How Much Does it Cost When Cows Burp?

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Abstract

What do cow burps have to do with climate change or the price of meat? Scientists say that the climate on the planet is changing because of the extra carbon in the Earth's atmosphere. As it happens, all our activities release carbon – taking the bus to school, charging your laptop, eating. Yes, eating! Especially, eating beef. Scientists calculated that producing 1 pound of beef results in 30 times more carbon emissions than producing 1 pound of wheat. And most of this carbon comes from cow burps!

Climate change is pretty expensive for us: for example, having to pay for houses and roads reconstruction after super destructive storms. As a result, some people are suggesting we should charge ourselves a small fee for doing things that release a lot of carbon. If this happens, both wheat and beef will become a little more expensive. But the increase in beef price would be higher.

Introduction

You may have heard people talk about carbon as a bad thing. Carbon dioxide is a gas which is naturally found in the Earth's atmosphere. The plants use it to photosynthesize. An important function of this gas is to keep the planet warm during the night when the Sun is not shining. We call carbon dioxide, methane (another gas which contains carbon) and a few other gases greenhouse gases. They act as a giant blanket keeping the planet's heat from escaping into space, just as the glass cover of a greenhouse keeps the tomato vines warm even in winter.

We are lucky to have greenhouse gases in the atmosphere but sometimes too much good can turn out to be bad. In the past century, we have been releasing a lot of greenhouse gases in our air. Most of them come from burning coal to produce electricity or gasoline in our cars. So today our blanket of carbon is thicker than ever before during human existence. These greenhouse gases trap extra heat and change the weather patterns we are used to. Summers become hotter and wild fires destroy entire forests. Winters become colder and it freezes when we least expect it. Rain doesn't fall when farmers need it most and droughts destroy entire crops. Warmer oceans produce more severe hurricanes and typhoons.

One major way in which we release carbon in the air is by growing our food and raising cattle. You may not realize it, but we use a lot of fossil fuels (such as natural gas, petroleum and coal) to bring food to our tables. We use them for things like farming equipment, trucks, and refrigeration. In addition, cows' burps and farts contain the powerful greenhouse gas methane. If we want to know how much carbon we release to produce a pound of beef or bread, we need to account for all of these.

Figure 1:
Does the price we pay for beef in the supermarket capture all its cost?
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Methods

Scientists use a special method called life cycle assessment, aka cradle-to-grave assessment. They calculate the impacts of a product during its entire life span: from growing the raw materials, transportation, and storage to end-use and disposal.

If you want to calculate the carbon released from producing and eating beef, for example, you have to add up the carbon from growing the corn feed for the cows, the fuel for the trucks delivering the cows to the slaughterhouse and the beef to the groceries store, electricity for the fridge where the meat is stored, and the gas for cooking it. Also, don't forget the methane that the cows belched and farted out. This gas is coming from their special digestive system. Ruminant animals such as cows, goats and sheep, have a gut full of bacteria which help them digest the food. But as the bacteria do their work, they produce methane which the ruminant animals let out.

Producing wheat for bread also results in released carbon. A lot of it comes from the fertilizers farmers put on the field to help the plants grow. These chemicals are made from natural gas – a direct source of carbon emissions. The tractors and farming equipment also requires petroleum. So do the trucks and packaging equipment. So even if wheat plants do not burp, growing them still causes us to release carbon in the atmosphere.

Results

Using data from the U.S. Government's Energy Information Administration and other science papers, researchers managed to add up all the different sources of carbon in the life cycle of beef and wheat (Fig. 1).
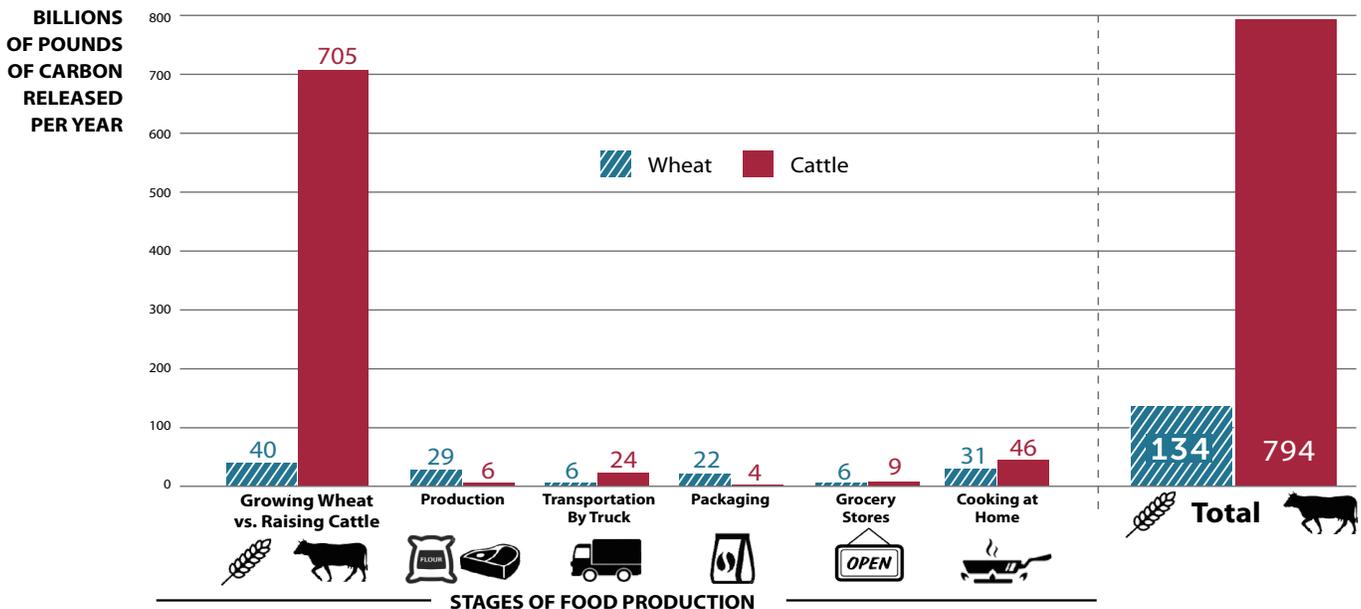
They determined that producing each pound of beef is responsible for about 30 pounds of carbon[1] released into the atmosphere. Multiplying this by how much beef we consumed in the U.S. in 2010, they found that this food resulted in about 800 billion extra pounds of carbon emissions.

Wheat crops are less carbon-intensive, i.e. producing a pound of wheat results in only one pound of carbon release. Given the amount of wheat we produced and ate in 2010, this plant's growth released six times less carbon than beef (~ 130 billion pounds of carbon per year).

Figure 1:
Comparing how much carbon is realeased from wheat vs. beef production:

(Actual unit of measurements is CO_2 e which accounts for all different greenhouse gases and their different global warming potentials.)

BILLIONS OF POUNDS OF CARBON RELEASED PER YEAR

Wheat / Cattle

Stage	Wheat	Cattle
Growing Wheat vs. Raising Cattle	40	705
Production	29	6
Transportation By Truck	6	24
Packaging	22	4
Grocery Stores	6	9
Cooking at Home	31	46
Total	134	794

STAGES OF FOOD PRODUCTION

Discussion

Climate change is not free for us. Dealing with colder winters, droughts and hurricanes is expensive. Think about a higher electricity bill, trucking in water and rebuilding houses. So the world governments are thinking about collecting a fee from the businesses which release carbon to make up for that cost. This means that farm owners who raise cattle and grow wheat might have to pay a fee for the carbon they released.

We are not sure what is a fair fee for each ton of carbon we release. Governments are considering to charge somewhere between $10 and $85 per ton of carbon. This means that the carbon fee for all the carbon released in producing all the wheat in 2010 (~60 million tons of carbon) would be between $600 million and $5 billion. Analogously, the carbon released from all the beef production in the U.S (~350 million tons of carbon) would cost between $3.5 billion and $30 billion.

Such fees might result in higher prices we pay for meat and bread in the supermarket. Price of wheat would go up by no more than 5 cents per pound (possible price increase is from 0.3 to 2%). The price of beef, however, would go up by as much as $1.50 per pound – a 40% increase. (The increase can range from 5% to 40%.)

Conclusion

If you want to be responsible for less carbon than your classmates, eat less beef, and more chicken or vegetarian meals. Some people, for example, go on an odd-day carnivorous diet – they eat meat every second day. On the even days they eat only veggies and dairy. Scientific studies show that such a diet is actually very healthy.

An added benefit is that cooking with less meat or without meat altogether is already cheaper. But according to this research, if the government begins collecting a fee for carbon released during food production, it will cost you even less!

Glossary of Key Terms

Greenhouse gas (GHG) emissions – releasing chemicals which trap the sun's heat and warm up the Earth's atmosphere. *E.g. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perflourocarbons (PFCs) and sulphur hexafluoride (SF_6).*

Emissions-intensive – activity which is responsible for releasing a lot of greenhouse gasses. *E.g. raising cattle is more emissions-intensive than growing wheat.*

Global warming potential (GWP) – different greenhouse gases trap different amounts of heat so we calculate how powerful is each one is warming the global climate. *E.g. one molecule of methane traps 25 times more heat than 1 molecule of carbon dioxide so we say that carbon dioxide's GWP is 1 while methane's GWP is 25.*

Emissions-intensive – a unit of measurement which accounts for all the different greenhouse gases and their different global warming potentials. *E.g. one ton of methane emissions/year = 25 tons of CO_2e /year.*

Life cycle assessment – counting carbon emissions from all stages of a product's life. *E.g. life cycle assessment of beef production counts the emissions from growing food for the cattle, cow burps, refrigerating, packaging, trucking and cooking the meat.*

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Check your understanding

1 Why is the process of life cycle assessment (LCA) a useful way of thinking about the global warming impacts of regular, everyday activities like eating beef? Draw a mini-LCA diagram of the beef production process and where carbon emissions occur along the way.

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2 Why would the price of beef increase more than the price of wheat if there were a cost or fee associated with carbon emissions?

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3 Do you think that living in a "climate friendly" way is (or can be) compatible with living in a healthy or economical way? Explain your opinion with evidence from the article?

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4 Write your own version of the abstract. An abstract is a brief summary of the entire paper. To write a good abstract, summarize each section in one or two sentences and connect them in a cohesive paragraph.