Addressing the 2050 Food Challenge – a Sustainable Solution Must Include Livestock

By 2050, earth will be home to nearly 10 billion people, a tripled human population during our lifetime. Only 1.8% of the earth's surface is arable land that can be used for growing crops, a resource not likely to increase, which means the amount of cropland per person will decline by 20%[1]. In the face of finite resources and a changing climate, we need sustainable solutions to the 2050 food challenge.
Our current food system is often criticised for not addressing chronic undernutrition, micronutrient deficiencies and obesity. And agriculture does contribute to issues of environmental sustainability. Livestock production is often seen as particularly egregious, and some people say we can better meet the 2050 food challenge by limiting or eliminating animal-source foods from our diet. Critics of animal agriculture go as far as to claim that globally, livestock produces more greenhouse gases than the entire transportation sector. Less livestock production would reduce greenhouse gas emissions, provide more food for humans by decreasing feed needed for livestock, and free up rangeland and feedlots for crop production.

In short – eat less meat to save the environment. At first glance, this simple solution seems elegant and one that should be readily adopted. However, the truth is far more complicated, as discussed in the present paper.

The Truth About US Livestock Emissions

The often-repeated comparison of climate change impacts from livestock to transportation originated from a global assessment of livestock's impact on the environment[1] titled "Livestock's Long Shadow". In this early work, different methodologies were used to benchmark GHG emissions from livestock versus transportation – a mistake discovered by us[2] that was later acknowledged and rectified by its authors[3]. Surprisingly, recent work[4], investigating "The diet that helps fight climate change", repeated the same mistake of comparing global livestock versus transportation carbon emissions went as far as to recommend that the world's population should adopt a Mediterranean diet to best protect the climate.

Globally, livestock contributes to 14.5% of all greenhouse gases[5]. A common practice of livestock critics in the US is to conflate global versus national statistics regarding sources of greenhouse gas emissions and their carbon footprint. In the US, direct greenhouse gas emissions from the entire livestock sector are 3.8% while transportation emissions are 26.4% of the total[6]. In California — a state with major livestock production and public concerns about climate change — livestock and transportation account for 5.4% and 36.9% of direct emissions[7]. The notion that if enough people were to reduce their meat consumption, that decision alone could offset the emissions from all cars on the road today, is certainly false and misleading, particularly for the US.

A recent study[8] entitled "Nutritional and greenhouse gas impacts of removing animals from U.S. agriculture" – supports and expands on evidence that animals are responsible for a relatively small piece of the GHG pie in the United States. If we were to completely switch to a vegan lifestyle, we would see a reduction of 2.6 per cent in GHGs throughout the United States. A measurable difference to be sure, but far from a major one. Furthermore, the study concluded that "removing animals from U.S. agriculture would reduce agricultural GHG emissions, but would also create a food supply incapable of supporting the U.S. population's nutritional requirements." At the risk of oversimplification, meat and dairy products offer a number of essential vitamins, minerals, fatty acids and amino acids that are difficult to find in plant-based diets, or with supplements.

Livestock production in the US has one of the lowest carbon footprints in the world. The total direct greenhouse gas emissions from US livestock have declined 11.3% since 1961

	1950	2015	Reference
Total Dairy Cows, million head	22	9.3 (-58%)	(9)
Milk Production, billion kg	52.9	94.6 (+79%)	(9)
Carbon Footprint		2/3 lower than 1950	(10)
	1970	**2015**	
Total Cattle, million head	112	89.1 (-20%)	(9)
Beef Production, billion kg	9.8	10.8 (+10%)	(9)
Carbon Footprint		16% lower than 1970	(11)

Table 1: Historic production improvement for the US dairy (1950 vs 2015) and beef (1970 vs 2015) herds

while production of livestock meat has more than doubled[12]. Table 1 shows the remarkable advances in productivity that have allowed US dairy and beef herds to shrink to historic levels. This massive increase in efficiency has been made possible by the technological, genetic, and management changes that have taken place in US agriculture since World War II.

The United States' success in this arena lies in the production efficiencies of these commodities, whereby fewer animals are needed to produce a given quantity of animal protein food, as the following milk production example[12] presented in Figure 1 demonstrates: The average dairy cow in the United States produces 10,091 kg milk/cow/year. In comparison, the average dairy cow in Mexico produces 4762 kg milk/cow/year. Thus, it requires two-plus cows in Mexico to produce the same amount of milk as one cow in the United States. India's average milk production per cow is 1134 kg milk/cow/year, increasing the enteric methane and manure production by a factor of nine times compared to the US cow. As a result, the GHG production for that same amount of milk is much lower for the United States versus the Mexican or Indian cow. Production efficiency is a critical factor in sustainable animal protein production and it varies drastically by region. The majority of global livestock GHG stem from enteric emissions and manure, particularly in developing countries that make up 80% and 75% of total livestock GHG, respectively[13].

Competition for Human Food

Critics often claim that livestock production is in serious

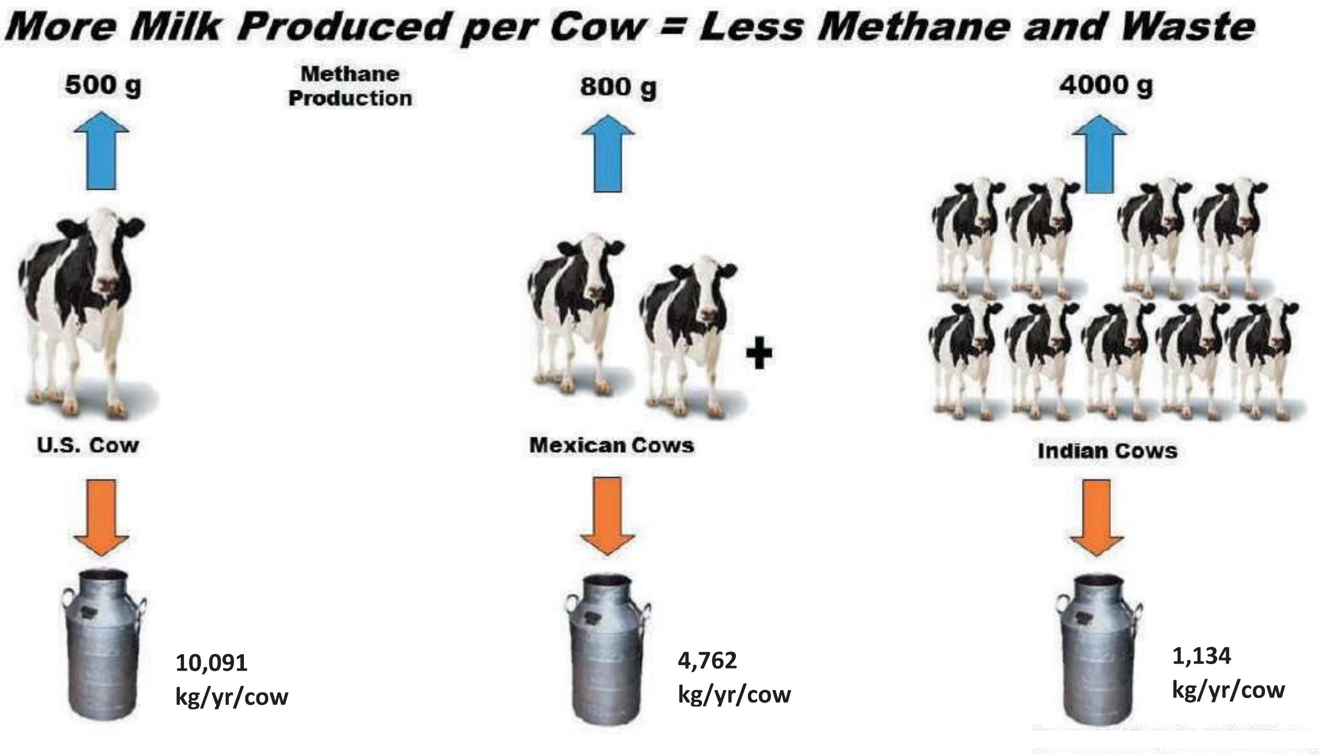

Figure 1: Comparison of the milk yield and methane emissions from US cows versus those from Mexico and India[12]

competition for land, water and other resources. However, in reality livestock act as "upcyclers" in our food system — they consume and use resources of lower value[14] and upgrade them to higher value products[15] and proteins[16]. For example, while most beef cattle in the US eat corn-based diets for the last four months of their life in feedlots, beef cattle spend most of their lives grazing marginal grasslands and eating food humans do not eat. Less than 10% of what beef cattle consume during their life is human-edible grain[17]. Grasses and hay account for over 80% of beef diet and the remainder includes by-products from the biofuels, food, and fibre industries. US dairy cattle are even more of an upcycler[14] because they produce high-quality protein daily in the form of milk and consume residue products left from production and processing of human edible foods and energy production in great quantity, which might otherwise go to landfills. Examples include soybean meal from soy oil production and distillers' grains from ethanol production. Globally, 86% of livestock diets is not edible for humans[18].

Integration of Plant-livestock Agriculture

Livestock production occupies approximately 30% of the ice-free land surface of the earth, or 70% of the land dedicated to food production[19]. However, 57% of the land used for livestock feed production is marginal[18], meaning it cannot be tilled to grow grains or vegetables because it is too rocky, is on too great a slope, has insufficient soil quality, or suffers from a lack of sufficient water. Livestock allow us to produce food on land that cannot and, in many cases, should not be tilled, which expands the land base available for food production. If we converted even a portion of current grasslands to croplands, we would increase erosion [14] and decrease habitat[20] for species that depend on grass-land ecosystems. Grasslands used by livestock are multifunctional. Well managed grazing protects wildlife habitat and provides other important ecosystem goods and services, such as recreation, wildlife habitat, and watersheds[21].

Furthermore, without livestock[8,22], plant agriculture would likely have to rely further on synthetic fertilizers, which are carbon-intensive and a significant cause of water and air pollution. Organic agriculture relies exclusively on non-synthetic fertilisers, mainly livestock manure[23].

Livestock Helps Us Sustainably and Holistically Address the 2050 Challenge

We can sustainably intensify livestock production with the right balance of science and ethics. Sustainable intensification means producing more with less, while simultaneously honouring social, environmental, and economic issues such as animal welfare, biodiversity, and the livelihoods of farmers. It is both possible and necessary.

Simple solutions, such as eliminating livestock farming or returning to the production practices of yesteryear, may seem attractive in the face of the daunting challenges of food security and sustainability. But, simple solutions to complex problems usually have unintended consequences. Plant and livestock agriculture depend on each other, and well-managed livestock systems can play a key role in preserving grassland ecosystems.

Our food, fibre, and biofuel industries are integrated. It's time to abandon reductionist, singularly-focused approaches and recognise that sustainable solutions are about improving the whole food system and must include livestock for us to nourish close to 10 billion healthy people in 2050 and preserve the planet for future generations.

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Frank Mitloehner

Professor and Air Quality Specialist in the Department of Animal Science at the University of California, Davis. He received his MS degree in Animal Science and Agricultural Engineering from the University of Leipzig, Germany, and his PhD degree in Animal Science from Texas Technical University. He is an expert in agricultural air quality, livestock housing and husbandry. Overall, he conducts research that is directly relevant to understanding and mitigating of air emissions from livestock operations, as well as the implications of these emissions for the health and safety of farm workers and neighbouring communities.

Email: fmmitloehner@ucdavis.edu