Your Questions About Food and Climate Change, Answered

How to shop, cook and eat in a warming world.

By: Julia Moskin, Brad Plumer, Rebecca Lieberman and Eden Weingart, New York Times, April 30, 2019

Big Picture

Does what I eat have an effect on climate change?

Yes. The world's food system is responsible for about one-quarter of the planet-warming greenhouse gases that humans generate each year. That includes raising and harvesting all the plants, animals and animal products we eat — beef, chicken, fish, milk, lentils, kale, corn and more — as well as processing, packaging and shipping food to markets all over the world. If you eat food, you're part of this system.

How exactly does food contribute to global warming?

Lots of ways. Here are four of the biggest: When forests are cleared to make room for farms and livestock — this happens on a daily basis in some parts of the world — large stores of carbon are released into the atmosphere, which heats up the planet. When cows, sheep and goats digest their food, they burp up methane, another potent greenhouse gas contributing to climate change. Animal manure and rice paddies are also big methane sources. Finally, fossil fuels are used to operate farm machinery, make fertilizer and ship food around the globe, all of which generate emissions.

Which foods have the largest impact?

Meat and dairy, particularly from cows, have an outsize impact, with livestock accounting for around 14.5 percent of the world's greenhouse gases each year. That's roughly the same amount as the emissions from all the cars, trucks, airplanes and ships combined in the world today.

In general, beef and lamb have the biggest climate footprint per gram of protein, while plant-based foods tend to have the smallest impact. Pork and chicken are somewhere in the middle. A major study published last year in the journal Science calculated the average greenhouse gas emissions associated with different foods.

Holy Cow!

The average greenhouse gas impact (in kilograms of CO_2) of getting 50 grams of protein from:

Beef	17.7
Lamb	9.9
Farmed crustaceans	9.1
Cheese	5.4
Pork	3.8
Farmed fish	3.0
Poultry	2.9
Eggs	2.1
Tofu	1.0
Beans	0.4
Nuts	0.1

Source: Poore and Nemecek, Science

Now, these are only averages. Beef raised in the United States generally produces fewer emissions than beef raised in Brazil or Argentina. Certain cheeses can have a larger greenhouse gas impact than a lamb chop. And some experts think these numbers may actually underestimate the impact of deforestation associated with farming and ranching.

But most studies agree with this general hierarchy: Plant-based foods usually have a lower impact than meat, and beef and lamb tend to be the worst offenders by a considerable margin.

Is there a simple food choice I can make that would reduce my climate footprint?

Consuming less red meat and dairy will typically have the biggest impact for most people in wealthy countries. That doesn't necessarily mean going vegan. You might just eat less of the foods with the biggest climate footprints, like beef, lamb and cheese. If you're looking for substitutes, pork, chicken, eggs and mollusks have a smaller footprint. But plant-based foods like beans, pulses, grains and soy tend to be the most climate-friendly options of all.

How much would changing my diet really help?

It varies from person to person. But a number of studies have concluded that people who currently eat a meat-heavy diet — including much of the population of the United States and Europe — could shrink their food-related footprint by one-third or more by moving to a vegetarian diet. Giving up dairy would reduce those emissions even further.

If you don't want to go that far, there are still ways to shrink your individual footprint. Just eating *less* meat and dairy, and more plants, can reduce emissions. Cutting back on red meat in particular can make a surprisingly large difference: According to a World Resources Institute analysis, if the average American replaced a third of the beef he or she eats with pork, poultry or legumes, his or her food-related emissions would still fall by around 13 percent.

Keep in mind that food consumption is often only a small fraction of a person's total carbon footprint: There's also driving, flying and home energy use to consider. But dietary changes are often one of the quickest ways for many people to lighten their impact on the planet.

I'm just one person! Can I really make a difference all by myself?

It's true that one person alone can make only a tiny dent in the global climate problem. It's just a really huge problem that requires large-scale action and policy changes to address. And food isn't even the biggest contributor to global warming; most of it is caused by burning fossil fuels for electricity, transportation and industry.

On the other hand, if many people collectively made changes to their diets, that could start to add up.

Scientists have warned that we'll need to slim down agriculture's climate impact in the years ahead if we want to get global warming under control, particularly as the world's population keeps growing. For that to happen, farmers and ranchers will need to find ways to curb their emissions and become much more efficient, growing more food on less land to limit deforestation. But experts have also argued that it would make a big difference if the world's heaviest meat eaters scaled back even moderately, helping to free up land to feed everyone else.

Why does meat have such a big climate impact?

Think about it this way: It's often more efficient to grow crops for humans to eat than it is to grow crops for animals to eat and then turn those animals into food for humans. One recent study by the United Nations Food and Agriculture Organization concluded that, on average, it takes about three pounds of grain to raise one pound of meat.

That's not the whole story. In their defense, cows, chickens and pigs often eat a lot of things that humans wouldn't otherwise eat, like grasses or crop residues. And meat can be rich in key nutrients like protein and iron. But, in general, it takes more land, energy and

water to produce a pound of animal protein than it does to produce a pound of plant protein.

Beef and lamb have an especially large climate footprint for another reason: The stomachs of cows and sheep contain bacteria that help them digest grass and other foods. But those bacteria create methane, a potent greenhouse gas, that is then released through burps (and a bit of flatulence).

Does it matter how the cows are raised?

Yes. Many cattle in the United States are raised on existing pasture that wouldn't otherwise be used, but it's a different story in places like Bolivia and Brazil, one of the world's largest beef exporters. There, millions of acres of rain forest have been burned to make space for meat production.

Studies have found that, as a result, beef from Brazil can have 10 times or more the climate impact of beef from the United States. Even within the United States, there can be significant variation in the carbon footprint of cattle herds, depending on factors like local climate conditions and how they're raised. Unfortunately, for this kind of information to be useful for consumers, we would need much more detailed labeling than exists today.

What about grass-fed beef?

In the United States, most cattle spend their first year on pastures eating grass, after which they are typically moved to a feedlot, where they are fattened up with grain. By contrast, "grass-fed" or "grass-finished" cattle keep grazing on grass until they are slaughtered.

Some scientists have suggested that grass-finished beef, if managed properly, can be a more sustainable option: As the cattle graze, they stimulate grass to grow deep roots and pull more carbon into the soil, helping to offset the cows' climate impact. But, on the flip side, grass-finished cattle also take longer to reach slaughter weight, which means they spend more time burping up methane into the atmosphere. Because of this, some studies have suggested that grass-fed beef can actually be worse for the climate over all, though the debate about this continues to rage.

For now, it's hard to say with confidence that grass-fed beef is consistently more climate-friendly than conventional beef.

What about chicken?

A number of studies have found that chicken and other poultry have a lesser climate impact than other livestock. Modern-day chickens are bred to be extremely efficient at converting feed into meat. That's not to say chicken is perfect: Industrial-scale poultry operations still create water pollution, and have prompted major concerns about animal

welfare. But if you're solely focused on climate change, chicken usually produces far fewer emissions than beef and a bit fewer than pork.

Should humans stop eating meat altogether?

Not necessarily. A number of experts have argued that a sustainable food system can and should still include plenty of animals. Cows and other livestock, after all, can often be raised on pasture that would otherwise be unsuitable for growing crops, and they eat crop residues that would otherwise go to waste. They produce manure that we can use as fertilizer. And animal agriculture provides livelihoods for some 1.3 billion people worldwide. In many countries, meat, eggs and milk offer a vital source of nutrition when there aren't good alternatives available.

That said, there are also millions of people around the world — in places like the United States, Europe and Australia — who currently eat far more meat than they need to for a healthy diet, according to a recent report in the medical journal The Lancet. And if we want to feed a growing population without adding to global warming or putting increased pressure on the world's forests, it would make a difference if the heaviest meat eaters cut back.

What about 'fake meat'?

New plant-based meat substitutes, like the Impossible Burger and Beyond Meat products, are increasingly showing up in supermarkets and even fast-food chains. Made from vegetables, starches, oils and synthesized proteins, these products attempt to mimic the taste and texture of meat more closely than traditional substitutes like tofu and seitan.

While the jury is still out on whether these products are any healthier, they do appear to have a smaller environmental footprint: One recent study estimated that a Beyond Burger had just one-tenth the climate impact of a beef burger.

In the future, researchers may be able to "grow" real meat from animal cell cultures — work is continuing on this front. But it's too early to say how helpful this will be from a climate perspective, not least because it could take a lot of energy to produce cell-cultured meat.

Are there other ways meat could become more climate-friendly?

Yes. If meat production around the world were to become more efficient, farmers and ranchers would be able to feed more people while reducing their emissions.

This is already happening in many places: The United States, for example, produces more beef today than it did in 1975 even though the total number of cattle has declined by about one-third. Advances in animal breeding, veterinary care, feed quality and grazing systems are already helping to shrink the climate footprint of livestock operations around the world, and there's a lot of room for further improvement. Some scientists are even

trying to figure out how to get cows to emit less methane by introducing seaweed or other feed additives to their diet.

Since it's unlikely that the whole world is going to go vegetarian anytime soon, these efforts will be critical for putting meat production on a more sustainable footing.

What kinds of seafood should I eat?

Wild fish often have a relatively small climate footprint, with the main source of emissions being the fuel burned by fishing boats. One recent analysis found that a number of popular wild fish — anchovies, sardines, herring, tuna, pollock, cod, haddock — have, on average, a lower carbon footprint than chicken or pork. Mollusks like clams, oysters and scallops are also great low-carbon choices. (We have dozens of good recipe options for you here.)

On the other hand, wild shrimp and lobster can have a larger impact than chicken or pork, because pulling them in demands extra fuel for the fishing boats.

There is a huge caveat to all wild seafood, though: At this point, the world is already catching about as much as it possibly can — most fisheries are being fished at their maximum sustainable level, while others are being overexploited. So there's not a ton of room for everyone in the world to increase their wild fish consumption. For now, you can check with science-based sources like Seafood Watch to see if the fish you buy is being harvested sustainably.

Seafood options in order from highest climate impact to lowest.

	Kg CO2/40 g protein
1 Farmed shrimp	4.8
2 Farmed tilapia	3.0
3 Wild tuna	0.6
4 Farmed salmon	0.6
5 Farmed mussels, oysters, scallops and clams	0.3
6 Wild anchovies, sardines and other small fish	0.1

Hilborn et al., Frontiers in Ecology and the Environment

Is farmed seafood a good long-term plan?

If we are going to eat more seafood in the coming decades, most of that increase will likely come from fish farms, also known as aquaculture. Fish farming can sometimes be a climate-friendly option, particularly for mollusks, but it isn't always. It often depends on farming practices and geography.

In places like Norway that have tight environmental regulations, farmed fish can have relatively low impact. But in parts of Southeast Asia, producers are clearing away mangrove forests to make way for shrimp farms, which leads to a big increase in

emissions. And some fish farms in China have produced enormous quantities of methane. There are plenty of promising efforts underway to clean up fish farming and make it more climate-friendly, but there's still a long way to go in many parts of the world.

How do I know whether a farmed fish is good or bad?

There are a number of groups, like the Aquaculture Stewardship Council and Friend of the Sea, that are starting to certify fish farms that adhere to environmental standards. That can be a good starting point. But a word of caution: Critics have warned that these labels still aren't perfect and often don't account for the full climate impacts of farmed seafood.

One recent study found some general trends in farmed seafood: Farmed mollusks (oysters, mussels, scallops) tend to be protein options with some of the lowest emissions around. That study also found that farmed salmon is, on average, lower impact than chicken or pork. On the other hand, farms for catfish and shrimp often require a large amount of energy to recirculate water and can sometimes have a larger climate footprint than even beef. But there's a lot of variation from farm to farm.

So what's the single best choice I can make about seafood?

You could incorporate more mollusks into your diet. Most Americans don't often eat them at home, but mussels, clams and scallops are familiar, succulent and easier to cook than you might think. We have recipes for you right here.

As for farmed or wild fish, they can often be a good low-carbon option, but it's a good idea to check first whether a product is certified as sustainable.

How much impact do milk and cheese have on climate change?

A number of studies have found that milk typically has a smaller climate footprint than chicken, eggs or pork per pound. Yogurt, cottage cheese and cream cheese are similar to milk.

But many other types of cheese, such as Cheddar or mozzarella, can have a significantly bigger footprint than chicken or pork, since it typically takes about 10 pounds of milk to make one pound of cheese.

Wait - cheese might be worse than chicken?

It depends on the cheese. But broadly speaking, yes, if you decide to go vegetarian by, say, eating cheese instead of chicken, your carbon footprint might not fall as much as you expect.

Are some kinds of milk better than others? I pay a lot more for organic milk.

The short answer is that you can't count on organic milk being better for the climate.

In the United States, that "organic" label on your milk just means that the cows spent at least 30 percent of their time grazing, weren't treated with hormones or antibiotics, and ate feed grown without synthetic fertilizers or pesticides. That's certainly appealing to many people. But there's no requirement that an organic dairy farm have a lower climate footprint than a conventional farm.

To date, studies have disagreed on whether organic dairy farms produce more, less or about the same amount of greenhouse gas emissions as conventional farms do, per gallon of milk. Most likely it varies a lot from farm to farm. The trouble is that there's nothing about the organic label that tells you anything specific about the climate impact of the carton of milk you're holding.

Which non-dairy milk is best?

Almond, oat and soy milk all have a smaller greenhouse gas footprint than cow's milk does. But, as always, there are caveats and trade-offs to consider. Almonds require a lot of water to grow, and this has been a problem in places like California. Soy milk tends to be fairly low-impact, as long as the soy is sustainably farmed.

Milk vs. 'Milk'

Environmental impacts of different types of milk, per liter.

	Emissions (kilograms CO_2)	Land Use (square meters)	Water Use (liters)
Cow	3.2	9.0	628
Rice	1.2	0.3	270
Soy	1.0	0.7	28
Oat	0.9	0.8	48
Almond	0.7	0.5	371

Source: Poore and Nemecek, Science

So are you saying I should become a vegan?

If you're interested in taking the plunge, a vegan diet does have the smallest climate footprint around.

I don't like vegan food. What would I eat?

If you like pasta with tomato sauce, hummus, avocado toast or peanut butter and jelly sandwiches, you actually do like some vegan food. Eating a fully vegan diet is hard for many Americans to imagine. Some assume that a vegan diet has to include meat "substitutes" like tofu, but that's not true: There's ample protein in beans, grains and nuts. And as more people become vegan, plant versions of ice cream, butter and even burgers are getting better all the time. For home cooks, the challenge is often producing a vegan dinner that everyone at the table will eat.

I don't think I can go completely vegan. What else can I try?

Another approach would be to simply eat less meat and dairy, and more protein-rich plants like beans, legumes, nuts and grains. (Here are recipes that go heavy on beans and grains.)

You could go vegetarian: no meat, poultry and fish, but dairy and eggs are allowed. The advantage here is that the rules are simple, and food manufacturers and restaurants are used to accommodating vegetarians. (We have vegetarian recipes for you that you can cook on a weeknight.)

Eating as a pescatarian, adding seafood to a vegetarian diet, can be a good compromise, and makes it easier to get protein into your meals.

To keep some meat in your diet, try cutting back to one serving of red meat per week, replacing the rest with chicken, pork, fish or plant proteins. This approach is more flexible, but it means more planning ahead and keeping track of what you eat.

Climate-Friendlier Diets

The average drop in food-related emissions when people switch from a typical Western diet to lower-impact ones:

Vegan (45% reduction) Vegetarian (30%) Partly replace meat and dairy with plants (30%) Replace beef and lamb with other meats (20%)

Source: Aleksandrowicz et al, PLoS One

Is organic produce really better than conventionally grown produce?

Organic produce is grown without synthetic fertilizers or pesticides, which is important to a lot of people. But that doesn't mean it's necessarily better from a climate perspective. In some cases, it can be a bit worse — organic farms often require more land than conventional farms. That said, organic farms' climate impact can vary widely from place to place, and the organic label, on its own, doesn't give you great information on the food's carbon footprint.

Should I worry whether my produce is local and seasonal?

In general, what you eat matters a lot more than where it comes from, since transportation accounts for only about 6 percent of food's total climate footprint. That said, there are a few things to consider.

Anything that's in season where you live, whether you buy it at a local farmers' market or at a supermarket, is usually a good choice.

Things get trickier when it comes to out-of-season produce. Some fruits and vegetables that are shipped by plane can have a surprisingly hefty carbon footprint. During the winter, that may include asparagus or blackberries — produce that's perishable and needs to move quickly between distant places. By contrast, apples, oranges and bananas are often shipped by sea, which is more fuel-efficient. Plenty of cold-climate vegetables, like carrots, potatoes and squash, can be stored after the fall harvest and last through the winter.

In some cases, though, there can be an advantage to food that's shipped in from elsewhere. If you live in the northern United States during the winter, it can be better to buy a tomato trucked in from California or Florida than to buy a local variety that was grown in an energy-intensive heated greenhouse.

Is food waste a big part of the climate change problem?

Yes. By some estimates, Americans end up throwing out roughly 20 percent of the food they buy. That means that all the energy it took to produce that food was wasted. If you're buying more food than you actually eat, your climate footprint will be bigger than it needs to be. So minimizing waste can be a pretty straightforward way to curb emissions.

Type of food do Americans throw out the most?

Percentage of food wasted or lost at the consumer level, by category.

- Fish and seafood 31%
- Fresh fruit 25%
- Fresh vegetables 24%
- Eggs 21%
- Meat and poultry 21%
- Dairy products 20%
- Grains 19%

Source: United States Department of Agriculture

How can I reduce my food waste?

There are lots of possibilities. If you cook, start with meal planning: Over the weekend, take 20 minutes to lay out three weeknight dinners, so that you buy only the food you

plan on cooking. (A similar rule applies if you eat out: Don't order more than you need.) Trim and wash your produce before putting it away, to make it easier to use. Be vigilant about eating or freezing the food in your refrigerator, instead of letting it spoil.

It's also worth remembering that "sell by" labels on food don't mean the item absolutely has to be tossed out after that date; they're usually manufacturer suggestions for peak quality. Many foods (with the exception of baby formula) can still be safely consumed after that date.

Should I be composting?

If you're able to, it's not a bad idea. When food is tossed into a landfill along with your other garbage, it begins to decompose and release methane into the atmosphere, where it warms the planet. Although a few American cities have started capturing some of this methane and recycling it for energy, most do not.

When composting is done right, the organic material in leftover food is converted into compost that can help grow crops, and methane emissions are cut significantly. Some cities, like New York, have started setting up centralized composting programs or curbside pickup. Or you can follow these tips to compost at home.

Should I use paper or plastic bags?

Paper shopping bags appear to be a bit worse from an emissions standpoint than plastic bags, although the plastic bags at supermarkets can't typically be recycled, and create waste that sticks around for much longer. But in general, packaging makes up only about 5 percent of global food-related emissions. What you eat matters a lot more for climate change than the packaging it comes in.

That said, it's a fine idea to reuse the bags that you do get, or to buy a reusable bag (as long as you keep it and use it often), or to minimize plastic bags when picking out produce. Other plastics at the store, like soda bottles or milk jugs, are tougher to avoid, but those can often be recycled.

Does recycling do anything?

It can help, though it's not as effective as reducing waste in the first place. Recycling aluminum, plastic and paper can cut energy use and curb emissions. But make sure you're recycling properly; follow these tips to make sure your recyclables don't just end up in the landfill.

Why aren't there labels in the grocery store explaining the carbon footprint of different foods?

Some experts have argued that there should be environmental labels on food, similar to nutrition labels. In theory, these labels could help interested consumers pick out lower-impact products and give farmers and producers more incentives to curb their emissions.

A recent study in the journal Science found that products that look very similar at the grocery store can have widely different climate footprints depending on how they're produced. One bar of chocolate may have the same climate impact as driving a car for 30 miles — if rain forests were cleared to grow the cocoa — while another chocolate bar may have very little climate impact at all. But without more detailed labeling than exists today, it's extremely difficult for a shopper to figure out the difference.

That said, a really detailed labeling scheme would likely require a lot more monitoring and emissions calculations, so it could take a fair bit of effort to put a system like this in place. For now, most shoppers will have to get by using rough rules of thumb.

Takeaways

1 Modern agriculture inevitably contributes to climate change, but some foods have a bigger impact than others. Beef, lamb and cheese tend to do the most climate damage. Pork, chicken and eggs are in the middle. Plants of all kinds typically have the lowest impact.

2 What you eat matters a lot more than whether it's local or organic, or what kind of bag you use to carry it home from the store.

3 You don't have to give up meat altogether to make a difference. Even smaller shifts, like eating less meat and more plants, or switching from beef to chicken, can reduce your climate footprint.

4 One simple way to cut your food-related emissions is to waste less. Buying what you need and actually eating it — instead of tossing it out — means that the energy used to produce your food has been spent efficiently.