gas emissions data for different means of transport in 2018 (Doll et al., 2020). g CO2e/t km stands for grams of carbon dioxide equivalents per one tonne of foods transported over one kilometre.

	Large truck	Plane to transport goods	Refrigerated cargo ship
Emissions (g CO_2e/t km)	137	1035	18

Table 2. Greenhouse gas emissions originating from transporting 1 kg of poultry or pork from Aalborg to Nuuk by boat. The trip includes transport from Aalborg (farm) to Aarhus (port) by truck and from Aarhus to Nuuk by boat.

	Transport by	Distance (km)	Carbon footprint for one tonne of meat (g CO_2e/t)	Carbon footprint for one tonne of meat (kg CO_2e/kg)
Transport Aalborg to Aarhus	Truck	101	Step 1 13837	0.013837
Transport Aarhus to Nuuk	Boat	2956	Step 1 53208	0.053208
Transport Aalborg to Nuuk by boat	—	—	—	0.067045

Table 3. Greenhouse gas emissions originating from transporting 1 kg of poultry or pork from Aalborg to Nuuk by plane. The trip includes transport from Aalborg (farm) to Copenhagen (airport) by truck and from Aarhus to Nuuk by plane.

	Transport by	Distance (km)	Carbon footprint for one tonne of meat (g CO_2e/t)	Carbon footprint for one tonne of meat (kg CO_2e/kg)
Transport Aalborg to Copenhagen	Truck	309	Step 3 42333	0.042333
Transport Copenhagen to Nuuk	Plane	3539	Step 3 3662865	3.662865
Transport Aalborg to Nuuk by plane	—	—	—	3.705198

Food's footprint (Handout 1 - For the teacher)

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Table 4. Greenhouse gas emissions data for each of the animal-based food alternatives in Greenland (data from Ziegler et al., 2021). kg CO2e/kg stands for kilograms of carbon dioxide equivalents per kilogram of food, which is a way to measure the intensity of greenhouse gas emissions.

	Pork imported by boat	Pork imported by plane	Poultry imported by boat	Poultry imported by plane	Seal hunted nearby	Seal hunted further away
Meat production (kg CO_2e/kg)	7.53	7.53	4.74	4.74	——	——
Fuel usage for hunting (kg CO_2e/kg)	——	——	——	——	1.73	4.51
Ammunition for hunting (kg CO_2e/kg)	——	——	——	——	0.01	0.01
Shipping (kg CO_2e/kg)	Step 2 0.07	3.71	0.07	3.71	——	——
Total (kg CO_2e/kg)	7.60	11.24	4.81	8.45	1.74	4.52

Food's footprint (Handout 2 - For the teacher)

In this activity you will use scientific data to evaluate which of the analysed animal-based options has the lowest carbon footprint in Greenland.

Grid to plot the data as a stacked plot. Use one colour per component contributing to the total carbon emissions intensity.