THE GOOD FOOD INSTITUTE

MEAT'S SUSTAINABILITY PROBLEM

Industrial animal agriculture may be the most environmentally damaging industry on Earth. It depletes habitat and resources, contributes to climate change, and spreads deadly illnesses. The industry has displaced communities of wild plants and animals on half the habitable land on Earth. Producing crops to feed animals emits massive quantities of greenhouse gases, and clearing forests and grasslands for pasture may release as much carbon as all other food production combined. Contamination of meat and farm fields by animal wastes spreads bacteria and viruses that sicken thousands of people in the United States every year, while overuse of antibiotics is causing a global public health crisis. These severe and wide-ranging problems threaten the stability of our ecosystems, our climate, and modern medicine. Organizations and individuals can mitigate these ecological and public health threats by promoting alternatives to animal products.

WHY IS ANIMAL AGRICULTURE UNSUSTAINABLE?

Animal Agriculture Wastes the Earth's Resources

As a leading driver of deforestation and other forms of land exploitation, meat production threatens vital ecosystems. Global demand for animal products is rising, and industrialized animal agriculture comes at a cost to wildlands and cropland. For example, over three-quarters of all agricultural land is used to support animals, and meat production is responsible for most of the rainforest destruction South America (De Sy et al. 2015; Roser and Ritchie 2018). The destruction of the last wildlands on Earth threatens an extinction event that could destabilize ecosystems worldwide. This would cause catastrophic changes to the climate, water availability, and global food security (Rockström et al. 2009).

Feeding animals in CAFOs also wastes resources that could be used to feed people. When animals eat human-edible foods or crops grown on land that otherwise could have grown food for humans, only a small fraction of that food becomes muscle tissue (meat). That inefficiency, multiplied by the massive scale of industrial animal agriculture, wastes food and water. In fact, food wasted by feeding crops to animals in the United States is more than all food wasted by grocers, restaurants, and consumers combined (Shepon et al. 2018). In addition, over 40% of U.S. cropland, fertilizer, and irrigation water is used to grow animal feed. American farmers could feed twice as many people a more nutritious diet simply by growing food for people instead of animals (Peters et al. 2016).

Animal Agriculture Is a Leading Cause of Climate Change

Production of meat and other animal products is a major contributor to climate change. Scientists estimate that up to 18% of global emissions are attributable to animal agriculture (Herrero et al. 2015). These emissions come from three major sources: animal feed production, methane from cattle digestion, and conversion of forests and prairie to pasture and cropland. The resource-intensive production of animal feed, such as corn and soybeans, accounts for most of the emissions from pork and poultry production (Kebreab et al. 2016). Most of these emissions come from the production and use of fertilizers. Producing fertilizers requires large amounts of energy, and when they are spread on farm fields nitrogen fertilizers give off N_2O, a greenhouse gas 300

times as potent as carbon dioxide. Overall, N_2O from fertilizers represents nearly half of all U.S. agricultural greenhouse gas emissions (EPA 2018).

Cattle and other ruminants produce methane during digestion. This 'enteric methane' eats up more than 25 percent of U.S. agricultural greenhouse gas emissions and is one reason why beef is the most climate-intensive common food (Poore and Nemecek 2018). Finally, when forests and grassland are cleared for pasture and feed crops, carbon stored in soil, roots, stems, and branches is released into the atmosphere. Carbon emissions from land conversion dramatically increase the climate cost of animal products (Poore and Nemecek 2018; Vermeulen, Campbell, and Ingram 2012). Globally, land conversion may release as much carbon as all agricultural production combined (Vermeulen, Campbell, and Ingram 2012).

Animal Agriculture Pollutes and Sickens

The concentration of waste at CAFOs presents critical challenges for human health and environmental stewardship. The largest CAFOs are each equivalent to a large city without a wastewater treatment system. They pollute local waterways and emit ammonia and hydrogen sulfide gases that sicken the people downwind in rural communities (Hellerstein and Fine 2017; Hribar 2010). In addition, untreated manure in streams and rivers contributes to algae blooms that choke waterways from the Great Lakes to the Chesapeake Bay and the Mississippi Delta and lead to vast dead zones (EPA 2013). Though less visible than a clear-cut forest, these algae blooms also damage critical habitat, reducing ecosystem resilience and damaging local economies.

Releasing untreated manure into waterways and onto vegetable fields also spreads disease. Outbreaks of E. coli, norovirus, and other foodborne illness associated with lettuce and other vegetables often can be traced back to farm animals, either through manure used as fertilizer or contaminated irrigation water. Contaminated animal products are also directly responsible for 52% of all foodborne illness in the United States, led by chicken and pork (Dewey-Mattia et al. 2018). All told, manure contamination sends 30,000 Americans to the hospital and kills hundreds each year (Painter et al. 2013).

The End of Working Antibiotics

Current agricultural practices also create antibiotic-resistant bacteria, a devastating public health threat. Healthy animals are fed low doses of antibiotics as growth promoters, causing microbes to adapt and become resistant (Hakim 2018; Harvey 2018; Marshall and Levy 2011). Then, when used in human medicine, these drugs don't work. If left unchecked, resistant bacteria could kill 10 million people each year by 2050 (O'Neill 2016).

CONCLUSION

Industrial animal agriculture is a major threat to global sustainability on several fronts. It displaces half the wild ecosystems on Earth and consumes half of America's crops. Deforestation and feed crop production for industrial farms are leading contributors to climate change. Fertilizers and manure from feed crops and CAFOs are the primary contributors to water pollution, rural air pollution, and foodborne illness in the United States. And the release of antibiotic resistant bacteria from CAFOs are leading to a global medical crisis. More efficient, less polluting, and safer food systems are needed to provide healthy food to a growing population. Innovative new ways of producing meat have arrived. Plant-based and clean meat ease food's impacts on land use and climate change and eliminate the spread of pollution and disease from concentrated animal wastes. These alternatives should be a part of every organization's plan for sustainability.

Industrial animal agriculture threatens the environment and society in four key ways. Here's how clean meat and plant-based meat stack up when compared to animal-based meat:

	INDUSTRIAL ANIMAL MEAT	PLANT-BASED MEAT	CLEAN MEAT
Land Use	Over one-third of all habitable land on Earth is used to support animals, threatening a global ecological crisis	**Harm:** Greatly Reduced **Certainty:** High	**Harm:** Greatly Reduced **Certainty:** High
Climate Change	Animal agriculture is responsible for the vast majority of food sector greenhouse gas emissions	**Harm:** Reduced **Certainty:** High	**Harm:** Reduced **Certainty:** Moderate
Water Pollution	Untreated manure and excess fertilizer are major sources of ecological damage and human illness	**Harm:** Greatly Reduced **Certainty:** High	**Harm:** Greatly Reduced **Certainty:** High
Antibiotic Resistance	Feeding antibiotics to healthy animals causes microbes to become resistant, making life-saving drugs useless in human medicine	**Harm:** Eliminated **Certainty:** High	**Harm:** Eliminated **Certainty:** High

REFERENCES:

De Sy, V., M. Herold, F. Achard, R. Beuchle, J G P, E. Lindquist, and L. Verchot. 2015. "Land Use Patterns and Related Carbon Losses Following Deforestation in South America." *Environmental Research Letters* 10 (12): 124004.

Dewey-Mattia, Daniel, Karunya Manikonda, Aron J. Hall, Matthew E. Wise, and Samuel J. Crowe. 2018. "Surveillance for Foodborne Disease Outbreaks – United States, 2009–2015." *Morbidity and Mortality Weekly Report. Surveillance Summaries* 67 (10): 1–11.

EPA. 2013. "Literature Review of Livestock and Poultry Manure and Implications for Water Quality." Washington, DC: Office of Water.

———. 2018. "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016." Washington, DC: EPA. https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf.

Hakim, Danny. 2018. "At Hamburger Central, Antibiotics for Cattle That Aren't Sick." *New York Times,* March 23, 2018. https://www.nytimes.com/2018/03/23/business/cattle-antiobiotics.html.

Harvey, Fiona. 2018. "Huge Levels of Antibiotic Use in U.S. Farming Revealed." *Guardian,* February 8, 2018. https://www.theguardian.com/environment/2018/feb/08/huge-levels-of-antibiotic-use-in-us-farming-revealed.

Hellerstein, Erica, and Ken Fine. 2017. "A Million Tons of Feces and an Unbearable Stench: Life near Industrial Pig Farms." *Guardian,* September 20, 2017. https://www.theguardian.com/us-news/2017/sep/20/north-carolina-hog-industry-pig-farms.

Herrero, Mario, Stefan Wirsenius, Benjamin Henderson, Cyrille Rigolot, Philip Thornton, Petr Havlík, Imke de Boer, and Pierre J. Gerber. 2015. "Livestock and the Environment: What Have We Learned in the Past Decade?" *Annual Review of Environment and Resources* 40 (1): 177–202.

Hribar, Carrie. 2010. "Understanding Concentrated Animal Feeding Operations and Their Impact on Communities." Edited by Mark Schultz. Bowling Green, OH: National Association of Local Boards of Health. https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf.

Kebreab, E., A. Liedke, D. Caro, S. Deimling, M. Binder, and M. Finkbeiner. 2016. "Environmental Impact of Using Specialty Feed Ingredients in Swine and Poultry Production: A Life Cycle Assessment." *Journal of Animal Science* 94 (6): 2664–81.

Marshall, B. M., and S. B. Levy. 2011. "Food Animals and Antimicrobials: Impacts on Human Health." *Clinical Microbiology Reviews* 24 (4): 718–33.

O'Neill, Jim. 2016. "Tackling Drug-Resistant Infections Globally: Final Report and Recommendations." London, UK: Review on Antimicrobial Resistance. https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf.

Painter, John A., Robert M. Hoekstra, Tracy Ayers, Robert V. Tauxe, Christopher R. Braden, Frederick J. Angulo, and Patricia M. Griffin. 2013. "Attribution of Foodborne Illnesses, Hospitalizations, and Deaths to Food Commodities by Using Outbreak Data, United States, 1998-2008." *Emerging Infectious Diseases* 19 (3): 407–15.

Peters, Christian J., Jamie Picardy, Amelia F. Darrouzet-Nardi, Jennifer L. Wilkins, Timothy S. Griffin, and Gary W. Fick. 2016. "Carrying Capacity of U.S. Agricultural Land: Ten Diet Scenarios." *Elementa: Science of the Anthropocene* 4: 000116.

Poore, J., and T. Nemecek. 2018. "Reducing Food's Environmental Impacts through Producers and Consumers." *Science* 360 (6392): 987–92.

Rockström, Johan, Will Steffen, Kevin Noone, Asa Persson, F. Stuart Chapin 3rd, Eric F. Lambin, Timothy M. Lenton, et al. 2009. "A Safe Operating Space for Humanity." *Nature* 461 (7263): 472–75.

Roser, Max, and Hannah Ritchie. 2018. "Yields and Land Use in Agriculture." Our World in Data. Accessed August 2, 2018. https://ourworldindata.org/yields-and-land-use-in-agriculture.

Shepon, A., G. Eshel, E. Noor, and R. Milo. 2018. "The Opportunity Cost of Animal Based Diets Exceeds All Food Losses." *Proceedings of the National Academy of Sciences of the United States of America* 115 (15): 3804–9.

Vermeulen, Sonja J., Bruce M. Campbell, and John S. I. Ingram. 2012. "Climate Change and Food Systems." *Annual Review of Environment and Resources* 37 (1): 195–222.

FOR MORE INFORMATION CONTACT:

Senior Environmental Scientist Isaac Emery, Ph.D.
isaace@gfi.org

GFI.ORG

POWERED BY PHILANTHROPY.
GFI IS A NONPROFIT 501(C)(3) ORGANIZATION.
POL-FS-ENVIRON ANIMAL AG-2018-0824

THE GOOD FOOD INSTITUTE