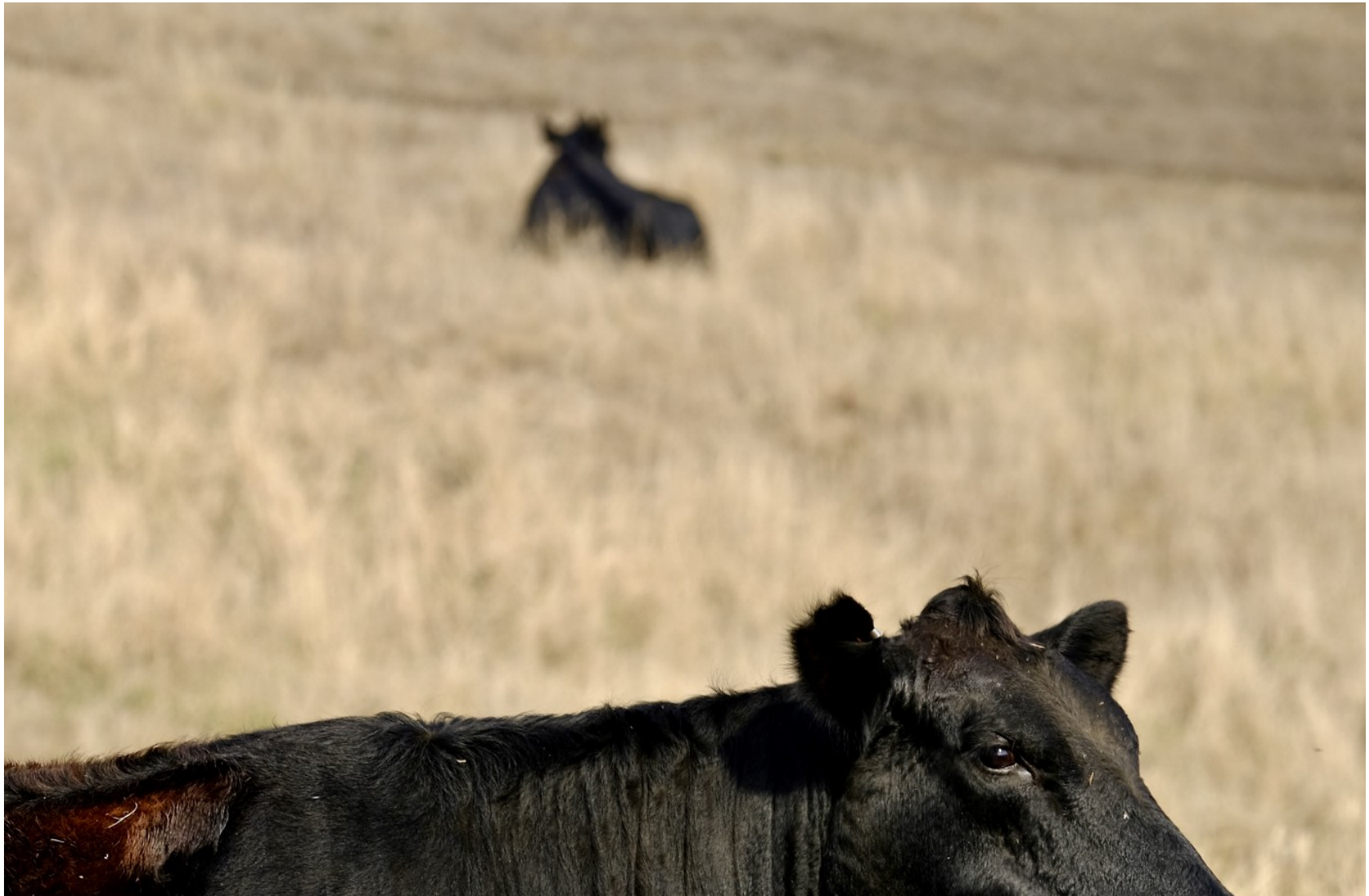

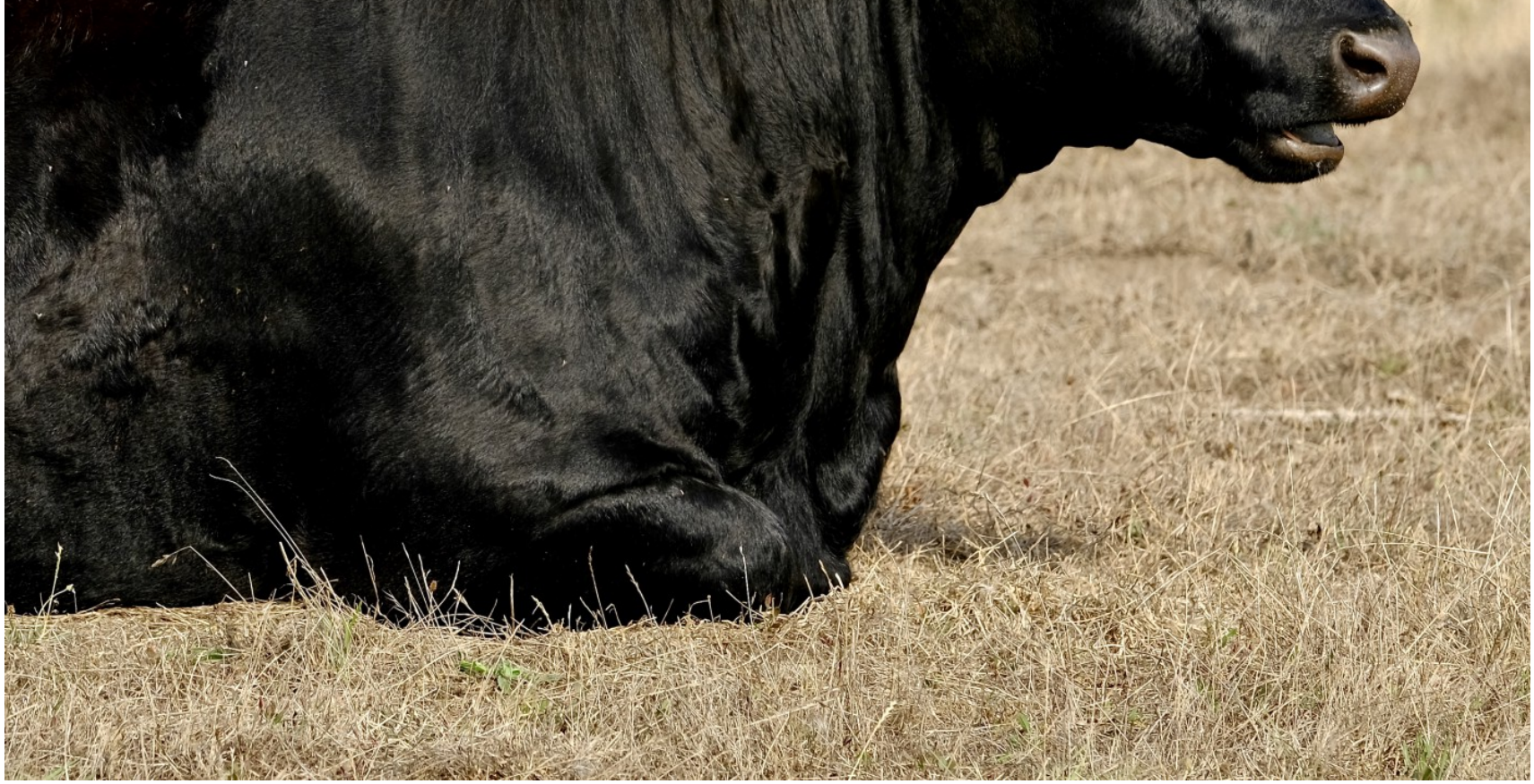

Cattle in Point Reyes, California. Photo by Jonathan Foley © 2017.

Beef Rules

It's easy to get confused about beef these days, especially when it comes to the environment. Some environmentalists say we should avoid beef altogether, while others suggest more sustainable beef production on grasslands is crucial to improving soil health, protecting biodiversity, and addressing climate change. So, what should we do? What's the most environmentally responsible choice as a consumer? Maybe some basic rules can help.

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Most of the beef produced in America has a *staggering* environmental impact. But some of it doesn't, and may even have crucial environmental benefits. Naturally, this has generated a lot of confusion among environmentalists who want their diet to align with the planet.

So, what should we eat? How can we tell the difference between "good beef" and "bad beef"? And what can we do about it?

First, let's look at the bulk of the beef produced in America today. Generally speaking, American beef cattle spend the majority of their life on grazing lands, and are then rapidly fattened (or "finished") for a few months in feedlots before they are slaughtered. At any given time, there are approximately 70–80 million beef cattle alive in the United States, with about 60–65 million on grazing lands, and 10–15 million in feedlots. Another ~20 million cattle live in dairy operations. Each year, we slaughter a

total of 30–35 million cattle in the United States for meat consumption, mostly from feedlots and by culling dairy herds.

In feedlots, cattle are kept in cramped spaces, fed grains (mainly corn, sorghum, and wheat) and forage (mainly alfalfa and corn silage), and pumped full of a myriad of antibiotics and growth hormones. This helps bring cattle to their slaughter weight very quickly, and with the marbled texture of beef that American consumers have grown accustomed to.

Naturally, keeping millions of cattle in confined feedlot operations creates some problems.

One is the use of antibiotics. Feedlot cattle are not given antibiotics because they are sick, but because antibiotics make the animals fatten faster. Amazingly, livestock use about 70% of the antibiotics consumed in the United States every year, and public health experts are concerned that this could give rise of antibiotic-resistance microbes. To help address this concern, the FDA has recently imposed to new rules to cut back on antibiotic use in animal production. But many fear that this is not enough to reduce the risk of antibiotic-resistant disease outbreaks, which could jump into the human population. This alone raises big questions about feedlot operations.

There are also concerns about animal welfare in feedlots. Scientific evidence shows that cattle in feedlots experience higher levels of stress and digestive problems than grass-fed cattle.

And it doesn't take much imagination to see that feedlots can have tremendous impacts on the environment.

Communities near feedlot operations often have to contend with manure runoff, water pollution, air pollution, and noxious odors. (I grew up down the road from a concentrated dairy operation, and can attest to this on a personal level.) The manure production of feedlots alone is staggering: Animal feedlots in America (including cattle, hogs, chickens, and other animals) produce an estimated 2 billion tons of manure every year, with no sewage treatment. That's over 130 times the production of all human feces (estimated at roughly 15 million tons of human feces per year) in the country, which is sent to sewage treatment facilities or septic tanks. And all that animal shit has to go somewhere — a lot of it ending up in our waterways and lakes. It's painful to even think about it.

But the environmental impact of feedlots goes far beyond the facilities. In fact, vast areas of the country are used to supply the feed needed to operate them. For example, corn alone occupies nearly 100 million acres (about the size of California) of US farmland, where most of it is used to make ethanol and animal feed (for cattle, hogs, chickens, and so on), instead of food people can eat directly. And so the land use, water use, chemical use, and environmental impact of growing this feed is largely driven by ethanol and meat production.

Mostly, it's just a giant waste of food, because the process of converting corn (or other grains) to edible beef is actually quite inefficient. In fact, it takes about 30 calories of

edible corn (which, unlike grass, we humans could eat ourselves) to grow one new calorie of edible beef. Where else do we throw away 29 out of 30 calories in the food system? (I should note that the beef industry likes to quote other feed-to-beef conversion numbers (like 5:1 or 7:1 or 10:1) but they are looking at the *weight* of the *entire* animal — including bones, organs, and hides — not the edible food that it produces, either in terms of calories or protein. Moreover, they don't include the grass or milk that cattle ate over their lifetimes outside the feedlot.) In terms of efficiency, the 30:1 ratio is the most direct way to compare the *food we could have eaten* (in the form of corn or other grains) versus the *food we actually get* (in terms of edible, boneless beef).

Cattle are also a major contributor to climate change. Most importantly, cattle burp (not fart) lots of methane, an important greenhouse gas that traps heat about 34 times effectively than carbon dioxide (averaged over 100 years, because methane traps heat even better than this, but doesn't live as long in the atmosphere). It is important to note that cattle burp methane whether on grazing land *or* in feedlots, so neither one is ideal for climate change.

> Most of the beef produced in America has a staggering environmental impact.

But not all beef cattle end up in feedlots. In fact, some beef in the United States is entirely grass-fed, and is never sent to feedlots. While there is growing interest in grass-fed beef, and the market is expanding quickly, it's still a tiny percentage (estimates range from 1 to 3%) of the US beef supply.

In many ways, grass-fed beef *can* be better for the environment. Well run grass-fed systems avoid most of the manure pollution and associated water quality issues of feedlots. Odors and air pollution are greatly reduced too. Plus, grass-fed cattle can often coexist with wildlife, making well-run pastures a potential benefit to biodiversity too.

Plus grass-fed operations largely avoid the problems of antibiotic resistance. And many see them as an improvement in animal welfare.

But it's not all good news.

Grass-fed beef cattle inherently take more land and more water to grow than their feedlot cousins. (Although this grazing land is often in semi-arid regions of the country that cannot be used for other kinds of food production, so this might be a moot point.)

And another potential downside of grass-fed beef is linked to their production of methane, a key contributor to climate change. Because grass-fed beef cattle take longer

to “finish” to their slaughtering weight, and therefore live longer, they generate more lifetime-cumulative methane emissions. Per pound, grass-fed beef generally releases more methane than feedlot beef, and, on the surface, is potentially worse for climate change.

On the surface, that is.

But a *very* intriguing potential benefit of grass-fed systems is that they may be able, at least in some circumstances, to offset their greenhouse gas emissions by improving soil health, building soil organic matter, and sequestering significant amounts of carbon from the atmosphere. Several groups have claimed that grazing systems, managed in very specific ways, can add enough carbon to the soil to *more than offset* their inherent greenhouse gas emissions, and become a climate *solution* instead of a climate problem.

While some studies have questioned how widespread and how long-term this phenomenon is — and I have questions about some claims being made — this is intriguing stuff. It may be possible to raise cattle in ways that is far less damaging to climate change, and in some circumstances, may even be *beneficial* to the climate, by sequestering enough carbon and offsetting more emissions than the cattle produced in the first place.

I would love for this to be true, and I think some groups have demonstrated that it is — at least in certain circumstances. But the questions that concern me are:

- How long can grazing soils keep building up organic matter (and soil carbon)? Don't soils eventually "saturate" their levels of organic matter, and can't hold any more — even as the cattle continue to belch methane? Doesn't this mean the effect is, in the end, temporary?
- And how widely can this practice be implemented? Does it work in all soil types, or just some? Does it work in wet climates, or dry? In cold, or warm? When does it work, and when does it not?

While I have some questions about the long-term benefits of grass-fed beef as a climate solution, I have no doubts that good grazing systems can be less damaging to climate change than feedlot systems, and sometimes can be net beneficial. It would be great to see many more systems like this, operating at the commercial scale.

Naturally, there is now a great deal of interest in grass-fed beef across the environmental community. It may be a more humane, environmentally-friendly, and safer way to deliver beef to the American market. And, at least in some

circumstances, it might be a way to rebuild soil health across large grazing areas of the country, offset greenhouse gas emissions, and be a (partial?) solution to climate change.

So, if it ends up being better, overall, for animals and the environment, shouldn't we all switch to grass-fed beef?

Sadly, no. It's not that simple.

> ...grazing systems, managed in very specific ways, can add enough carbon to the soil to more than offset their inherent greenhouse gas emissions, and become a climate solution instead of climate problem.

turns out that there is no easy way to replace all of the feedlot beef production in the

It United States with grazing cattle.

A very interesting study by Matthew Hayek and Rachael Garrett shows that the current pasture systems in the U.S. could only produce about 27% of the current beef supply of the country. (Other studies suggest a somewhat higher figure, but they all conclude that grass-fed systems alone cannot meet the current American demand for beef.) Even supplementing these grass-fed operations with forage from American croplands would only meet about 60% of the current U.S. beef demand.

Some people disagree, of course, and suggest that better grazing practices can boost the productivity of grasslands — maybe enough to help offset the feedlots. If true, that would be very helpful. Some very cool demonstration projects seem to suggest this. And the very few peer-reviewed studies on this also suggest productivity gains are possible, but more research is needed to see how big this effect is, under what circumstances it can happen, and for how long.

But, for now, it seems to me that grass-fed systems probably can't entirely replace the immense beef production of American feedlots.

And even if grass-fed operations *could* significantly boost their productivity everywhere, scale up their market share by 30x-100x, and eventually offset all feedlot beef production, it would be a *herculean* effort — taking decades of work, hundreds of millions of acres, and billions and billions of dollars. In the meantime, cutting back on the demand for feed-lot beef seems like a wise, no-regrets strategy.

So here's the crux of the issue.

Yes, it seems that grass-fed beef *can* be better for many environmental issues than feedlot beef. And, in some circumstances, well-managed grazing systems may even be a climate change solution. More research is needed to understand how best to take advantage of this possibility, and under what circumstances it may best work. And much more investment is needed to scale it up.

But, even so, there is no easy way for grass-fed cattle to immediately and completely meet the American demand for beef. Maybe someday, but not anytime soon.

The *only* way to ensure we quickly reduce the environmental impacts of beef in this country is to simply cut the demand for feedlot beef — by a lot.

One way to do this, of course, is to dramatically cut back our beef consumption, since feedlots produce the vast majority of the stuff. Just eat less.

Overall, the US population is eating less beef these days, and that has contributed to a reduction in beef-related environmental impacts. (By the way, we're not becoming vegans *en masse*; We're mainly replacing beef with chicken.) Nonetheless, Americans still eat far more beef than most other people (e.g., we eat four times the global average), and we eat far more than is recommended for our health. Needless to say, we could stand to cut our beef consumption dramatically.

We could meet some of our desire for beef with new plant-based substitutes, including burgers from Impossible Foods and Beyond Meat. These meat-alternatives are proving to be immensely popular, and may eventually replace a sizable fraction of US beef production, but the industry is still a long way from doing that. And the potential for laboratory-grown meat products, where animal cells are grown in vats without live animals involved, are intriguing too. (Although I have questions about lab-grown meat, because animal cells need to eat *something*, and are inherently less thermodynamically efficient than plants — just like living animals — and I wonder what the feedstocks will be, and what resources they will take.)

Besides changing our diets, another place beef consumption can be *effectively* reduced is by eliminating waste in the beef supply chain. Typically speaking, post-harvest food waste accounts for about a third of the food grown on the planet. And a recent study of US food losses shows that we lose about 38% of meat consumed in the United States, roughly split between losses at the retail level and consumer level. If we could cut back on this waste, we could reduce the land, water, natural resources, and environmental

impacts it took to grow beef that is never even consumed. Surely we can all agree that this is a useful place to focus.

So, based on all of this, and with apologies to Michael Pollan and his "Food Rules", I have some basic rules to guide the environmentally-responsible consumption of beef.

Eat much less beef. Feedlot beef is an environmental mess, and even if grass-fed beef is great for the environment, we probably can't grow enough of it, quickly enough, in the United States (at least under current grassland management techniques) to keep eating so much of it. We've got it cut back some of it, at least in the short run.

Waste none of it. Beef is one of the most resource-intensive things we produce in the food system, no matter how it's grown, and any unnecessary waste is a tragedy. We should treat beef as something precious, that took enormous resources to grow, and it shouldn't ever be left to waste.

Source it from soil-building grasslands. While I still have a few questions about grass-fed beef, and whether it *always* builds soils and is beneficial to climate change, it is clear that grass-fed systems can often be better for the environment. And with more research

and investment, it is only going to get better. So let's support the ranchers who do this work, and help reward them for making beef as sustainable as possible.

To me, even in this ongoing debate, with lots of confusing claims and counter-claims, my relationship with beef is going to be simple: eat less, waste none, and try to source it from grass.

And, of course, keep having constructive discussions about the future of meat, our diets, and the environment of this planet. We all have much more to learn.

NOTE: This essay was updated to clarify a few points. For example, I added a paragraph about the possible enhancement of grassland productivity under better management regimes. And I added a short parenthetical comment about methane's role as a greenhouse gas, to help reduce confusion on how CO2 and CH4 compare as a greenhouse warming agent. A few other points were reworded to reduce confusion.

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These views are his own.


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