

Sustainable Cattle Raising and Healthy Consumption of Beef: Keys to a Better Future

Yuqing Mao

Advisor:

Jan E. Dizard

Pioneer Academics

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Abstract

Cattle raising is one of the most environment damaging agricultural activities, which usually gets overlooked by the public. Diet with extensive amount of red meat also threatens our health and well-being. This paper reveals environmental impacts of cattle raising including air pollution, water contamination and land degradation, and risk of excess beef consumption such as increased chance of getting heart related diseases. The paper then provides solutions for environmental problems of cattle raising and suggestions for healthier future diet.

In conclusion, the author finds the balance between sustainable cattle raising and healthy beef consumption. Sustainable cattle raising methods usually produce less beef than conventional concentrated raising method, which perfectly match with healthy diet which only include small amount of red meat.

1. Introduction:

Animal husbandry, an industry that includes controlled cultivation, management, and production of domestic animals, is an essential industry. Animals are raised for utility--for food, fur, hides, medicines and to assist labor and travel. (Britannica) Although the livestock industry is crucial, it contributes to a range of environmental impacts. For example, 18% of global greenhouse gas emissions that contribute to climate change are from the livestock industry. Carbon dioxide emission caused by the industry, conservatively estimated, is approximately 7,516 million tons per year. These numbers are derived from data for the years 1964-2001. In recent years, some believe that the livestock industry contributes over 51% of the global greenhouse gas emission and emits 32,564 million tons of carbon dioxide into the atmosphere yearly (Dopelt). No matter which set of data is closer to reality, we cannot overlook the environmental impact of the livestock industry. Researchers are afraid that we

will exceed the 565 gigaton carbon dioxide limit (the amount of CO₂ that scientists believe we could still release to the atmosphere.) by 2030 due to the livestock industry. In addition, the industry is also responsible for approximately 68% of nitrous oxide emissions, 64% of total ammonia emissions, and 35-50% of methane emissions worldwide. (Dopelt) These numbers are significant and shows how important it is for us to solve this problem.

Food production is a major part of the livestock industry and meat is an indispensable part of diet for lots of people. Therefore, we can't simply solve the problem by giving up on the industry. Environmentalists have been advocating for a vegetable dominated diet, where we eat 50% of vegetables and get most of our protein from plants, so we don't need to produce as much meat. (EAT Lancet Commission) However, nutritionists also claim that red meat contains vital elements that our bodies need and some nutrients in red meat are unattainable from plants. For example, Vitamin B12 is unattainable from plants. Iron, despite being absorbed from plants, is absorbed much better from meat. Controversial claims about the value of eating meat and whether we can we raise livestock sustainably make it clear that we need to examine this agricultural sector carefully.

Beef is a representative of the red meat family, known for the amount of protein it contains and its delicious taste. Based on a statistic from the US Department of Agriculture (USDA) in 2017, there are more than 720,000 beef cow-calf operations in the US, which makes beef the largest segment of US agriculture. (Place) At the same time, cattle raising is one of the main contributors to the greenhouse gas emission of the industry. Beef production contributes over 40% of the greenhouse gas emissions associated with the raising of all livestock. Furthermore, beef has the lowest feed conversion ratio (FCR) of all meat, eggs and milk products. To make one kilogram of beef, approximately 25 kilograms of feed is needed. Beef also has the lowest energy conversion efficiency, only 1.9% of the calory input get converted into edible beef product. (Hannah Ritchie) These numbers make cattle the most

unsustainable livestock to raise. As a result, I would like to focus on the sustainability of cattle raising, the nutritional benefits of beef, and whether we should consume beef healthily in our diet.

2. Consumption of beef

The consumption of meat has rapidly increased in recent decades. According to Australia's Department of Agriculture, Water and the Environment, meat consumption increased by 58% over the years from 1998 to 2018 and reached 360 million tons. Population and the amount of meat consumed per person both increased, contributing to the total increase in meat consumption. The change in consumer preferences and income growth, especially in developing countries, resulted in the increase of per person consumption. (Department of Agriculture) Such significant increase in total meat consumption, however, isn't reflected in the global per person consumption of beef. According to research on Meat and Dairy Production last revised in 2019, global per person consumption per year of beef in 1961 was 9.38 kilograms. The number fluctuated over the years and was estimated to be 9.32 kilograms in 2013. The annual per person consumption of beef rose to about 11 kilograms in the late 1970s. However, two recessions took place in early 1980s and early 1990s and pushed the number back to approximately 9 kilograms per person per year. Overall, the number has not changed dramatically. (Hannah Ritchie) It would make sense if such stable demand resulted in a stable supply. However, total beef production rose from 28.76 million tons in 1961 to 67.9 million tons in 2013 and 71.61 million tons in 2018. (Hannah Ritchie) Such increase in production can only be explained by the population growth from about 3 billion in the 1960s to approximately 7 billion in the 2010s. Compared to pork and chicken production, which increased at the same time by 400% and 1300 % respectively, the stability of beef consumption is surprising. It no doubt reflects the greater expense of raising cattle: beef remains something of a "luxury." (Hannah Ritchie)

3. Criticisms of beef

Criticisms of beef have risen in recent decades, focused on environmental concerns and the health implications of consuming beef. Environmentally, beef is truly a villain. It harms the environment mainly through air pollution, water contamination, and land conversion. Currently, there are basically two ways of cattle raising: on pasture (grass fed) and on concentrated feeding operations (CFO) (Lipson). Both methods harm the environment in different ways.

a. Air Pollution:

Methane and nitrous oxide are two main greenhouse gases produced by livestock raising. Globally, methane is responsible for 25% of the total anthropogenic greenhouse gas emissions, and nitrous oxide is responsible for 31% (Lipson). Methane is a potent greenhouse gas which has 20 times more global warming potency than a similar amount of carbon dioxide. Nitrous oxide's global warming potency is 300 times more than a similar amount of carbon dioxide. As one of the main contributors of these two gases, livestock raising has significantly contributed to global warming. Methane is produced during the digestive process of animals. Ruminants, including cows, produce much more methane than monogastric animals like chickens or pigs. Nitrous Oxide is produced in the process of manure management. The emission level depends on the collection, storage and local weather and humidity. For industrial concentrated feeding operations (CFOs) that are popular in the US, large amounts of manure are generated and stored in open pits which emit nitrous oxide. Aside from the raising process, the post-slaughter processing also produces substantial emission due to intense energy consumption and the degradation of left-over carcass processing byproducts (Lipson).

Pasture raising is normally considered more sustainable, but grazing produces approximately 3-3.5 times more methane comparing to intense raising due to the low

digestibility of the diet of grass fed cattle. The grain-based diet of intense raising is much easier to digest thus emits less methane. However, the production of grain to feed cattle also has a large carbon footprint: each method presents problems.

b. Water Contamination:

Water contamination is another major issue with livestock raising. Cattle produce more excreta compared to other livestock. As industrial agriculture became popular, CFOs emerged all around the world. Such intensive a mode of livestock significantly increases the stress on the environment, especially on water quality. Most of the water resources consumed in the raising process, including drinking and servicing water, return to the environment in the form of liquid manure, slurry and wastewater. Livestock excreta contain extensive amount of nutrients, oxygen depleting substances and pathogens and also heavy metals, drug residues, hormones and antibiotics if livestock is raised in a concentrated manner. These substances have considerable impact on water systems. The amount of pollutants released by CFOs well exceed the buffering capacity of surrounding ecosystems, thus polluting surface water and groundwater (Mateo-Sagasta). Among all agricultural sectors, livestock production releases the most organic matter, pathogens, and pollutants such as drug residues.

c. Land Conversion:

Livestock raising has a profound impact globally on vegetative cover, soil quality and nutrient levels in soil. Changing land to pastureland causes degradation of grassland, desertification and deforestation. 10-20 percent of the grassland on earth is degraded due to overgrazing. Desertification caused by overgrazing resulted in a loss of 8-12 tons of carbon per hectare in soil and 10-16 tons of carbon above ground. For cattle specifically, grass-fed beef can consume an average of 35,000 kilocalories of vegetation per kilogram of slaughtered weight, which quickly wipes out the local vegetative cover. Grain-fed cattle don't cause vegetation loss, but the amount of grain they require greatly reduces overall food production

efficiency. Comparing to the normal 3:1 ratio between amount of grain fed and amount of meat produced, 1kg of beef requires 7kg of grain (Lipson). Such low conversion rate makes beef the livestock that takes up the most amount of land space. Based on a statistic from the World Wildlife Fund, “25% of global land use, land-use change, and forestry emissions are driven by beef production.” (WWF) This includes direct uses of land for beef production such as space used to graze cattle and burning down forests to build pastures. Indirect uses such as the farmland used for producing grains to feed the cows are also included. Clearly, pasture farming and CFOs both require an extensive amount of land resources. Overgrazing is the major issue to solve if we want to reduce land degradation caused by livestock raising.

d. Nutritional Criticisms

On the nutrition perspective, beef is also controversial. The main argument is around whether red meat is bad for our body. Some nutrition scientists claim that red meat contains more saturated fat and increases the risk of heart disease, diabetes and cancer. Others say that red meat is our best source for iron and vitamin B12.

4. Sustainable cattle raising

All critiques of cattle raising emphasize the urgency of the issue. Seeking more sustainable solutions is on the top of our to-do list. Environmental scientists realized the importance of solving this problem and have done extensive research on solutions to make cattle raising more sustainable. Application of sustainable cattle raising approaches is vital to solve this issue.

Sustainable production of beef:

Various beef production strategies to enhance the sustainability of the system, have been proposed by environmental scientists. The effectiveness of these approaches needs to be measured in real scenarios, but a considerable number of suggested methodologies are

theoretically promising. The approaches mainly focus on solving specific environmental problems, such as air pollution, land conversion or water contamination.

a. Strategies to reduce air pollution

One of the simplest ways to reduce carbon emissions from agriculture is to raise cattle on small local farms instead of remote large industrial farms. The short distance between food source and customers reduces carbon emissions due to transportation. Small scale farms also have less carbon emissions compared to large industrial farms. Although it would be ideal if such approach could be applied globally, not all lands are suitable for farming and grazing and not all areas have the space to build farms.

Solutions specifically designed for cattle are more focused. Cows are draft animals, which means they are able to plow fields and thereby increase crop production efficiency. Using cows limits the need for tractors and other machinery powered by fossil fuels, which reduces greenhouse gas emission (Lipson). Other advantages of this strategy include reduced cost for farming by reducing the need for labor and machineries and reduces the fat percentage in the meat because the cattle get more exercise by working on the field. Although such an approach has plenty of benefits, the amount of cattle that are needed on the field is limited, therefore the amount of beef such approach can produce is restricted.

Methane emission is another significant portion of air pollution caused by cattle raising. Recent research by researchers at UC Davis has found an effective solution. By adding seaweed to the diet of cattle methane emissions can be reduced up to 82 percent. Ermias Kebreab, professor and Sesnon Endowed Chair of the Department of Animal Science and director of the World Food Center, conducted this study with his Ph.D. graduate student Breanna Roque. In the course of five months, Kebreab and Roque added small amounts of seaweed to the diet of 21 cattle and tracked their weight gain and

methane emissions. The results showed that for cattle that consumed approximately 80 grams of seaweed gained as much weight as cattle that were fed conventional diets, while producing 82 percent less methane. “We now have sound evidence that seaweed in cattle diet is effective at reducing greenhouse gases and that the efficacy does not diminish over time,” said Kebreab. Roque added: “This could help farmers sustainably produce the beef and dairy products we need to feed the world.” (Nelson) This research could mean a lot to our future agricultural development. Since cattle raising is responsible for a major part of the greenhouse gas emissions from agriculture, reducing methane production is crucial. At the same time, by feeding cows with seaweed instead of grains we also take off burden off of grain farms. In terms of cost, seaweed is much cheaper than conventional grains. Therefore, such an approach is truly promising for future developments of the industry.

Other suggested methods to limit methane and nitrous oxide emission include selective breeding to make cattle digest food more effectively thus reducing methane emissions. Proper manure management to reduce decomposition and minimize methane and nitrous oxide emissions is also crucial.

b. Strategies to reduce water contamination

Water pollution from cattle raising mainly comes from antibiotics and manure. To reduce water contamination from cattle raising, researchers developed a series of strategies to mitigate these environmental impacts. Having fewer CFOs would be a great contribution to solve the issue. Our environment, fortunately, has strong ability to adjust and balance extra nutrients and substance. As a result, manure in dispersed farms and ranches is totally acceptable to the environment. However, CFOs produce massive amount of manure and release them in a concentrated manner, which goes well beyond the buffering capacity of ecosystems.

Effective and sustainable manure management is essential to improve the operation of CFOs. Luckily, cattle manure is good fertilizer, with a low risk of over-fertilization and positive benefits for soil structure, which means instead of letting all the manure run into lakes and rivers, the manure should be collected and used for fertilizers is a win-win. If the application of cattle manure as fertilizer reduces the demand for chemical fertilizers, this strategy can further reduce water contamination. Although this solution is promising, the amount of manure CFOs produce exceeds the local demand of fertilizer and transferring manure to distant farms involves carbon emission and could be costly for farmers. Therefore, more nutrient management strategies are important.

Effective nutrient management strategies are being experimented all over the world. Effective nutrient cycling between plants, soil and animals, and improved plant and animal nutrient retention and efficiency is a scientific way to effectively conserve energy and minimize runoff. Polyface Farm operated by Joel Salatin has effectively demonstrated proper nutrient cycling and farm management. Michael Pollan stated in *The Omnivore's Dilemma* that “the relationship between cows and chickens on this farm takes the form of a loop rather than a line.” (212, Pollan) Chickens on Salatin's Polyface Farm produce tasty eggs because they get natural nutrients from cattle manure and cattle on Salatin's farm don't need antibiotics to stay healthy because chickens fertilize and sanitize the pasture for the cattle. This cycle is only one example of Salatin's farming methodologies, and it effectively minimized waste and reduced polluted run-off. On Salatin's farm, “everything's connected to everything else,” just like how our natural world works. Such farming strategies might end up being the most sustainable solution. However, again, not every region has the ability to operate a farm like Salatin's, thus a comprehensive application of mixed strategies is a cleverer choice.

c. Strategies to mitigate land conversion

Pasture and ranch fields require extensive amounts of space, which is normally acquired by clearing forests, either with chain saws or fire. The burning process emits a considerable amount of carbon and harvesting wood also releases carbon. Multipurpose ranch land is solution to the problem. As wind power gets more and more popular, raising cattle on wind farms has been proven effective. This way, the same land is used for two purposes, thus saving limited land resources.

There is still an abundant amount of land that is unsuitable for crops or other uses, making them perfect candidate for pastures for cows and other domestic animals. In some cases, cattle and crops can even be raised together. Grazing animals, including cows, goats and water buffalo, can provide positive ecosystem benefits and improve plant species composition by removing biomass that could fuel fires, by controlling vegetative growth, and by dispersing seeds (Lipson). Cattle are just like other animals and function as positive additions to environmental stability. If farmers put cattle back into their original role in nature while raising them instead of raising them in ranches or CFOs, further landscape conversion can be minimized.

To minimize land degradation, Salatin's Polyface farm also apply smart and effective approaches. To make sure cattle don't just eat one portion of the pasture, Salatin manipulates shade on the pasture to move the herd around and give the pasture time to grow. This way, Salatin didn't force the animals to reluctantly do something but controlled their behavior using their nature. Salation's farm, from a sustainable and an ethical perspective, presents a great model for future farms.

These strategies are promising, but most of them face the same issue---applying these strategies will reduce the productivity of beef worldwide. CFOs have extensive environmental impact, but its productivity has enabled many of us to afford consuming beef.

It's almost impossible to produce the same amount of beef at relatively low cost with more sustainable approaches. Therefore, effort on the consumption side also need to be made.

5. Healthy consumption of beef and its environmental benefits:

Based on a report from the EAT-Lancet Commission, global red meat consumption is 288% higher than what's considered healthy for us and for the planet. In the US specifically, red meat consumption is 638% higher than the suggested healthy amount and milk consumption is 145% higher than the suggested amount. (Willett) Clearly, we are consuming much more of red meat than we're supposed to. Practicing a healthy diet with less red meat involved also solves the problem of low productivity of sustainable cattle raising.

Consumption of beef will likely to go down with consumption of red meat, which means even if the supply of beef goes down, we'll still have sufficient beef for the new diet.

Painly, eating less red meat is healthier. Based on statistics and calculations of the EAT-Lancet Commission, healthier diet with minimal amount of red meat can potentially reduce approximately 11 million annual death among adults, which represents more than 20% of all adult death per year. (Willett) This doesn't mean red meat should be banned from a healthy diet. Red meat contains crucial elements and nutrients for our body to function, but the current per person consumption amount is way beyond the amount needed for proper human function.

6. Conclusion

Scientists predict that there will be approximately 10 billion people on earth by 2050. Whether we can healthily and sustainably feed our population is a challenge humanity face as a whole. Solving cattle production related issues is a crucial step on our journey. Although strategies above all have promising results if conducted properly, controversies over solutions will continue. One of the most serious of these opposing claims is that most of the suggested

approaches above, such as the Polyface farm form of farming, are more costly than conventional CFOs. Such increase in cost would result in sharp increases in the price of beef, which is already one of the more expensive meats. However, this claim is more complicated than its superficial appearance. Despite the fact that CFOs can make beef cheaper for consumers, its external cost can't be overlooked. All of the related environmental impacts of CFOs are considered as their external cost. If the cost of dealing with the environmental impacts were factored into the cost of a steak or hamburger patty, beef from CFOs would likely be much more expensive than beef raised sustainably. As a result, in the long term, sustainable farming approaches will even be cheaper for society as a whole.

Aside from sustainability, a healthy diet is also crucial for our future. Raising beef sustainably also means that it is healthier because fewer or no antibiotics are needed to keep cattle healthy. Finding balance between sustainable animal husbandry and healthy diet, where we can produce enough meat sustainably while ensure the majority of people in the world can live a healthy diet. Reduced consumption of beef combined with sustainable cattle raising techniques perfectly satisfy sustainability and healthy diet. To be sure, the higher price of beef means that people will eat less beef, some because they cannot afford it and some because they will regard it as a special treat rather than an everyday item in their diet. That, too, given the broad consensus of dieticians, will make us healthier. And there may be more opportunities for small to make a living on the land, reviving rural areas who are struggling almost everywhere.

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