Increasing Livestock Sustainability with Methane-mitigating Feed Additives

Demand for animal protein in developed countries is stable and increasing strongly in emerging countries. The combination of their nutrient density, desire of people to improve their diets and a growing world population will continue to drive future growth. The United Nations Food and Agriculture Organisation (FAO) projects that global demand for milk and meat will rise by 58% and 74% between 2010 and 2050.

Demand at that scale cannot be met solely through expansion; livestock must also be raised more efficiently and sustainably, and animal health solutions offer a path to achieve this goal. Reducing animal disease and optimising yield, through better genetics and preventative care means fewer animals are needed to meet global demand for protein.

An emerging class of animal feed supplements that inhibit methane production in ruminants offers a promising new way to further reduce the climate footprint of livestock production. This article analyses political, regulatory, practical and market considerations related to the introduction and use of methane-reducing feed additives, while offering recommendations to improve pathways to market.

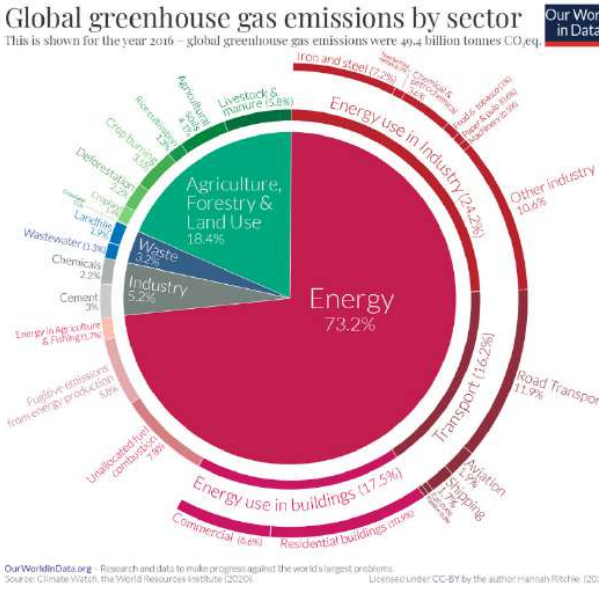

Chart 1: Global greenhouse gas emissions by sector

The Emissions Challenge

The main GHG emissions (carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are emitted from both natural and man-made sources (see Chart 1). Scientifically, the sources of emissions are irrelevant because the warming effect is the same, yet from a societal acceptance perspective there are differences. Society tends not to question naturally occurring biological processes created through millions of years of evolution – including for example ruminant enteric fermentation. But society does increasingly question the effect of many man-made activities, especially if they are wasteful and the emissions are significant.

To illustrate, unintentional methane leaks from energy production – often from poorly maintained pipelines –release about as much methane (3.11 billion tonnes CO_2 equivalent annually) as all of agriculture (3.45 billion tonnes CO_2 equivalent), and certainly more than ruminant enteric fermentation.

Methane is different than CO_2 – it is 28 times more potent than CO_2, but unlike CO_2, which has a life span of centuries, methane breaks down after 10 or so years. Cutting methane emissions therefore almost immediately reduces its concentrations in the atmosphere and slows warming. It is no surprise that over 150 countries support the Global Methane Pledge to lower methane overall emissions by 30% by 2030, and this target could be sharpened further.

40% of methane is emitted from natural biological sources like decomposition, ocean release, etc. and 60% is from man-made sources like landfills, oil and natural gas systems, mining, combustion, wastewater treatment, and industrial processes, according to the International Energy Agency. Beef and dairy cows eat plants which contain carbon, which their stomachs convert into methane, 90% of which is belched out and 10% of which is flatulence. Considering methane emissions from agriculture, enteric fermentation by ruminants represents about 31% as shown in Chart 2.

Animal Health and Animal Feed Solutions

The animal health sector can play a contributing role in both GHG mitigation and adaption strategies. Mitigation strategies are those that aim to reduce existing GHGs from the environment or reduce the rate of new GHG emissions. Feed additives are part of both the mitigation and adaptation stories. Adaptation strategies aim to reduce the effects of climate change. For the animal health sector, this can include helping animals manage heat stress, increase capacity to address emerging diseases, and responding to diseases in new geographies.

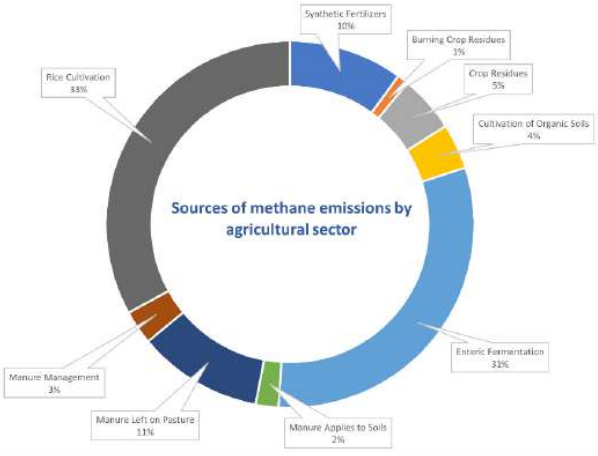

Chart 2: Sources of methane emissions by agricultural sector

Further improving animal health is the most efficient way to ensure that as few as possible greenhouse gasses are emitted. Healthier animals are more productive, less prone to disease, weight loss or death, leading to more animal protein being produced using fewer resources. In addition, existing good feed practices and products that improve digestibility, reduce pathogens, or increase weight, also contribute significantly to lower emissions. The feed sector is constantly developing new fats, oils, carbohydrates, minerals, etc. with positive effects on digestion.

Various new natural and synthetic supplements specifically geared at reducing methane emissions are either on the market or in development. Most of them function by disrupting methane production, or by moving the composition of the microbial community away from methane-producing microbes. The most prevalent are considered here.

Red seaweed (Asparagopsis) fed to ruminants has shown encouraging results of 80% methane reduction. A large-scale trial in Australia concluding in 2023 showed methane reductions of around 28%. The active ingredient is bromoform which is categorized by the U.S. EPA as a probable human carcinogen with a potential human safety concern. Commercial developers state the product is safe given the very low bromoform levels. In addition, some research has found residues in some animal proteins, and this, combined with a possible carcinogenic effect, raises challenges regarding acceptance in international trade of animal products fed the additive. Although a promising product, its likely more safety data will be needed before permits are granted in major markets.

3-Nitrooxypropanol or 3-NOP is a feed additive that reduces enteric methane emissions from dairy and reproductive cows. It is approved for commercial use in 45 markets including large ruminant markets like Brazil and the European Union, with approval expected in the U.S. in 2024. Application works by adding a small amount daily to feed, and this can reduce beef cattle emissions by about 45% and dairy cow emissions reductions by an average 30%. The product has no negative production quality effects and leads to an increase in milk fat.

There are a range of other products and approaches. For example, one commercially available product blends plant-based products including wild carrot and coriander seed oil and claims to reduce enteric emissions from dairy cattle by 11%, though these claims are questioned by several academics. Another blend brings together garlic and citrus extracts and claims a 38% reduction. Another company has an additive that stimulates a natural process in the rumen, creating ammonia from hydrogen, which would otherwise become methane, and states that it leads to a 10% methane reduction. There is a probiotic formula which claims to reduce methane emissions by 20%.

Research is ongoing in many public and private entities including into areas such as adding natural gas ozone into cattle drinking water (reduce emissions by 20%), and new vaccines that can reduce methane emissions.

Success Criteria for Products

These products are at different stages of development, acceptance, and commercialisation. Some have generated large amounts of scientific data and credibility, others have not. Looking ahead it is important that products meet certain requirements, the most important of which are considered here.

1. **Proven safety.** An additive must be proven to be safe for consumption by animals, consumption by humans through animal protein, for handling by humans (on-farm and in production), and for the environment (excretion). The only acceptable way to guarantee these safety conditions is through an assessment by a government agency.
2. **Effect on performance.** An additive will not be used if it has a negative effect on an animal's welfare or on output/performance. This is not a trade-off farmers will accept.
3. **Methane reduction efficacy.** An additive must reduce sufficient qualities of methane, and the assessments showing such quantities must be based on independent and accessible scientific evidence. A life cycle analysis of a product needs to incorporate all the GHG's emitted including during its production.
4. **Usability.** An additive must be easily usable by dairy and beef farmers. Globally, 37% of ruminant enteric methane emissions are generated by ruminants on free-ranging systems on rangelands and grasslands, 60% in mixed systems, and 2% from beef cattle in feedlots. How to get the right amounts to the cattle at the right times in different settings is an important consideration.
5. **Production.** An additive must be produced in the right quantities. This may present challenges for some technologies. For example, how to grow, harvest, process, and transport red seaweed in sufficient quantities? What is the full life GHG emissions from such processes?
6. **Consumer acceptance.** If an additive meets the first three conditions, it should not be challenging to gain consumer acceptance of a product which reduces methane emissions and contributes positively to reducing greenhouse gas emissions.
7. **Value.** Farmers will use additives if they can recoup the cost outlay. There are different ways costs can be recouped.

- **Market incentives through enhanced feed efficiency.** Up to 12% of ingested gross energy (feed) can be lost in the form of methane. Additives that enhance efficiency by helping the ruminant to conserve energy that would otherwise be lost as methane are an incentive to pay for methane reducing feed additives.
- **Market prices.** Charging higher (premium) prices for meat and milk from animals fed the additives. This is challenging as the evidence shows that few consumers are prepared to pay more for this type of societal benefit, and this means there will be a de facto niche market for animals that have being fed the additives. In addition, asking consumers in emerging markets to pay more does not work.
- **Government intervention.** For example, providing a subsidy for feeding additives that allow farmers to reduce their emissions. Some governments may go this way, some may not. Another government intervention is standards – requiring farmers to produce more sustainably – may work in some areas, though not in others.
- **Methane tax.** Such a tax could make it more attractive for farmers to use feed additives to reduce emissions. This could include a carbon credit/market approach. Taxes are politically undesirable and technically difficult to implement and would not work in emerging countries.

Market Perspectives

Many food processors, retailers, food and beverage companies and farm operations have a true interest in reducing their emissions, and many companies have taken significant action. Many corporations have climate pledges to lower their emissions and are increasingly being held

accountable by shareholders regarding what actions they are taking. There is pressure to do better.

Animal health solutions, including feed additive technologies, offer these companies real and immediate possibilities to reduce emissions in their production chains. Groups such as the Global Dairy Platform – that brings together all major global dairy companies, have called for increased use of feed additives and other animal health approaches. Several meat companies have also actively called for adoption and application of these techniques. A major challenge for many of these companies are the costs related to the additives, as well as the credibility of the accounting systems of methane emissions avoided through use of the products.

Political and Regulatory Considerations

The United Nations Food and Agriculture Organisation (FAO) states most countries are not properly leveraging animal health as a pathway for emissions reductions. Only 14 of 148 countries who submitted national climate action plans in 2021 included improving animal health as a way to do so.

Some regions are moving. For example, the European Union specifically mentions, as part of its overall methane reduction strategy, the use of technologies such as feed to reduce emissions. It approved a 3-NOP product in 2022 stating "Cutting farming-related methane emissions is key in our fight against climate change and today's approval is a very telling example of what we can achieve through new agricultural innovations."

Whichever regulatory approach is taken, it requires some level of political drive from policy makers who would like to facilitate animal health methane emission reduction strategies and tools.

Looking Ahead

Adoption of any animal health solution that reduces methane emissions is desirable from an environmental point of view, and some additives will have secondary benefits attractive for farmers. For better adoption of animal health solutions, the following areas need to progress.

Governments should incorporate animal health tools into their National Climate Action Programs, including the use of methane reducing additives.

There needs to be consensus that assessment of product claims is needed. This is usually done by governments, and such assessment benefits farmers and society, reassuring that products are safe and have the claimed effect.

Stakeholders and governments need to work together to implement proactive political strategies to promote animal health research and encourage uptake. Such strategies could include financing of research, encouraging uptake through financial benefits, regulatory fast lanes, farmer carbon credits, and consideration of public subsidies to achieve public good. Similar financing has happened in many other areas to promote uptake of carbon friendly technologies.

The wider food and agriculture chain and support industries have a responsibility to promote the uptake of all technologies that reduce methane, including feed additives. This responsibility runs from farm to fork. Different models exist to work together. Proactive communication about benefits and drawbacks needs to be part of this.

There needs to be clarity and standardisation regarding how to calculate methane reductions claims. A life cycle approach is best. Currently there are too many ways of calculating emissions from ruminants. To illustrate this point, is an example of a large convenience food company that had its beef farmers use a lemongrass-based additive. Claims were made that methane emissions were reduced by some 33%. Upon rigorous scientific review, 33% applied only to part of the emissions and the actual emissions saved was 3%. There was no suggested mal intention by the company, only unclear calculations.

Research into any approaches or mechanisms that inhibit methane emissions from cattle and other ruminants needs to continue and be supported. This includes ongoing existing partnerships, public and private research.

Authors note: A new FAO report called 'Methane emissions in livestock and rice systems. Sources, quantification, mitigation and metrics' is set to be launched presently and provides a good overview of methane reducing approaches and technologies.

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