

Re-thinking Meat: How Climate Change Is Disrupting the Food Industry

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ABSTRACT

Among vegetarian, vegan, and animal advocates, it has been common practice for many decades to cede the term “meat” to livestock producers, and to ask people to sacrifice meat. Yet during those decades, global consumption of livestock products has exploded. People have often overlooked the fact that “meat” has been defined for centuries as an essential food that includes plant-based versions, and plant-based meat has always been framed as equivalent or superior to animal-based meat. In fact, replacing animal-based foods with better alternatives is said to be the only pragmatic way to stop climate change quickly as needed. However, it is unlikely to happen through efforts to reduce meat consumption. It is much more likely to happen through efforts to disrupt meat production and consumption by making and marketing meat and other foods directly from plants.

Keywords: Food, Agriculture, Tofu, Yuba, Livestock, Climate Change, Greenhouse Gas Emissions, World Bank Group, Food and Agriculture Organization (FAO)

INTRODUCTION

The invitation to write this chapter started with the following introductory claims: “Our understanding about the benefits and negatives related to the consumption of meat... is influenced by dietary habits and social norms but also by their marketing. There is however ample scientific evidence that excessive meat consumption is not good for the natural environment and can be detrimental to human health.”

But this chapter will explain why the abovementioned claims are themselves detrimental. First, plant-based food producers sometimes market their products as “meat” (Field Roast FAQ, n.d.), and dictionaries define “meat” as an essential food that includes plant-based meat (Merriam Webster’s, n.d.); so a critique of “excessive meat consumption” is unnecessarily ambiguous if it does not specify whether the meat in question is animal-based or plant-based.

Second, the abovementioned claims imply that moderate animal-based meat consumption could be good for the natural environment, when there is plenty of evidence to the contrary. Third, those claims wrongly imply that it could be good for the environment for people to switch from consuming animal-based meat to consuming dairy products and eggs. Fourth, those claims suggest that advocating against excessive meat consumption could be successful, but this is

contradicted by history. Fifth, those claims omit any reference to climate change, though plenty of evidence indicates that climate change is unique among environmental risks in being large-scale, transboundary, potentially irreversible, and potentially catastrophic in the near term.

While this chapter will provide evidence to contradict the abovementioned claims and their implications, it will also propose ways in which some common views of animal- and plant-based meat might be constructively reassessed.

Short History Of “Meat”

In English, the word “meat” was used in the early Middle Ages as a generic term to describe foods in general. Later in the Middle Ages, the word gradually became focused on various types of flesh used for food, including the flesh of vegetables (Online Etymology Dictionary, n.d.)

These days, food companies market products such as “grain meat” (Wegmans, n.d.) and “nut meat” (Vegie Delights, n.d.), practically always marketing them as being equivalent or superior to animal-based meat.

The phenomenon by which plant-based meat is considered equivalent or superior to animal-based meat is not new. Soyfoods started to be considered superior foods in China during the Han dynasty (206 BC–220 AD), when soy sprouts began to be used alternately as both food and medicine. During this period, the introduction of the hand-turned stone mill helped in developing and expanding the production of soymilk, fermented black soybeans, fermented soybean paste, soy sauce, and fermented tofu (Soyinfo Center, 2014).

Starting in the ninth century AD, a form of soy meat called Yuba was created from the film formed when soybeans are boiled; this began first in China and soon after in Japan (Tsutsumi & Tsutsui, 2009). Around the same time, soybean oil and cake – as well as tofu – also started to be created in China (Soyinfo Center, 2014). The earliest known document to use the word “tofu” was written by Tao Ku around the year 965 (Soyinfo Center, 2014). The document was called *Qing Yilu* – which translates to “Anecdotes, Simple and Exotic” – and it framed soyfoods as superior to animal-based foods.

Several centuries later in China, an encyclopedic document entitled *Jujia Biyong Shilei Quanji* – which translates to “Essential Arts for Family Living” – described methods of making plant-based sausage using wheat gluten. From then through to modern times, soybeans have been rarely used in whole form in Asian cuisine (Soyinfo Center, 2014).

In modern times, disruption of one industry after another has become prevalent. However, this was not always so. In fact, the history of meat shows that its production generally developed in phases of evolution and consolidation, rather than through rapid disruption.

Originally, in Paleolithic societies, people's success in hunting wild animals was never assured; shooting an arrow and missing the target was often as likely as success. As technology for hunting improved, success still was highly variable, notably dependent on seasonality, local climatic conditions, and the local availability of desired animals (Chiles & Fitzgerald, 2017).

Later, after the transition from hunting to animal agriculture, animals were first used for draft labor, eggs, milk, wool, and soil fertilization more than for meat. Feed crops were generally considered too valuable to feed to animals. Livestock products were mainly reserved for rich people, and even for them, livestock products often provided a minor contribution to diets overall (Chiles & Fitzgerald, 2017).

The evolution of democracy brought with it a positive political connotation when animal-based meat was taken up by the non-rich. At the same time, vegetarianism became denigrated as being for poor and/or non-Western people. However, vegetarianism was still common due to widespread poverty and the lack of industrialized processes to produce, process, refrigerate, and transport animal-based foods.

Industrialization of livestock production brought refrigeration, transportation, large-scale production, and reduced prices. It also meant that consumption of animal-based foods was no longer dependent on seasonality, local climatic conditions, and the local availability of desired animals. Animal-based foods became symbols of prosperity and health (Chiles & Fitzgerald, 2017). This occurred even though modern European genes may have favored vegetarianism (Ye, Gao, Wang, Bar-Yosef, & Keinan, 2017). Yet while the size and marketing prowess of the livestock sector have increased year after year for many years, plant-based diets have persisted all over the world, even among people who do not live in poverty.

Sacrificing Meat

As described above, the origins of the word “meat” indicate that plant-based meat has long been a rival to animal-based meat. This suggests that there is no good reason for ceding the term “meat” to livestock producers and asking people to sacrifice meat.

Indeed, since “meat” is commonly defined as an essential food, livestock producers would be expected to benefit by having a monopoly on the marketing of “meat”. As evidence of this, a conglomerate representing livestock producers in the European Union has lobbied for the word “meat” to be reserved for animal-based products (Mammoser, 2017). Another tactic used by some livestock producers – and by some people who cannot imagine giving up animal-based meat – is to call plant-based meat “fake”.

Yet plant-based meat need not involve any more processing than does whole wheat bread, which nobody calls fake. In fact, plant-based meat has almost always been produced by artisanal methods – whereas animal-based meat has long been produced in developed economies primarily in factory settings, using hormones and antibiotics.

Producers of plant-based meat never use hormones or antibiotics, and they also often avoid genetically modified organisms – which are rarely avoided in animal-based meat production. With that in mind, and considering the long history of plant-based meat, animal-based meat could be considered less authentic than plant-based meat. In other words, animal-based meat could be considered an ersatz version of meat when compared to plant-based meat.

However, among vegetarian, vegan, and animal advocates, it has been common practice for many decades to cede the terms “meat” and “milk” to livestock producers, and to ask people to sacrifice meat and milk. Yet during those decades, global consumption of livestock products has exploded six-fold (Renner, 2014), twice as fast as human population growth. Further evidence for a case not to cede the term “meat” to livestock producers exists in a major trend to market plant-based meat for sustainability (Retailer News Insider, 2014). Therefore, some part of vegetarian, vegan, and animal advocacy might merit re-thinking.

Perhaps the most popular campaign that advocates for people to sacrifice meat is the Meatless Mondays campaign. By touting “meatless” eating in its name, the campaign overlooks the fact that dictionaries define meat as an essential food that includes plant-based versions.

The Meatless Mondays campaign prioritizes a prescription from medical authorities who have indicated that a 15 percent reduction in saturated fat is needed for good medical health (Kamila, 2011). According to the campaign, this can be fully achieved if people give up consuming meat just one day per week.

However, by its name and otherwise, the Meatless Mondays campaign fails to emphasize that dairy products often contain even more saturated fat per serving than does meat, and eggs too contain a significant amount of saturated fat; nor does the campaign indicate what change in consumption is needed for good climatic health.

For example, for consumers concerned about saturated fat, a fitness website has estimated that a 3.5-ounce fast-food hamburger contains approximately 4 grams of saturated fat (at <http://www.myfitnesspal.com/food/calories/45914216>) – while the same website has estimated that 100 grams (equivalent to 3.5 ounces) of quiche Lorraine contains 8 grams of saturated fat (at <http://www.myfitnesspal.com/food/calories/traditionnelle-quiche-lorraine-510312963>). Yet the Meatless Mondays campaign can and does lead some people to switch from a hamburger to quiche Lorraine, which can worsen both public health and climate change.

If the Meatless Mondays campaign were to clarify that it frowns upon eggs and dairy products as well as animal-based meat, then it could potentially yield a 13 percent replacement of livestock products with better alternatives. Yet 13 percent less livestock products would be far less than the amount of replacement that is actually needed to reverse climate change – which is somewhere between 50 to 85 percent, depending on whose analysis is used (Goodland, 2014).

However, it seems unlikely that Meatless Mondays will ever yield even 13 percent less livestock products. After all, the campaign frames what is needed as a sacrifice, so the needed action is likely to suffer the same fate as everything that promotes sacrifice – i.e., people who sacrifice livestock products one day are likely to crave them more the next day. Indeed, the Meatless Monday campaign anachronistically touts its basis in American rationing during World War I (Meatless Monday History, n.d.), after which a major expansion in meat production occurred in the U.S. (The National Provisioner, 2016). Yet no consumer product is successfully sold by pressing people to use it just one day a week. For example, consumers might be wary of choosing Pepsi Cola at all if its marketing promoted it as a one-day-a-week drink, conceding that Coca Cola remains the drink of choice the rest of the week.

In fact, while the Meatless Mondays campaign has expanded around the world since 2003, the worldwide consumption of livestock products did not fall in the subsequent decade; it rather continued to rise (Nierenberg & Reynolds, 2012). It continued to rise even from 2007-2012 – which is especially striking when considering the wave of economic downturns in one region after another from 2007-2012. In earlier times in history, the consumption of livestock products dropped markedly during economic downturns (The Afro-American, 1974).

Actual trends in global meat consumption are surely more important than the trend of organizations to adopt Meatless Mondays. Perhaps the organizers of Meatless Mondays would achieve more success by framing alternatives to livestock products as better products, rather than a sacrifice. If alternatives to livestock products might seem hard to promote, then one might consider as an example the fact that bicycles may be hard to promote to car-lovers, but bike advocates normally do not frame bike-riding as a sacrifice.

The Meatless Monday campaign promotes sacrificing meat to reduce health risks, energy and water usage, and carbon emissions. Yet goals for such reductions are common in the case of many consumer products, and they usually do not motivate major action to replace any products. In contrast, emergencies normally motivate major action – and both the UN Intergovernmental Panel on Climate Change and the UN International Energy Agency have warned that greenhouse gas emissions must be reduced significantly by 2020 (Smithsonian, 2012) or at the latest 2026 (Dechert, 2016), or else climate change may no longer be controllable. Therefore, climate change may be the most compelling motivation on which to dwell.

An alternative to the Meatless Mondays campaign is a campaign that has a similar but more sophisticated name, namely Meat Free Mondays, founded and operated by three members of a famous family, Mary, Stella, and Paul McCartney. By replacing the term “Meatless” with “Meat Free,” they have moved from using a term that connotes taking something away to a term that raises the idea of being free. Unlike the Meatless Mondays campaign, the Meat Free Monday campaign was launched specifically to address climate change (Lean, 2014).

The Meat Free Monday campaign has made it clear that it does not support switching from animal-based meat to eggs or dairy (e.g., at <https://www.meatfreemondays.com/vegan-quarter->

puts-plant-based-food-centre-stage). Sometimes the Meat Free Monday campaign has clearly stated that it promotes “plant-based meats” (e.g., at www.meatfreemondays.com/pledge-brunch-spotlights-un-climate-summit-pledge-campaign).

So there are several ways in which the Meatless Monday campaign could easily improve itself to become more relevant – notably by using a more positive and climate-oriented approach to its advocacy; by clarifying that it does not support switching from animal-based meat to eggs or dairy; and by promoting plant-based meat.

In recent years, activists have promoted the idea of getting people to sacrifice animal-based meat by taxing it. Yet people who favor animal-based meat far outnumber those who do not, so it is likely to be political suicide for politicians to propose taxing animal-based meat in almost every jurisdiction in the world. Moreover, in any particular jurisdiction, taxing animal-based meat to combat climate change would contradict the fact that climate change can be managed effectively only with a global approach. Anyway, tax is generally imposed on an industry to get companies to do something only when there is not a business case to do it – yet there is a business case for replacing livestock products with better alternatives (Goodland & Anhang, 2009).

A Case To Replace

A vivid example of how detrimental it can be to advocate for “less meat” was displayed during a meeting in 2015 where public comments were made on recommendations for U.S. dietary guidelines. Those comments can be seen and heard in a video of the meeting (Health.gov, 2015). A man representing McCormick Spices played to the crowd, saying “let’s spice up the guidelines!” He proposed that consumers would buy his company’s products “not because they have to but because they want to.”

Some speakers at the meeting said they were attending on behalf of a broad coalition representing “millions of Americans” anxious for the dietary guidelines to incorporate recommendations for “less meat” to improve environmental sustainability. One couldn’t help wondering who would win a contest between millions of “less meat” consumers *versus* hundreds of millions of meat consumers.

Indeed, a number of speakers representing livestock interests spoke as if they represented the average consumer, and they pitched livestock products as center-of-the-plate foods in the most positive terms possible.

In contrast, none of those promoting “less meat” pitched anything easily perceived by an average consumer as center-of-the-plate foods. Instead, they pressed for meat to be replaced with things like “fruits and vegetables” and “more plants”. They left it to the audience to puzzle over how vegetables and fruits might be something other than side dishes and desserts, and how a plant could be a center-of-the-plate food.

Contradicting the claim by the “less meat” speakers that they spoke for a broad coalition, virtually all but one of them were clearly Caucasian. In contrast, many speakers outside that coalition were clearly African American, Asian American, and Hispanic American.

One speaker said “less meat” is needed because emissions of methane and nitrous oxide from livestock production “may double by 2070... making it impossible to meet climate change targets” and “Americans are eager for good science-based information.”

Yet according to the world’s most prominent climate authorities, the world must significantly reduce greenhouse gases by 2020 (Smithsonian, 2012) or at the latest 2026 (Dechert, 2016), or else climate change may no longer be controllable.

So the “less meat” speakers failed to define correctly what is needed. They also failed to explain that Americans cannot act to meet climate targets on their own. That is because greenhouse gas emissions and climate change are large-scale and do not respect borders. So climate targets can be met only if people in much more populous countries participate, especially China and India.

Yet it is even less possible to sell “less meat” in China and India than it is in the U.S., as there is much less perception in those countries that there is an excess of meat consumption.

“Less meat” proponents also failed to talk about how widely-cited assessments of food and climate change by the FAO and others have focused on *all* livestock production, not just meat production. Yet promotion of “less dairy products” and “less eggs” would be even less acceptable than “less meat” in China and India – particularly in India, where dairy products are especially preferred.

So it seems that what’s needed is some sort of positive, internationally acceptable marketing of center-of-the-plate and other plant-based products. They could be called something like “Happy Better Vegan Foods”.

In part because positive marketing of center-of-the-plate products is already being undertaken by plant-based food producers who market products such as “grain meat” and “nut meat“, it seems that recommendations for changing U.S. dietary guidelines were mistaken in prescribing “smaller meat portions” without qualifying them as animal-based meat portions.

If a term such as “Happy Better Vegan Foods” would be used, then what’s needed could be framed as preferable, delicious center-of-the plate foods and plant-based alternatives to dairy products and eggs. This could inspire consumers to choose what’s needed not because of dietary guidelines, but because they want to – the holy grail prescribed by the man from McCormick Spices.

A variation on the “less meat” theme came from a speaker advocating for the “humane” raising of animals. She spoke of her concern for greenhouse gas emissions, saying: “The FAO has evidence to show that 14.5 percent of anthropogenic greenhouse gas emissions come from livestock production”. Therefore, this speaker claimed, “there is an overwhelming case” to accept recommendations for “less meat”.

However, the FAO report that originated the cited 14.5 percent emissions estimate actually promotes more livestock production, to be facilitated by “technologies and practices currently used by the 10 percent of producers with the lowest emission intensity” (Gerber et al., 2013). The lowest emission intensity producers are those with the most confined operations – which means that they raise animals in the least humane way possible.

The FAO’s livestock-climate analysis cited by the “less meat” speakers was used in the recommendations for “less meat” that they cited, but the FAO’s analysis elicited no criticism from the “less meat” speakers. Yet the FAO’s livestock-climate analysis has been written by livestock specialists, not environmental specialists, and the FAO is just one of nineteen UN specialized agencies.

In contrast, Bill Gates has written an article (Gates, 2013) prescribing the replacement of most livestock products with better alternatives, citing environmental specialists employed by two other UN specialized agencies – the World Bank and IFC – who have explained how livestock account for much more greenhouse gas than the FAO asserts (Goodland & Anhang, 2009). One of those environmental specialists wrote a critique of the FAO’s partnership with global livestock industry associations that was published by The New York Times (Goodland, 2012).

Whether “less meat” activists use the FAO’s analysis or not, if they otherwise want to address climate change properly, then they might serve themselves and others well by defining the key problem as being the need to reduce emissions significantly before climate tipping points occur, and by settling on a calculation of how much livestock reduction is needed to avoid those tipping points.

Our world is at stake, so there is an ethical need to act without worrying what policymakers or consumers might accept. In a past case, it turned out that such worrying was undue (Shaw & Stroup, 1995), and it similarly involved large-scale emissions that do not respect borders. Specifically, in the 1990s, environmentalists worried whether policymakers and consumers would accept (under the Montreal Protocol) eliminating coolants and aerosols that destroy the ozone layer. People loved their spray cans, refrigerators, and air conditioners just as much as people today love consuming livestock products. Yet decisions were made to frame alternative products as positive things, and to talk about spray cans as much as refrigerators and air conditioners – and to define exactly what was needed – and it worked (Parry, 2011).

As with coolants and aerosols, it should not matter that “less meat” proponents are vastly outnumbered. So were Steve Jobs and Bill Gates long ago. They didn’t tone down out of fear of

what policymakers or consumers might accept. They just went ahead with marketing Happier and Better things – which made their competitors’ products obsolete in only a few years – and the same can be done with Happy Better Vegan Foods.

The case promoted by “less meat” proponents at the meeting for public comments on proposed U.S. dietary guidelines ended up not being reflected in new U.S. dietary guidelines. This might not be considered surprising. After all, Steve Jobs and Bill Gates did not market fewer mainframe computers; instead they marketed Happier Better Cheaper Computers. Similarly, rather than promoting less meat, greater success might well come from promoting plant-based meat to replace animal-based meat.

Peak Livestock

The FAO’s report entitled “Livestock’s Long Shadow” contemplates actions to manage a projected doubling in livestock production to feed the projected 9 billion people who will be alive in 2050. Specifically, “Livestock’s Long Shadow” projects that “the production of meat will double between now and 2050” (Steinfeld et al., 2006, p. 388). Yet the FAO’s projection is based on a presumed large-scale expansion of the livestock sector, which would lead to “further destruction of natural habitats like rainforests” and would “not solve food insecurity,” according to the Soil Association (Soil Association, 2010).

The FAO’s projection presumes that it is possible for the livestock sector to continue expanding. In contrast, a projection that demand for animal products could decline through at least 2030 has been published by the International Food Policy Research Institute (IFPRI) in its report entitled “Feeding the Future’s Changing Diets” (Msangi & Rosegrant, 2011, p.6). IFPRI co-published with the FAO a report 15 years ago that kicked off the “Livestock Revolution,” projecting inevitably more livestock (Delgado, Rosegrant, Steinfeld, Ehui, & Courbois, 1999). So it is particularly striking to see the IFPRI now projecting such a different future.

In thinking about whether livestock production is bound to expand or contract, it is worthwhile noting that there are presently more than 173 billion animals raised for food each year (Chomping Climate Change, 2015). In fact, it has been said that replacing livestock products with better alternatives may be the only pragmatic strategy to reverse climate change before it’s too late (Goodland, 2014). That’s because livestock and feed production is estimated to occupy 45 percent of all land on earth (Thornton, Herrero, & Ericksen, 2011) – that’s all land, both arable and non-arable, not excluding ice caps or mountaintops or anything else. Much of that 45 percent of all land was once forested, and could be forested again, yielding many more trees to absorb excess carbon from our atmosphere.

In 2006, the FAO published a report estimating that livestock were responsible for 18 percent of anthropogenic greenhouse gas emissions – yet that report prescribed no less livestock, but rather more factory farming: “The principle means of limiting livestock’s impact on the environment must be... intensification” (Steinfeld et al., 2006, p. 236). That report's lead author and a co-

author later wrote to confirm that prescription (Steinfeld & Gerber, 2010). The FAO subsequently published a 2013 report that reduced its livestock emissions estimate from 18 percent to 14.5 percent, and paired that estimate with prescriptions to facilitate 70 percent more livestock production by 2050 (Gerber et al., 2013).

However, livestock products can be replaced with better alternatives in order to reverse climate change before it is too late (Goodland, 2014). If livestock are not replaced with better alternatives voluntarily, then climate change is likely to force it. Notably, a one degree Celsius rise in temperature above optimum in a growing season causes a 10 percent decline in grain yields (Brown, 2011). This is already happening in some regions.

Spikes in the prices of grains used to feed animals have started to make animal-based meat production unprofitable. For example, at the start of 2017, it was forecast that the average U.S. pork producer would lose money for the year, after having been unprofitable in 2016, and before that in 2012-2013, and in 2008-2009 (Plain, 2017).

The phenomenon of ongoing unprofitability has occurred in Chinese pork production (Day, 2015). In the U.S., the production of feedlot beef – the vast majority of beef in the U.S. – has been unprofitable for the past two years (Soderlin, 2017). Indeed, as of January 2017, few countries in the world could claim long-term profitability in cattle enterprises, even though beef prices rose to record highs in 2013-2014 (Behrendt & Weeks, 2017).

While poultry production may be profitable for now, poultry are expected to suffer the worst of any livestock under climate change, as they are particularly sensitive to temperature-associated environmental challenges, especially heat stress (Bhadauria et al., 2014). In fact, heat stress from climate change may have only just started to be felt. As conservative an organization as PriceWaterhouseCoopers has warned of a possible six degree Celsius rise in global temperature this century (PwC, 2012) – that’s a 10.8° Fahrenheit rise – which implies a 60 percent decline in agricultural outputs.

It has been said that energy specialists may aim for continued expansion of the energy sector until Peak Oil is reached, when demand for oil can no longer be met because of a terminal decline in production (Heinberg, 2017). Similarly, livestock specialists may continue to aim for expansion of the livestock sector until “Peak Livestock” is reached.

However, there are some notable differences between the oil and livestock industries. The production of oil takes place underwater and underground, so it is relatively unaffected by climate change. Conversely, the production of livestock and crops to feed them takes place aboveground and largely outdoors – where agriculture is more exposed to the impacts of climate change than any other industry.

Until recently, evidence was slim that climate change was causing dire hardship and large-scale die-offs in the raising of livestock and crops that feed them. However, there has recently been

a noticeable spike in such hardships and die-offs all over the world (Admin, 2015). This has helped to create a point of inflection, whereby after many years of expansion of the livestock sector, there suddenly appears to be a trend favoring the replacement of animal-based foods with plant-based ones.

While a point of inflection seems to be taking hold (e.g., see Sciponi, 2016), projections are still commonly cited not only for a doubling in livestock production, but also for 70 percent more food; and in some places, it has even been noted that the FAO projects a potential need for 100 percent more food worldwide by 2050 (WFP, 2009). Yet such FAO projections have been called a “big fat lie” (Soil Association 2010). After all, human population is not projected to increase by 70 percent or 100 percent by 2050.

The UN Population Division’s medium-variant projection for human population in 2050 is 9.6 billion (up from around 7.5 billion in 2017), while its low-variant project for human population in 2050 is 8.3 billion (see <https://esa.un.org/unpd/wpp>). 8.3 billion people would be 12 percent more than exist today (in 2017), while 9.6 billion would be 30 percent more people than today. If 12 to 30 percent more people exist in 2050 than today, then there is no obvious good reason why the world would need 70 percent more food.

The UN Population Division has not expressed any opinion on whether its low- or medium-variant projection is more likely to be fulfilled. So even if nothing is done to reduce the incidence of overweight and obese people — and the most recent data indicates that a shocking 2.2 billion people are overweight or obese today (Afshin, 2017) — it seems that between 12 and 30 percent more food would be needed in 2050, not 70 percent more food.

Yet the UN’s projection for between 12 percent and 30 percent more people in 2050 does not factor in any potential for population contraction due to sea-level rise due to climate change (ENS, 2013). Sea-level rise driven by climate change is said to imperil 1700 cities in the U.S. alone, including New York, Boston, and Miami (Strauss, 2013). Much poorer cities across the world face a similar risk, and they are much less capable of managing that risk (ENS, 2013). This suggests that fewer people may well exist in 2050 than today, which by itself should mean that the world would need less food, not more.

Whether or not fewer people exist in 2050 than today, disruptive climate events are already causing declines in agricultural output in every region of the world. These declines are projected to worsen over time in both magnitude and geographic scope. This is helping to create a new business case – connected to climate change – for making meat directly from crops, rather than from feeding many times the same amount of crops to animals.

Trends in the food industry have historically been supply-led, rather than demand-driven. For example, food industry leaders – rather than consumers – have been responsible for such innovations as chicken nuggets, Big Macs, and bacon-wrapped pizza. In fact, supply-led trends are generally the norm in most categories of consumer products. For example, consumers did

not (nor could they) originate trends favoring digital TVs, iPhones, or drones; those trends were originated by industry leaders. However, while consumers have not originated those trends, they have had the power to help drive or stop their spread. So to drive a trend, it is essential to engage consumers.

Large-scale die-offs of livestock and feed crops due to climate change now provide extra reason for food industry leaders to be interested in replacing animal-based foods with plant-based ones. Food industry leaders have generally ignored vegetarian or vegan advocacy based on concerns over public health and animal rights – but they cannot ignore climate change. In other words, climate change is uniquely and unmistakably advancing a business case for disruption of the food industry.

Culture Change?

While a business case connected to climate change is developing for making meat directly from plants rather than from animals, animal-rights activists rarely incorporate this business case in their advocacy. Instead, animal-rights activists generally advocate for a change in culture – otherwise known as “culture change” – whereby people in the future would reject the systemic aggression and violence used in raising and slaughtering animals to become food.

When animal-rights activists advocate for culture change in the age of climate change, it would seem ethically sound for them to recognize that culture change is normally generational, taking typically 50-100 years to achieve, under the best of circumstances, with reversals not uncommon (e.g., one can think of the "Dark Ages" or today's "Brexit").

So activists working toward such culture change could be acting perversely, if they could better succeed with a climate strategy. A strategy that seeks culture change might not only extend the misuse of animals for decades longer than under a climate change strategy, but could mean that activists would be resigning themselves to the possibility of extinction of much of life on earth.

Conversely, a strategy could better succeed by recognizing the origin and positive associations of the word “meat”, and by aiming to disrupt rather than reduce its consumption. One perspective on such a strategy has been enunciated by Ethan Brown, the founder and CEO of a company named “Beyond Meat”.

Mr. Brown said in a televised interview in 2014: “We've been having meat as humans for about 2.3 million years so there is a great familiarity with it, the way it crosses across the teeth, the way it bites, etc and we don't want to walk away from that. You know, fried chicken tastes great. Steak tastes great. Let's just take the amino acid, the fats, from another source and recreate those so we can take an animal entirely out of the equation. I also think about what happened with the automotive sector where we had horse drawn carriages, the internal combustion engine came along and basically obviated the need for the horse in that equation. We're trying to do the same with animal protein” (CBS This Morning, 2014).

Mr. Brown also invoked climate change in that interview: “And here's an important statistic, so people have a certain hopelessness about climate change, they say ‘I don't know what to do?’ but, in fact, 51 percent of greenhouse gas emissions can be attributed to livestock” (CBS This Morning, 2014).

In other words, the best strategy to address climate change – and to disrupt the meat industry – may involve engaging people to persuade them to do something that fits their existing priorities, rather than advocating something that requires them to change their priorities. Less meat or meatless diets, vegan diets, and animal rights rank nowhere on most people's lists of priorities. Conversely, climate change is among the very top few priorities for many policymakers, industry leaders, and other individuals across the world.

So activists can implement a quick, global strategy of engaging people to learn how climate change imperils life on earth in the near term, but can be reversed through plant-based meat and other plant-based foods. Already, momentum has been building in efforts to replace animal-based foods with plant-based ones, often with references to climate change.

Companies that have tried sticking with animal agriculture have already started to go out of business (e.g., see Genoways, 2015), while financiers of plant-based food companies have started to become the envy of investors everywhere (Wortham & Miller, 2013). A similar phenomenon has occurred in every disrupted industry. For example, in many poor countries, about 20 years ago, only a few percent of people had telephones; a few years later, 25 percent had mobile access; a few years later, the figure was 70-80 percent (Sullivan, 2007). These days, analog telephones and their manufacturers can scarcely be found anymore, anywhere in the world.

Surveys consistently show that consumers buy food items primarily on the basis of price and quality. Quality includes ease and speed of preparation and delivery, cleanliness of retail outlets, and good taste. Only a relatively small percentage of consumers have ever chosen foods on any other basis, and there is no sign that this will change anytime soon. While activists have a long track record of agitating for less or no meat, the results show more meat-eating year after year, not less.

Climate-friendliness is now sometimes included as part of marketing of food quality to consumers. Indeed, there is no practical alternative for consumers to reverse climate change – especially if it is true that livestock products are responsible for at least 51 percent of anthropogenic greenhouse gas emissions.

One reason why animal advocacy has not reduced global consumption of animal products is that most activists do not account for the way people normally decide to try different foods. Most people will happily experiment one meal at a time, and will then repeat if the new meal made them happy. In contrast, promoting a vegan/vegetarian diet will appear to most people as abrupt

and radical as if McDonald's were to promote a "meatarian" diet. Instead, McDonald's has conquered one country after another by marketing "Happy Meals". In order to match or beat McDonalds' success, animal advocates might do well to promote something even more positive, such as "Happier Meals" – promoting plant-based meat burgers as the best ones to choose any day of the week or year.

CONCLUSION

Authoritative projections indicate that climate change may no longer be reversible if emissions are not cut significantly by 2020 (Smithsonian, 2012) or at the latest 2026 (Dechert, 2016). Yet according to the International Energy Agency, the amount of renewable energy infrastructure that is needed to stop climate change could only be fully developed long after 2026, and will cost at least \$53 trillion (Kramer, 2013).

A faster and much more economical strategy begins with recognizing that livestock production accounts for at least half of human-caused greenhouse gas (De Schutter, 2014) and uses 45 percent of all land on earth (ILRI, 2011). Replacing livestock products with better alternatives offers a unique dual opportunity to reduce greenhouse gas emissions while freeing up land to enable more trees to capture excess atmospheric carbon.

Better alternatives to livestock products are generally made from grains and legumes, such as wheat, peas, sorghum, and beans. Such foods are better than livestock products because any food that comes directly from a plant will generally be responsible for much less greenhouse gas than are livestock products. According to an article in *Nature* (Petherick, 2012), improvements in the way livestock are raised can achieve only 4 percent reduction in greenhouse gas emissions through 2030. That is much less reduction in emissions than every other industry is being called upon to achieve, and indeed is a trivial amount relative to what the food industry should be called upon to achieve (Goodland, 2013).

People can change their food choices literally overnight. That is a key reason why replacing animal-based foods with better alternatives is said to be the only pragmatic way to stop climate change quickly as needed. But it is unlikely to happen through efforts to reduce meat consumption. It is much more likely to happen through efforts to disrupt meat production and consumption by making and marketing meat and other foods directly from plants.

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