



Diet Doctor Podcast

Frank Mitloehner, PhD

Episode 51

Dr. Bret Scher: Welcome back to the Diet Doctor podcast, I'm your host Dr. Bret Scher. Today is my pleasure to be joined by Prof. Frank Mitloehner. Now Prof. Mitloehner is a professor and air quality extension specialist in the Department of animal science at UC Davis. He has a PhD in animal science. And as you'll just see he took an interesting path from Germany to find his way to the United States.

He got his PhD in Texas and then ended up at UC Davis where he is now the director of the CLEAR center and he is doing research on ways to reduce methane emissions from ruminants. But as you'll hear from his message what he's really passionate about is making sure that we understand the importance of methane emissions and where they rank in terms of the risk of greenhouse gases compared to carbon dioxide and how the narrative we're hearing is not the full picture.

I think his message is so important because we hear so much in the media about the contribution of ruminants to greenhouse gases, about the impact of eating less meat or going vegan could have on the environment. And because we hear so much in the media, sometimes we lose the perspective of where it fits into the whole picture and that's where Frank really shines as he really helps us see the broader perspective and to see where this ranks.

It's not that it has no impact, it clearly has an impact, but boy, you might be surprised to hear some of the specifics that he talks about, about the contribution of ruminants to greenhouse gases.

So, I hope this is an eye-opening discussion for you. Please share it with your friends if you find it helpful and come back for more episodes of the Diet Doctor podcast. Prof. Frank Mitloehner, thank you so much for joining me today on the Diet Doctor podcast.

Prof. Frank Mitloehner: I'm very happy to do so, thank you.

Bret: Now, I first came across you on Twitter. You were posting some very thoughtful and nuanced posts about climate change and about animals and that kind of peaked my interest because it seems like this is such a polarized topic. And it's refreshing to see somebody who sort of speaks about the nuance and speaks about clarity.

But first before we get into that, I want you tell us a little bit about your story. Where you came from... because you're originally from Germany, but somehow you found your way to UC Davis with a PhD in animal science. So that sounds like an unusual course, but let me hear from you.

How did you get there?

Frank: Oh yeah, my life story is really unusual. So I grew up near the Dutch border in the western part of Germany and I always had an interest for livestock. I didn't know why, but I did. But I even had a greater interest in psychology, human psychology actually and I wanted to become a psychiatrist. And actually worked in psychiatric hospitals for several years as an orderly, at the bottom of the hierarchy and still really stuck with it and decided, you know, that's my career path; becoming a psychiatrist.

So I applied for med school... for medical school and I was rejected. And my girlfriend did the same thing and she was accepted and we both applied at the same university. That's Leipzig University in East Germany. And that happened right in the year that the wall came down. Right in the year that the wall came down. Everybody else went the other direction from east to west.

We wanted to go from west to east and be part of this reunification process. So again she was accepted I was rejected and heartbroken. During that time we spent three months in southern Africa and by a total coincidence we got to stay a little bit on ostrich ranches and game ranches and cattle farms and so on and I was struck... I was really interested by it. Even though I had zero agricultural background, I was very much interested.

And when we returned from South Africa back to Germany I found a letter in my mailbox from the medical school admissions committee saying that, Mr. Mitloehner we are sorry to inform you that we erroneously rejected your application to our school and we now want to invite you to join us in the fall.

Bret: I thought that only happened in the movies. So, that actually happened.

Frank: And here is something I should've said before namely that before that letter came my girlfriend and I went to Leipzig University for her to enroll and for me to find a major that would fit me. And what I found was a major in tropical and subtropical agriculture. And I signed up for it I don't know why I signed up for it. With a degree in agricultural engineering.

And so then we went home and we found that letter in the mail from the med school, I took that letter and ripped into pieces and I studied tropical and subtropical agriculture. I then studied all different kinds of livestock species. Every year in the summer I went to tropical farms... to tropical countries and worked on farms and ranches in Paraguay and all over Africa, in Australia, in Indonesia, in China and so on and that was really super interesting.

What I didn't know at the time was that... ..in my family hundreds of years of ancestry was in animal agriculture and forestry. I have two brothers and neither my brothers nor I knew about that. But... we two years ago went on a search for our ancestry, for our roots and we found that there was all that livestock interest and all that forestry interest and my oldest brother became a professor for forestry and I became a professor for animal science. And so life goes in wicked ways. I know that was a long story but kind of interesting.

Bret: Interesting, very interesting. I'm afraid to ask... what happened to the girlfriend?

Frank: She studied medicine and married this doctor.

Bret: Okay, and you found your way to UC Davis with a PhD in animal science where you are now the director of the CLEAR center at UC Davis and professor and air quality extension specialist. Now, we hear so much about climate change and what are the contributing factors to climate

change. And there's no doubt that you can measure the temperature of the earth, the earth is getting warmer and there are a number of things that can contribute to it.

We hear about cars, we hear about airplanes, we hear about just the burning of fossil fuels in general and we hear about cows and ruminants of all kinds and we hear about soya. But each of those components are different, so if you could explain sort of what the components are of each of those sources of climate change and why we need to think about them a little bit differently.

Frank: Yeah, it's not a short story and it's pretty complex and that's where the confusion comes from. But in general the warming that occurs is caused by the sun. And the sun radiates down solar radiation to the surface of the earth. And normally that solar radiation would come in, but then be reflected back into space... But there are gases called greenhouse gases that are in the atmosphere.

And these greenhouse gases which include CO₂, carbon dioxide, methane, nitrous oxide, these greenhouse gases are in the atmosphere and when the solar radiation hits those gas molecules, they actually trap the heat. They trap the heat from the sun. And so, the more of these molecules exist in our atmosphere, the more solar radiation is trapped and retained in our atmosphere. And that's where the warming effect comes from. So in the past there was the notion that these three greenhouse gases, CO₂, methane and nitrous oxide differ, but only with respect to what's called the global warming potential.

Which is their ability to trap heat from the sun and there's the notion that methane is 28 times more potent than CO₂. And nitrous oxide is 265 times more potent than CO₂. So, that methane with 28 and nitrous oxide with 265 times the potency of CO₂ are particularly noteworthy and important to be captured-- sorry, to be reduced.

What people leave out is some other differences that are very important, namely that CO₂ and nitrous oxide are long-lived climate pollutants; once there in the air, they stay there for hundreds if not thousands of years and methane being really different that way. Because methane is not just produced like the other gases, but also destroyed. And that happens within approximately 10 years.

So, methane is not just produced; it's also destroyed almost at equal rates. Now, you asked there are different sources for these gases? Who produces what? By far, the number one greenhouse gas with respect to total amount in the atmosphere is CO₂. By far. And CO₂, carbon dioxide, is carbon that largely stems from the use of fossil fuel; oil, coal and gas. What is oil, coal and gas? It's pretty much plant and animal material from millions of years ago.

These plants and animals died and they fossilized and then got stored down there in the ground and over the last 70 or so years we extracted about half of all these fossil fuels from the ground, we burned them and now that carbon is in the atmosphere. And every time the sun hits those gas molecules, these gas molecules heat up and trap the heat and that's why we have a global warming issue.

Most climate scientists will agree that the use of fossil fuels is the main culprit in human-caused climate change. However there are people, critiques particularly of animal agriculture that were on the record of being very critical of animal agriculture in the past-- in the past more on animal welfare grounds and other issues-- that now say, well we must look at methane, methane that stems from ruminant livestock in particular.

And then because the methane is so potent, figure out how much methane is produced and how we can reduce all methane sources.

Bret: Let me interrupt for one second. So when we talk about ruminants, we frequently hear “cows”. Everybody talks about cows. But ruminants are cows, goats, sheep, there are others, but when you talk about sort of numbers and percentages is cows overwhelmingly the highest percentage of ruminants and that’s why people talk about it? Or is it just the one we eat, so people talk about it?

Frank: No, cattle are the most important species. So you have-- In the United States for example we have 90 million beef cattle, 9 million dairy cows, so we have a lot. There are about 100 million large ruminants in the United States. But, you know, just so you know prior to the European settlement of the United States, we also had 100 million large ruminants in the country.

But at that time it was 60, 70 million bison and it was 40 million pronghorn antelopes. The white people from Europe came here and they slaughtered most of those and replaced them over time with domesticated ruminants.

Bret: So that’s very interesting.

Frank: Why am I telling you--

Bret: So, if the total number of ruminants hasn’t changed in that time period, then the contribution of ruminants to global warming hasn’t changed in that time period. Is that a true statement?

Frank: That’s correct. That is a true statement, but it’s only part of the story. It is a true statement that... ..over the last 250 years or so we have not added additional... additional - that’s really important, ...biogenic methane. I say biogenic because biogenic means related to biological activity of animals, let’s say all of rice paddies. As a contrast to biogenic methane there’s also the so-called fossil methane.

And fossil methane is methane that’s associated with the storage of fossil fuels. Now, how is that different? Is fossil methane, let’s say, different from biogenic methane that comes from cows? And the answer is yes, even though the methane in both cases is CH₄, chemically the same. But in the case of fossil methane... ..the fate of what happens to that methane is different to the fate of what happens to the livestock methane. In both cases methane stays in the atmosphere for 10 years and I told you, it’s then destroyed.

The destruction process is called oxidation. To be precise it’s called hydroxyl oxidation. And methane in that process is converted to CO₂. It’s converted to CO₂. So in the case of burning fossil fuels we have methane and CO₂ in the atmosphere. In the case of fossil methane that’s converted into CO₂ again and that CO₂ is now additional. It’s new additional CO₂. But in the case of a cow it’s different. Let me walk through this; it’s kind of exciting. Maybe only to me, but we’ll see.

Bret: I like people getting excited about what they talk about. So let’s hear it.

Frank: In the case of biogenic methane, the methane from cows, you have to ask yourself where does that carbon that’s in the methane, that CH₄, where does that carbon come from and where is it going? So I just told you, the fossil methane is going from the ground into the atmosphere... one way street. But the biogenic methane is different. Think of what you learned in school about what plants need to live.

Plants need sunlight and they need... they need CO₂ and they need water, right? Why do they need CO₂? They need CO₂ because they need to build carbohydrates. So they need the carbon from the CO₂, from the atmospheric CO₂, to build carbohydrates, such as cellulose or starch. So the plants now take that carbon out of the air, they make carbohydrates and then that cow comes along and she eats that plant and converts a small portion of the carbohydrate she eats, by eating that plant, into enteric methane, it's biogenic methane.

That methane is then either belched out or it's produced by means of manure conversion. It's not coming out the back end like many of your listeners think. It's coming out of the front end mainly. That's called enteric emissions. That methane is now belched out and... Again, methane is CH₄, ...that methane is carbon containing. And that carbon in the methane originated in the atmospheric CO₂ before it went into photosynthesis. So does that make sense?

Bret: Yes. So the plant basically took CO₂ out of the atmosphere, made carbohydrate out of it and the cow converted that into protein for itself and methane. So it's sort of taking CO₂ out and putting methane out as a result.

Frank: Correct. And then that methane stays in the air for 10 years and is then via hydroxyl oxidation converted again into CO₂. That CO₂ that's resulting from this oxidative process is not new carbon to the atmosphere. It's recycled carbon.

Bret: It's already taken out of the atmosphere and then put back.

Frank: And given back to the atmosphere. In other words the biogenic carbon, the biogenic methane is not new carbon. It's recycled carbon. It's not new, it's recycled. And the cycle I've just described to you is called the biogenic carbon cycle. And here is why that matters. In the case of fossil fuel all the carbon that came from the ground goes into the atmosphere.

It's new additional carbon, hence it's new additional warming. In the case of biogenic carbon it's not new additional carbon and it's not new additional warming. As long as we keep our livestock herds constant and don't grow them and we haven't done that in decades in the United States and in most other developed countries, as long as we don't increase the herd sizes the amount of methane produced and the amount of method destroyed remains the same and we're not adding new additional carbon.

And hence... and now hold yourself on the chair... we're not adding additional warming. We are not adding additional warming. Now, that's a big deal and it's a total change in the narrative around the warming impact of our livestock herds. One that its critics have to get used to, because that's the way it goes.

Bret: Yeah, when you hear it put like that, it's 180° from what you hear from livestock critics. So, I guess if you break it down, if you say, do ruminants contribute to global warming? A simple question like that. The answer still has to be yes to a degree, but it's not so simple, because otherwise there would be no debate. If the answer was just now there would be no debate. So, would you answer like yes to that simple question and say but they are not contributing any more than they have over the past centuries?

Frank: So, yeah this is where the question is really getting important here. This is a really important question. So, if you have constant livestock herds then the amount of methane produced and the amount of method destroyed are equal. And that means constant herds do not add additional warming. If you add you additional methane because you're growing your livestock herds, then

you are adding additional warming.

That's new methane there, because if you grow your herds, you put in additional methane and that's a warming impact. In fact it's a big warming impact, because methane is a potent greenhouse gas.

But here comes something also very exciting, which is that if you manage to decrease methane and that can happen by different means: it could happen because you are decreasing herd size or because you're feeding feed additives or you're putting in manure technologies to reduce methane.

If you do reduce methane then you induce global cooling, because you're actively pulling carbon out of the atmosphere. And that has a cooling effect.

Bret: So, the critics are right then to say if we can reduce herd sizes we will reduce global warming.

Frank: Yes.

Bret: So that part of the narrative is true. But let's talk about relative contribution. Because you've actually just posted something, I think, yesterday on Twitter, which was a very nice graph showing that if you go vegan, your impact is 0.8... I think it's tons of CO₂ equivalents.

But one transatlantic flight was 1.6 tons of CO₂ equivalent. So help explain that because the battery-powered car was 1.95, public transportation was 0.98, so these are all more than going vegan. So, explain how we can compare them directly to say what is the impact I will have by going vegan versus what is the impact I have by flying cross-country and driving in my gas guzzler and that? How can we measure that?

Frank: So, first of all I don't really agree with the premise that one should compare foods to let's say driving a car. Because the food that we grow, and particularly the contribution of the food that is due to biogenic methane is as I said a different contribution, that the biogenic portion of food that we eat is a different contribution versus the fossil fuel derived greenhouse gases.

Which is a net addition to the atmosphere. In one case you have a circular cycle, the biogenic carbon cycle. In the other case you have a one-way street from the ground into the atmosphere. Now in the past until now people took all greenhouse gases and they converted them, methane and nitrous oxide, converted them into what's called CO₂ equivalents. Acting and arguing as if the only difference across these gases were their potency to trap heat. Not considering that methane is a short-lived climate pollutant and not just produced but also destroyed.

These comparisons like the one I posted yesterday does not take into consideration that methane is also destroyed. It only takes into consideration that it's produced. And if you ignore that difference then you make all those sources that produce methane look terrible, when indeed much more nuance is needed.

Bret: That's interesting because even on that post you made, it looks like the contribution of ruminants still pale in comparison to a transatlantic flight and you're saying that's overestimating the effect of methane, because it doesn't factor in the fact that it's recycled and it's shorter lived.

Frank: That's exactly right. So, if you use their argument that all greenhouse gases are pretty much... not the same, but that they can be converted into CO₂ and that they behave the same in

the atmosphere, which is not true as I said, but if you were to agree with that, then going vegan for one year per person would reduce a person's carbon footprint by 0.8 tons of what's called CO2 equivalent gases. 0.8 tones.

One transatlantic flight per person is 1.6 tons. So, going vegan for one year per person has half the carbon saving impact as one transatlantic flight. And so it's certainly not true that changing your diet will have a massive impact on our climate. Another study that I read recently, and I know the authors well as some first-class scientists, has found that if we as a nation were to go vegan, so all 330 million Americans were to go vegan, it would reduce the nation's footprint by 2.2 % of the total.

If we were as a nation to go a meatless Monday, it would reduce our carbon footprint by 0.3%. Now, considering how much noise is around this topic, these numbers don't jive with the actual findings.

Bret: Yeah, that's really interesting. And so many times when emotion and ideology get involved the message transcends the science. And I think you can see that's definitely the case here. And there was a very scathing article recently in the New York Times, "The End Of Meat Is Here". And so, there are a couple of quotes from that article. One is, "Animal agriculture is the leading cause of global warming."

Another quote is, "We cannot protect our environment while continuing to eat meat regularly. This is not a refutable perspective." And then the third quote I want to read is, "Eating a plant-based diet is the most important contribution every individual can make to reduce global warming." Is any of that true?

Frank: Well, I have to say we all have our filters. We all have our biases and I have mine. So, I first have to say that. Now, this gentleman's vices are clear and they have been documented over the years. He is a very active vegan and really an activist in this field. He is an excellent writer I have to say but a lot of the content he writes is just not based on facts.

And so on the reason why I have a beef with it, I mean a real beef with it, is because he leads us on a dangerous path. And why is that? Because he makes people believe that what we eat is the most important consideration when reducing a nation's carbon footprint. When indeed, you know, very aware of what really drives all carbon footprint... We just went through a major lockdown. Half of the world was on lockdown, as you know. Half of the world's human population was on lockdown.

And what happened? Emissions went down in ways we have never seen before. All those cities like Beijing and Delhi and Tokyo and Los Angeles had crystal clear skies... blue skies every day, blue skies. And then some of those economies went back to business, like China, and the air quality went right back to where it was.

Air quality and greenhouse gases went right back to where they were. I have news for you, our cars didn't stop. Our cars, trucks, trains, planes, ships did. So, people like the for the author of this article that you quoted, put us on a wrong path, on a dangerous path for solutions by telling people all you need to do is change what you eat and we will save all climate. This is a dangerous message that is misleading the public to make choices that will not get us to our goal.

Bret: But, yet despite that, this article got a lot of attention and a lot of circulation. And it also called on social issues about the poor working in the meat industry and how we can help those

people by not eating meat.

Which, I was little confused as well, because I don't think the poverty of the people working in the fields and harvesting lettuce is any different than that in the meat industry. I don't know about that. But that was another part of this article, I sort of was a little surprised about. Can you speak to that at all?

Frank: Well, this topic is very important to me. In fact I have done a lot of research on under-represented minorities, on undocumented workers in animal agriculture. And I have measured gas emissions, particle emissions that people are subjected to, because I want to make sure that whatever conditions there might be that people consider hazardous or worse. Indeed are hazardous or worse.

And if so, then we need to mitigate, or if not, then people need to know that too. And so I've had a lot of contact with people in animal agriculture that fall into this category of people that I've described. And I can tell you if we were to shut down these plans, then these people would be out of employment. If you were to translate what you wrote and give it to those folks and for those of them who can't read it, they would tell them where to take it.

Because that would mean if we were to follow his advice then we would send these millions of people who are oftentimes not well educated and who take jobs in plant agriculture because they need an income, they would not take that very likely. In fact he is dealing with the livelihoods of millions of people. And that in my opinion is just grossly unfair.

Bret: Especially when what he's saying is not really based in fact as you pointed out and completely negates the health aspect of it and not the other part of the problem when the health and environmental aspects are combined or even the ethical aspects. And they are all sort of rolled into one. And that's kind of what Eat Lancet was about.

It's sort of-- we've talked about this before in the podcast with Georgia Ede and we have some posts about it on our website, but it basically was a two-headed attack on meat from a health perspective and an environmental perspective.

But we've already sort of refuted the health aspect, because even what they've quoted in the paper had nothing to do with their recommendations and it was pretty clear that science didn't back the recommendations from a health standpoint. But what about from the environmental standpoint as well? Did that also fall horribly short in terms of what it claimed was true?

Frank: Yeah, I think it did. And because sometimes it's the most powerful to read it from the horse's mouth, I will read something to you. I was blown away by the conclusions that Eat Lancet made on the environmental side.

Because I looked at their data very carefully and I did not find that their conclusions were based on their own data. In fact when they compared the various diets to one another and that was a vegan diet, a vegetarian diet, the business as usual diet, the Eat Lancet diet and so on, when they compared across the categories of water used, air equality and greenhouse gases and biodiversity and so on, I found that in most categories there were no differences across diets at all.

Only in some categories actually the plant-based diets were worse than the business as usual diets. For example when it came to biodiversity because row cropping is not very kind to little animals like insects and rodents and rabbits and so forth.

So the only difference that they described was one across greenhouse gases... of greenhouse gases and here I found some pretty significant mistakes as well. So I tweeted about it. At that time I was pretty new to twitter but I tweeted about it and I received a reply by Fabrice DeClerk, the science director of Eat Lancet, which I will read to you.

Before I read it to you just know that the report promoted a planetary diet meant to protect humans and planet health. And that is the way it was always depicted. So now I critiqued this report based on its environmental merits and said that I don't see environmental differences across diets, I don't see that their conclusions are supported by their data.

And here's what Fabrice wrote to me. "The eat meat consumption limits proposed by the commission were not set to environmental considerations, but were solely in light of health recommendations. The dietary guidelines only referred to healthy eating, thus it is not the diet reduced climate change, but the diet reduced the risk of premature mortality due to the dietary related health causes."

Bret: Wow.

Frank: Now, you tell me if this, what I've just read to you, jives with what you read when you read the report.

Bret: Absolutely not, absolutely not.

Frank: There you go. I later had the good luck to be invited to Cornell university and debate Eat Lancet with this gentleman who wrote me this email in front of an interested crowd. So that was really good to kind of clear the air a little bit, because I was quite upset about what was written, what was tooted out to the public and what was later taught in private.

Bret: Is that debate online anywhere? I'd love to see that.

Frank: What I've just read to is my twitter handle. You just need to go and find me, GHGGuru and his name and then you'll find it.

Bret: Very good. So, surrounding that Eat Lancet report there was all this celebrity attraction now to vegan diets for the environment and one of the biggest areas of hypocrisy that I saw was the at the Golden Globes, the Academy Awards, going vegan for the environment with people flying cross-country and riding in their limousines and having flowers shipped in from different countries, but they were making a stand of going vegan and they were making an impact.

Now, you can argue that it could have an impact, but it just seems like such hypocrisy. Now I feel like I'm biased, that maybe I'm being overly harsh, but from our discussion so far today it seems like it's even worse than I thought. That type of hypocrisy.

Frank: Well, I can only tell you, first of all yes, we all have our biases and I have mine, but when I hear what I hear about how veganism will save the world from environmental degradation and so on, it's just laughable, I mean, simply laughable. And I have really stopped arguing with people who don't want to listen. They just their fingers in their ears and don't listen, yet come out with claims that are harsh, that are most times unsubstantiated.

And, you know, at the end of the day what surprises me the most is not what these people say, they've always said what they say now, but what surprises me is how supported they are by the mainstream media. Now, I'm not the kind of person who will talk about fake news and so on, but

I am very much surprised about the lack of balance when it comes to reporting about veganism. And I am surprised by that, I really am surprised by that.

For example I heard, and I heard it from the vegan society of the United States, I don't know if that's the proper name of it... That one of their greatest concerns is the lack of retention sticking to the vegan diet. I didn't know that before but to every one active vegan in the United States there are five former vegans.

In other words there is an 84% non-retention time, no retention time meaning 84% of all vegan stay vegan for only one year and then they stop. 84% stop after one year. Now, if this was such a fantastic diet that makes you feel so wonderful and it's so tasty. Everything is wonderful... then why would that many people quit it after one year? And the people who try it are not people who are just bored or something, okay?

Going vegan is a commitment. This is a major commitment. You really have to plan on how you assemble your diet in order not to become deficient. So these people, they really work on that. But after a year, 84% say, forget it. Now, I ask you what are the reasons for 84% of people are stopping this dietary choice? Is it lack of nutrition? Is it lack of taste?

I don't know, but it's effect and one that's never discussed in the media, I've never once heard it and I also don't hear those total rates discussed anymore. You know, it's depicted as a major movement and it sounds as if 20%, 30%, 40% of people are now vegans. It's ridiculous. It's 1% or 2%.

Bret: Yeah, I don't want this to turn into an anti-vegan podcast, but everything you said really rings true. And part of the problem is though it's trying to be promoted as the one diet for everybody. And anytime I think we get into that discussion of the one diet for everybody that's... you're stepping in it right there, because it just doesn't exist. And some people are going to thrive as vegans.

Are going to be able to handle it logistically, they're going to be able to enjoy it, they're going to be able to get enough proteins and the right supplements and without too many high glycemic carbs and their blood sugars will still okay. Some people are going to be able to do that and feel great. But certainly not everybody as the statistics you just showed. And we have to admit that it's a nutritionally incomplete diet.

You do have to supplement. So, the question then becomes okay so now a healthy omnivore diet, a low-carb diet, a keto diet which are more meat heavy, do those contribute more to the atmospheric pollution?

Or, not atmospheric pollution, but the greenhouse gases? And the answer here's clearly it's not that clear. But some people say, look our society thrives on cars and transportation, it's an international society, and factories, this is progress, this is what we need for our economy, we can't just shut it down, but we can reduce how much meat we eat. Now, is that an accurate statement? Have you heard that? What's your reaction there?

Frank: So, first of all it is true that what we eat has an impact on the environment. And the impact of animal source foods is greater, is larger than that of plant-based foods. That impact is larger. But absolutely dwarfed by other human activities that use fossil fuels in particular, which not only produce those greenhouse gases and that's what we talked about so far, but also other pollutants that are precursors in the formation of smog and of particles that we inhale.

Fossil fuel combustion produces all of these submissions at rates that are very significant. What this Covid 19 pandemic has really shown us is this. Even with a massive lockdown, with an unprecedented lockdown and people not using cars, trucks, trains, planes, ships and so on as much or at all in certain societies, even with that, the effects are very short-lived. Very short-lived. I mean the question really is do we want to abandon all of that?

Do we want to drastically change how we get from A to B? Do we all concur that we should all work from home most times all the time? Do we can concur that we no longer go to meetings, no more conferences? How about school? How about universities and all of that? Do we concur that we should change what we eat? The answer to all of that is no.

I can tell you that right now we can sit here in our Eiffel tower-- in our ivory tower all we want... and decide what's best for society. At the end of the day people decide based on their preferences, based on their cultures, based on their financial and other conditions.

And to what we in academia come up with might be a guidance to some of those folks, but they can make those decisions all by themselves. You know, nobody can tell us--

Bret: Go on.

Frank: Nobody can tell us who to vote for, nobody can tell us who to pray for and nobody can tell us what to eat. These are personal decisions that are nobody else's business.

Bret: I think that's a great way to say it and I apologize for interrupting because I got excited about what you are saying. Because it does come down to personal decisions. So, some people are going to decide, I need to drive my car that gets 15 miles to the gallon, to and from meetings and to and from work and to and from the grocery store, but I still want to impact the environment so maybe I'll eat less meat.

Or someone can say I understand the relative contributions, so I'm going to bike to work, I'm going to walk to the grocery store and I'm going to continue to eat meat because I know that's going to have the bigger impact. And it's going to be a personal decision, but where we get into trouble is like you said, when the media portrays it as one way when the nuance of the science isn't discussed. And that's why I really appreciate a discussion like this and I appreciate your messages.

Now, I also wanted to shift gears for just a minute to talk about this concept of regenerative agriculture. Because I hear that term a lot and the concept of it is very exciting for me. That you can have a farm or a ranch that has lots of topsoil and annual crops and migrating animals the way they're sort of meant to migrate that actually traps carbon in the soil and makes for healthier soil, but is actually a carbon sink to take carbon out of the air.

And this concept that it can actually be part of the solution rather than the problem... But then I guess the counter side of that, the detractors to that say you can only do this on such microscopic scale, you can't scale this, you can't make it common practice so it really doesn't impact the environment at all. Where do you stand on that side of the regenerative agriculture?

Frank: So, there are different levels here that we need to discuss. First of all... ..is the notion that salts and plants sequester and assimilate only relatively small amounts of carb. Is that true? And I will take you now to the environmental protection agency greenhouse gas inventory, the most recent one which found that land use such as forestry and agriculture, particularly agriculture, emits a total of 10.5% of all greenhouse gases in United States.

So they are a source of 10.5% of all greenhouse gases. But the same report says that agriculture and forestry are a sink of 11.8% of all greenhouse gases. A source of 10.5 and a sink of 11.8. But for whatever reason, that second half of my statement never makes it into the mainstream... into the mainstream media reporting and I wonder why that is.

These are the only two sectors in society that have the capability of locking down a lot of carbon in the soil. And those people say, oh, it's minuscule. That's not minuscule. 11.8% is a lot... it's huge. So you asked me for regenerative. Regenerative I think is a very important concept and it is one that I think leads the charge within agriculture with respect to its potency of trapping carbon and improving soil health.

But all of agriculture can do it. Can store carbon, can have all different kinds of ecosystem services that are beneficial. Regenerative agriculture, a form of agriculture that for example rotates livestock in an optimized form or treats the land in a way that is least invasive... so with minimum of plowing and tilling, with more no till, with more rotational grazing for livestock and so on, these systems will allow you to suck more carbon out of the atmosphere, the plants take the carbon on, they give it off into the soil and as long as you leave that soil relatively undisturbed, it stays there.

This is really important and will not allow some distractors to pooh-pooh that and say, this is nothing; we should just forget about it. In fact I want to share my opinion that I believe that a lot of this discussion around agriculture and the discussion about our personal choices, our lifestyle choices and how important they are to our environmental footprint as a nation is nothing more than a smokescreen by many of the major polluters in society.

We have fewer than 50 companies in this country here, fewer than 50 companies that emit 70%, that's 7-0, of all greenhouse gases. Many of the reporting that you hear and see around what we should eat and so on is supported by those very companies. And some of those, many of those are fossil fuel trading companies.

So I am in support of regenerative agriculture, I'm in support of agriculture overall and I think that we have to better, to further our understanding about our food, not just what we should put into our body and what the effects of it are, let's say health outcomes and so on, but we should also further our understanding where that comes from. Let's not forget all the stuff that you eat at any given time has some origin in agriculture.

No farms, no food. We are treating our farmers terribly wrong right now. We are treating them wrong, because every time they hear from the public, it is something negative. I want to give you just the statistics that hopefully drives the message out. In the last agricultural census for the United States that came out I think last year, it was described that we have 2 million farms in total in the United States. 2 million... that sounds like a large number.

But the report also said that one and a half of the 2 million farms have an annual revenue of less than \$25,000. Meaning 1.5 of the 2 million farms we have in this country are hobby farmers. They don't make a living from their farming activities. The same report also said that there are only 80,000 farmers... 8-0... 80,000 farmers and ranchers in this country that produce two thirds of all food we consume. 80,000.

These are not the small boutique farmers. All the farmers we just talked about, the small regenerative farms and so on, but these are big farms producing 2/3 of all the food we consume. The average age of these farmers is 60. So they are close to retirement age and they are thinking actively, what do I do when I retire? What do I do with my farm?

And the current pressures that society puts onto our farming community leads to a decision that many of them make. Which is, I'm out of here. I don't want to do this anymore, I'm done. And what the negative PR doesn't do, the negative reporting... what that doesn't do, the economic pressures do. Because we don't pay enough for the food that we consume.

It cannot be that a farmer, a poultry farmer gets \$.10 of profit when selling one chicken. It cannot be right that a swine farmer makes between 4 to 6 dollars per fully sold pig. It cannot be that a gallon of milk is sold for a price cheaper than the same amount of water. This is wrong.

Bret: That's very sobering. I mean it's a little depressing. So if there's one thing that this whole lockdown has also shown us in addition to the contribution to pollution that we have to stop, the other thing is the importance of supporting local agriculture, local farmers and local farmers market rather than relying on these few large companies that you're referring to.

But is that financially viable? I mean because these statistics you just said are a little distressing and I'd like to think that we can support our local farmers and that can be a financially sustainable path to the future of a healthier food system.

Frank: Well, I think it is of critical importance. I think it is of strategic importance to our nation, to human kind, to support its farming base. Because that is the base that nurtures us. -In my opinion--

Bret: How do we do that?

Frank: In my opinion there are two really critical sectors of society. The one is supplying and supporting human health and the other one is supplying and supporting food, food production. And while the one of the two, the health sector, is very much appreciated and health workers, whether that's doctors or nurses, are praised as heroes, the people growing our food are not.

Well, have you heard anyone praising our farmers during Covid 19 the way that they praised nurses and doctors? Even though they were as essential and they worked day in day out, just like the health professionals did. We do not assign the value to our food sector the way we do to our health sector and that's a mistake.

Now, small farms, you asked about small farms and local farms. I think that they are important and I think it's really worthwhile to support them and I do that. But I also have to say that I do that because I can afford it. It is certainly more expensive to go to the farmers market and buy my food there than going to the Walmart and do it at scale. There's no question about that.

Bret: Right, and that's the problem we run into and that's where-- I don't like to fall back on government as a solution, but with government subsidies, you know, at least the perception is we're subsidizing corn, wheat and soy as opposed to subsidizing the local farmers to make a probably more sustainable food system. So do you think government plays a role there?

Frank: Well, in general I'd like to see as little government in the marketplace as possible but in this case here I have to say... when people think of the small farms that sell at the farmers market, they think of those as being most sustainable, right? Would you agree? But in reality they are totally unsustainable.

And the reason why they're not sustainable is because a very important pillar of sustainability in addition to environmental quality and animal welfare and food safety and worker issues, in addition to those four pillars, the fifth pillar is financial sustainability, financial viability. And these

small farms are currently not financially viable. And that's a real problem because we want them to be financially viable and we want them to be sustainable in that way and be able to pass on their farm to the next generation.

But we are currently not making that possible because society is not willing to pay the price. So we have to keep in mind, sustainability is not just about the environment. Sustainability encompasses these other issues as well. And the financial angle is a very important one. If you are cash-strapped, then you have to decide, you know, how much of your heart is really in it and whether you continue.

Bret: It's a great point and it really puts into perspective as a societal problem, not just a personal problem, which it certainly can be, but a true societal problem which I think the whole Covid 19 pandemic has sort of brought it to the surface, as is always the case.

A lot of times we only get one side of the story shouting the loudest, so that's why I am so thankful to have you on the podcast today to give the other side which I think is a very thoughtful and nuanced and important side to hear. So, thank you for your work and thank you for taking the time. Where can people find you to hear more about what you have to say and see what you're doing at UC Davis and your research and so forth?

Frank: So, I'm director of the CLEAR center, clear as in see-through and we have a web platform which is clear.ucdavis.edu and then I'm pretty active on Twitter as you mentioned, my handle is GHG... That's greenhouse gas... GHGGuru and the discussions are good, I am having fun there and I invite you to do the same.

Bret: Very good. Thank you again and keep up the great work and keep spreading the message that people need to hear.

Frank: Thank you very much for having me. It was really fun, thanks.