# Understanding (& Reducing) Dairy Greenhouse Gas Emissions

Featuring Frank Mitloehner

Director, UC Davis CLEAR Center

**DJ May** 00:01
Welcome to the Decode 6 Podcast, where we take your questions about carbon and ecosystem services and match them to the experts with the answers. I'm your host, DJ May. This week we're talking about the big picture of dairy emissions. What are the sources of dairy emissions? How can we reduce them? And what opportunities do we have to improve dairy production in the future? Our expert with the answers is Dr. Frank Mitloehner, a professor and air quality specialist in Cooperative Extension in the Department of Animal Science at UC Davis. In his dual academic and extension roles, Frank shares his knowledge and research with students, scientists, farmers and ranchers, policymakers and the public. He is also director of the CLEAR Center, which uses research and communication to bring clarity to the intersection of animal agriculture and the environment. In doing so, the clear center is helping our global community understand the environmental and human health impacts of livestock so we can make informed decisions about the foods we eat while reducing environmental impacts. Frank, welcome. It's great to have you on the show.

**Frank Mitloehner** 01:11
Well, thank you for having me.

**DJ May** 01:13
Perfect. We're gonna dive straight in. So what do we know about greenhouse gas emissions from livestock and dairy farms in particular?

**Frank Mitloehner** 01:23
Well, there are three greenhouse gases, there's carbon dioxide, and methane and nitrous oxide. And they differ quite a bit with respect to how much heat from the sun they trap per molecule. While most other industries really emit a lot of carbon dioxide by burning fossil fuels, like oil, coal and gas, the livestock industry, and that includes dairy, produces mainly methane gas, methane is about almost 30 times three zero, almost 30 times more powerful per molecule of gas than carbon dioxide. But the good thing about methane is that yes, it is powerful in trapping heat from the sun, but it is short lived. There are other molecules, other molecules that kill that gas, and that happens in approximately one decade, in contrast to 1000 years for co2. So dairies do produce methane. And that is something we have to watch. And something we need to mitigate meaning reduce. But when we do, we can reduce warming, and that's an opportunity.

**DJ May** 02:35
Perfect. So in the context of like, overall greenhouse gas emissions, how much is coming from livestock.

**Frank Mitloehner** 02:42
So in the United States, approximately 2% of our greenhouse gases come from dairy, and about the same, maybe a little more from beef. So the EPA, the Environmental Protection Agency quantifies all livestock as emitting approximately for a little bit over 4% of all greenhouse gases in

the United States. Globally, the total emissions of livestock greenhouse gases are quantified as 11% by the United Nations Food and Agriculture Organization.

**DJ May** 03:15
Okay, perfect. When we think about where greenhouse gases are coming from, with livestock, in on farm, in particular, what are the sources? Where exactly are those gases coming from?

**Frank Mitloehner** 03:27
There are two main sources, the one is called enteric emissions. And that means when cattle let's say, and other ruminants, when they eat grasses, and that's their number one really dietary item, when they eat grasses or other cellulose containing feedstuffs, then the methane producing microbes in the digestive tract will produce that gas. It's an unintended consequence of digestive, of being able to digest cellulose. That gas builds up in the rumen in that large stomach compartment, and sooner or later needs to come out and it comes out via belching. And that's called enteric emissions. That's the number one source of methane from animal agriculture. The number two source is decomposing manure and oxygen deprived conditions, also called anaerobic conditions.

**DJ May** 04:26
Okay, so if manure is exposed to oxygen, do we still see greenhouse gas emissions?

**Frank Mitloehner** 04:32
When manure is, let's say treat it with oxygen, let's say you mix it or you infuse oxygen into it, then you will not produce methane gas. You would produce CO2 but not methane, CH4. And so methane is generally generated under oxygen deprived conditions, whether that's in the anaerobic rumen of the animals, or whether it's in a lagoon, let's say, where the manure is stored in an unknown aerobic fashion.

**DJ May** 05:01
Okay, perfect. So when we think about those sources of greenhouse gases on the farm, what are some ways we could reduce them?

**Frank Mitloehner** 05:11
There are several really good approaches that are, that are bubbling ups, no pun intended. The one is related to the animal manure. If you cover the lagoon, and you prevent the gases from going into the air, then that's called a digester or a covered lagoon, you trap the gases, they will not not go into the air, but they are trapped. And about 60% Six, zero, that is 60% of that biogas mixture is methane. And when while most people view methane as a problem, methane actually can be part of the solution. Why so because methane is really energy. Methane is the same thing as the natural gas that you burn at home, to heat your home, or to cook food. So it is a problem if it goes into the air and utilize and it's just off gassing, because then it's a greenhouse gas. But if you trap it, then you can convert that methane into transportation fuels, let's say and run vehicle fleets like heavy duty trucks, or electric vehicles, or you can make it into power for homes. So you can make something that used to be a liability into an asset. That's on the manure side. On the animal side, the enteric side, there are several approaches. One of them is the feeding of feed additives, feed additives are things that you add to the diet of the animals. And these additives

can either change the microbial composition in the rumen, away from those microbes that form methane to those that don't, or feed additives can also potentially reduce the actual enzymatic process of methane formation. That's one approach feed additives. Another approach is breeding. Believe it or not, there are low methane and high methane producing cows, and we can through breeding select cattle for low methane. And in the future, we'll do that because it makes no sense. We don't want too much methane to leave the animal because it's a unwanted energy loss, about 10% of the energy we feed to cows gets lost as methane. So that can be changed through breeding. Then there is another approach the New Zealanders are working on, which is a methane vaccine. That's not ready for primetime, but people are working on it. And last but not least, there is a boneless and that's like a capsule that you can launch in the rumen of those animals. And you have to replace it once every six months. And it slowly releases an active ingredient to reduce enteric methane. So feed additives, breeding vaccination bonuses, and on the manures. Side, anaerobic digesters producing biogas that's converted into fuel power.

**DJ May** 08:08
Perfect. And then one other thing I've been kind of thinking about, what about applying manure, like saying you take it out and you put it on a field instead of leaving it in a lagoon or some other way? All

**Frank Mitloehner** 08:21
manure is lent applied sooner or later as fertilizer? So that's not something unusual. That's standard. That's what everybody does. So lagoon water is lagoon continents never just left there, three or four times a year, it's used as fertilizer and applied to crops.

**DJ May** 08:40
Is there any way to make that more sustainable? Or are we pretty efficient already? With applied manure?

**Frank Mitloehner** 08:45
Yes, we can make it more efficient by making sure that we are applying the lagoon water and therefore the nutrients to crops at times when the crops are ready to take the nutrients on. And that's referred to as applying that manure at agronomic rates. It means applied at the time the crops are ready at the rates they need. And not too much, not too little, not at the wrong time. So for example, you don't want to land apply lagoon board in the middle of winter when the ground is frozen. That makes no sense or applied. When you don't have crops on the field. You have to do it when new crops are ready other otherwise, you will run into unwanted nutrient losses, also called emissions or pollution.

**DJ May** 09:35
Yeah. From a from a farmer perspective, if you were going to give advice if they wanted to make some maybe small changes to impact their emissions, what would you say is the most practical or the easiest way to get your foot in the door?

**Frank Mitloehner** 09:53
So there are so so many different farm types. And so it's almost impossible to answer that question. Other than by saying, look at what your best solutions are the ones that work best for

you. Please know this issue will not just go away, it is here to stay. Even if you operate in a state that currently doesn't have regulations and so on like California does, it is very unlikely that this issue will go away because the people who buy your milk and your meat and so on, they are asking questions about carbon footprint, how it has changed over the last 510 1520 years, what you're doing to improve and so on. So it behooves a farmer to investigate this issue, and and to find out what the best approach is for you. Many of these approaches are cost neutral, or even beneficial from an economic perspective. And at the same time, also help on the environmental side. And this is what we work on feverishly yet UC Davis, finding solutions that work, not just environmentally, but also economically, because if the latter doesn't happen, then farmers will not do it because they have to be able to run their farm. Perfect. Well, thank

**DJ May** 11:18
you, Frank, any final thoughts? Before we wrap up?

**Frank Mitloehner** 11:20
Well, I just want your listeners to know that many people, including myself, are quite tired of farmers getting the bad rap of farmers are extremely important to our society, just like our doctors and nurses are. And while the latter here, provide service to improve our health and maintain it. Our farmers are there to grow our food. And we need our farmers. And we need society to work with our farmers to live up to all the news, societal expectations, they change every couple of years, okay? And please know that if you want all these things to happen, somebody has to pay for them, too. It's not our farmers that are averse to change. They're they're willing to change. But as a society, we have to decide, what are we willing to ask them to do? How are we willing to support them, because we don't want them to shut down shop, closed shop and leave the business, we need our farmers. And in order to make them stay in the business and pass it on to the next generation. We we need to do better as a society. And I just want to thank everybody who is a farmer and was listening to this and assure you that many people in my profession at the universities are very eager to help you stay in business and stay vibrant. And at the same time, inform agencies and so on to use best available data to come up with solutions that work.

**DJ May** 13:01
Well said Frank, that's great. Thank you so much for your time. It was great having you.

**Frank Mitloehner** 13:05
You're most welcome. Thanks for having me.

**DJ May** 13:07
And that's today's show. If you want to learn more about dairy emissions, stop by decode6.org We're releasing a whole bunch of content that will help you or your clients make their dairy operations more sustainable, including feed production enteric, methane manure management and herd management. And if you want to learn more about Frank's work in the clear center, check out the show notes. Finally, if you liked the show, subscribe, and share it with a friend. We'd like to thank dairy management incorporated for their generous support of this podcast. Until next time!