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Government Subsidization and the Reduction of Enteric Emissions in the United States

Is implementing a policy of national enteric emissions standards a feasible national policy option to reduce methane emissions in the United States?

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Abstract

This paper explores policy options aimed at the mitigation of methane emissions produced as a byproduct of enteric fermentation in ruminant animals. Through a comparative analysis of government policies utilized in Europe, Australia, and New Zealand, this paper explores options for implementation within the United States. After focusing on the extensive subsidies received by the agriculture sector in the United States, this paper concludes that requiring farms and corporations to meet mitigation standards in exchange for subsidies is plausible and has worked in other, comparable foreign industries.

Author's Note

Farming and raising livestock is not an abstract concept for me. Growing up in rural Missouri and attending the University of Nebraska has presented me with countless opportunities to personally interact with agriculture. I understand the impact and importance of the United States' agricultural sector, and have become interested in researching ways in which agriculture can become cleaner and safer for our climate while still maintaining the level of production and profitability necessary for our world. The global community must make significant changes in the near future if we hope to salvage the climate that we have long taken for granted. I believe this paper provides a unique and relevant approach regarding how the United States can begin making small, yet meaningful, changes on the journey toward a more sustainable industry.

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I. INTRODUCTION

Scientific consensus on the issue of climate change solidifies the belief that anthropogenic activities are responsible for the Earth's changing climate. Various sectors of industrial life (commercial, transportation, agriculture, residential, energy) have been identified as the main emitters of harmful pollutants that are trapped within the atmosphere and warm our planet. Methane (CH4) gas accounted for 10% of all United States emissions in 2018, with nearly 28% of methane emissions coming solely from enteric fermentation in the agriculture sector (EPA, 2020). According to the United Nations, methane's qualification as a short-lived pollutant shows that a reduction of enteric methane can mitigate climate change within a lifetime (FAO, 2017). Currently, there are limited government policies or subsidies available for research on enteric emissions reduction within the United States. This paper will analyze comparative policies from European and Oceanic States, specifically focusing on subsidization programs in each country and the feasibility of implementing similar programs in the United States.

II. LIVESTOCK AND AGRICULTURE EMISSIONS

The agriculture sector has established itself as the foundation of economic and supply chain systems around the world. According to the United Nations, over 60% (4.6 billion) of Earth's human population is reliant upon agriculture for survival (FAO, 2013). In developing countries, this dependence has been exacerbated by practices that prioritize successful yields, while

developed countries with diversified industrial sectors are slightly less reliant on agriculture economically. Although dependence on agriculture as an occupation is not a prevalent occurrence, worldwide supply chains have created interdependence between developed countries' agriculture sectors that, in turn, feed the vast majority of the world. This massive web of agriculture supply chain creates a damaging byproduct of harmful greenhouse gas (GHG) emissions that are catalyzing the climate change process.

Due to the multi-step process that is required to move food from farm to table, as well as the various cross-sector collaborations between the transportation, agriculture, and energy sectors, exact measurements of agriculture emissions can be difficult to calculate. Estimates currently maintain that agriculture is responsible for between 8-12% of global GHG emissions (C2ES, 2019). The agriculture sector, however, is vast and comprised of various sub-sectors (crop, livestock, grasses). They produce different emissions, the majority of which are methane and nitrous oxide from livestock and crop practices, respectively (Russell, 2014).

Livestock plays a large role in both the economic and emissions sides of the agriculture industry. Meat, milk, and eggs comprise more than 34% of the world's protein intake, and provide income and food-security to billions of people (Russell, 2014). That reliance, albeit beneficial, creates harmful emissions. Similar to the agricultural sector, the sub-categories of emissions produced by livestock-raising practices are numerous. Manure management and enteric fermentation are currently the two largest methane emitters in the livestock industry (Key & Tallard, 2012). The majority of gas produced is methane, which is disproportionately released via the process of enteric fermentation—a natural digestive process in ruminant animals such as cows, goats, and sheep. Enteric fermentation accounts for over 44% of livestock emissions and nearly 88% of the methane produced by livestock (FAO, n.d.).

III. Reducing Livestock Methane Emissions

Current research provides farmers, policymakers, and scientists with a variety of ways to reduce enteric emissions. The most promising and effective technique remains altering feed ingredients and introducing engineered additives that assist in the digestive process. A change in feed ingredients to produce a more fibrous and carbohydrate-rich feed has the ability to lower microbial populations in the rumen and therefore decrease methane emissions (Jones, 2014). Increased foraging and corn-based feed, as opposed to hay, has shown reductions in microbial production, therefore reducing methane emissions (Jones, 2014).

Multiple private companies, scientific research institutions, and universities are working to develop a feed additive that reduces emissions and sustains necessary nutrients for the animals. DSM, a health and wellness company headquartered in the Netherlands, has created Bovaer, a feed additive that promises to reduce enteric methane emissions by 30% (DSM, n.d.). DSM claims that the daily addition of one quarter teaspoon of Bovaer into a ruminant animal's feed will immediately begin to reduce CH4 emissions (DSM, n.d.). This additive has no effect on the animal's health or the safety of human consumption, making it a promising step towards emissions reduction.

In a University of California research project, researchers found that adding seaweed into cattle's daily feed has similar emissions reducing effects as those of the Bovaer additive. The addition of seaweed actively impedes methane-producing enzymes from developing in a ruminant's stomach (Kennedy, 2018). Researchers involved in the project claim that breathalyzing tests prove that emissions reduction is nearly immediate, with substantial reductions being seen in less than twenty-four hours (Kennedy, 2018). Similarly to Bovaer, the seaweed has been proven to not affect the taste of the cow's milk.

Genetically engineering and modifying the enzymes in a ruminant's stomach provides a third methane reduction option. New Zealand scientists have developed a vaccine that targets the methane-producing microbes in the rumen in an effort to alter the byproduct process (Watts, 2019). Vaccination and removal of these methanogens is currently in early stage testing. If successful, however, this technique could provide farmers with a safe and environmentally friendly option for methane reduction.

IV. Linking Government and Scientific Interests

With the effects of climate change poised to impact countries across the entire globe, government leaders have called upon policymakers to regulate emissions in order to slow rising temperatures and mitigate the

forthcoming impacts. Policy solutions have targeted methane emissions, and an increase in research and public knowledge on the methane byproduct of animal production will likely only further intensify calls to regulate the ruminant industry. Governmental policy options are only feasible when both farming and economic production are not harmed. Currently, two policy options have been researched as economically feasible and scientifically effective: taxation and subsidization. Specific programming examples implemented in European and Oceanic States that prove the potential for these policy methods to be implemented in the United States will be explored in further sections.

The taxation of beef is currently touted as an effective policy option that naturally balances the economic market while decreasing methane emissions produced by cattle. Studies on the effectiveness of variables to tax (emissions, beef output) are in general agreement that the taxation of head of cattle provides the most market friendly option (Bonnet et al., 2016). Taxing farmers for each head of cattle will, in turn naturally raise the price of beef for consumers. This will likely reduce the demand, which will lead to less heads of cattle being raised. As a result, less methane will be produced via enteric fermentation in cattle. A beef tax requires little operational and technical change from farmers and producers compared with the methane mitigation options (vaccination, altering feed) offered in the previous section. Taxation, however, is notorious for being politically difficult to win support, so a beef tax has yet to be successfully implemented anywhere in the world.

Subsidization, on the other hand, is a policy tool that requires less political finesse in implementation and has current precedence for success around the world. Subsidies are utilized by governments worldwide to monetarily support businesses or industries in order to maintain competitive market prices on goods. Subsidies tied to the relationship between livestock and emissions are best described by two categories: abatement and abatement technology (Gerber et al., 2010). Abatement subsidies reward farmers based on emissions reduction compared with a pre-determined standard. In this model, subsidy amounts will often vary. Technological abatement, on the other hand, offers subsidies correlating to technology that produces less, or mitigates, emissions. For example, a subsidy may be offered to a farmer who uses a feed additive that is proven to produce fewer emissions through enteric fermentation.

V. Successful Policy Initiatives: A Comparative Policy Study

The prevalence of subsidies in capitalistic market structures provides support for the implementation of an enteric emissions-reducing subsidization plan in the United States. The European Union is the first presented case study. In response to climate change, the European Union launched multiple programs aimed at reducing emissions across all industries in Europe, including the common agriculture policy (CAP), which focused on cutting non-CO2 emissions from across the EU's agriculture sector (European Commission, n.d.-b).

CAP balances funding and projects between both mitigation and adaptation efforts. In working to understand the shift in farming practices and alter the means of production that farmers will have to endure, the CAP program offers subsidies to producers that partake in environmentally friendly farming practices (European Commission, n.d.-a). This program would be categorized under the "abatement technology subsidy" presented in the previous section. Subsidies offered through the CAP are available to rural, landowning farmers who produce high-demand crops, maintain necessary sinks and forestry, and are compliant with environmental regulation (Delayen, 2007). For example, the EU boasted an impressive 22% reduction in agricultural emissions from 1990-2012 (Matthews, 2020). The CAP has played a major role in this reduction, and new reforms that further improve the efficiency of the subsidies provide exciting prospects to agriculture subsidization programs in Europe.

A key component of CAP is its focus on rural development. Nearly one-third of Europe's land is categorized as "rural," a substantial amount of which is utilized for agricultural practices (European Commission, 2020). The Rural Development Program distributes funds to rural landowners and farmers that meet a comprehensive standards requirement. For example, the program offered an abatement technology subsidy to a pepper farm in Hungary that utilizes only renewable energy (European Commission, n.d.-c).

Similarly, Australia and New Zealand have formulated comprehensive agriculture policies aimed at reducing emissions. Each, individually, has extensive

agricultural emissions mitigation goals that have the ability to have industry-wide impacts. What distinguishes the two countries with regard to agriculture and methane emissions are their plans and successes in reducing enteric methane emissions while maintaining solid economic growth and cattle yields.

Agriculture plays a major role in New Zealand's economy. In 2015, approximately 5% of the country's GDP was comprised by the agriculture sector, and nearly $30 billion was accumulated by the country just in agriculture exports (Environment Foundation, 2018). Methane released through the process of enteric fermentation in cows and sheep accounts for nearly one-third of the country's GHG emissions per year (Roy, 2019). The reliance on New Zealand's agriculture sector for economic stability requires a fluid emissions plan that will mitigate any harmful economic impact.

Unlike CAP, New Zealand has created a top-down approach. Whereas the EU funds individual farms' implementation of solutions, New Zealand has directed government subsidies into complex scientific research in an effort to find applicable and scientifically-proven solutions that can eventually be implemented by farmers. Thus far, these solutions have focused on efforts similar to those previously mentioned in Section III. Current scientific projects that are receiving subsidies include research into the mass production of seaweed (Roy, 2019) and producing genetically modified sheep that emit less GHGs (Smee, 2019). New Zealand's cattle exports grew by 2% over the past five years, while methane emissions from agriculture shrunk by roughly half a ton of methane in carbon dioxide equivalent (Stats NZ, 2020). This is an encouraging sign for the industry.

Reduction programs currently subsidized by the Australian government bridge the gap between the top-down and bottom-up approaches seen in New Zealand and the EU, respectively. In 2012, Australia launched the National Livestock Methane Program, which connected researchers with livestock farmers, enabling scientists to conduct field research on farms and provide input on how production would change with the implementation of their research findings (Meat & Livestock Australia, n.d.). In addition to research subsidies, Australia provides direct abatement technology subsidization to farmers (Department of Primary Industries and Regional Development, 2019).

VI. Implementing Abatement Technology Subsidy Programs in the United States

In 2019, the United States granted over $19 billion in subsidies to farmers (Charles, 2019). The agriculture industry in the United States is notorious for its constant need for subsidization. Subsidies are primarily used for keeping farm commodities competitive on the global market, though some grants are also available for research and development. The United States' massive subsidization budget for agriculture provides room to increase the budget put toward sustainable research. Increased awareness and implementation of cleaner farming techniques have the ability to mitigate climate change, a benefit for both agriculture producers and the United States government.

As politics continue to dominate legislative efforts aimed at mitigating emissions, implementing abatement technology subsidy programs offers policymakers a less political and more cost-effective solution. Cost has become a primary target of Republican lawmakers toward the recent Green New Deal legislation. In addition to politicians' unease with the cost of climate legislation, the majority of the American public is hesitant to fund large-scale emissions reduction programs (Hamel et al., 2019). This program would not require any new budget allocations, therefore preventing politics from intervening in the implementation of the program. Decreasing political stagnation is a crucial element of any climate legislation, so, without budget allocation, this subsidization program provides an effective and realistic policy proposal.

The implementation of a subsidy program in response to the enteric emissions problem in the United States is feasible. While there is no clear blueprint for implementation, pairing enteric methane reduction strategies with government subsidization has the potential to benefit all parties involved. With high levels of subsidization currently in place in the United States, new legislation or additional appropriation of funds is unnecessary. Rather, the creation of new standards regarding ruminant animals and increased subsidization for on-farm research is a plausible solution to enteric emissions reduction. These standards can be set by the USDA with input from various agencies, including the EPA and other environmental and farm interest groups.

The agriculture sector of United States is currently experiencing a chasm between the agricultural and economic production of large factory farms and small family-owned farms. Although small family farms (designated by less than $350,000 in gross cash farm income) accounted for 90% of United States farms in 2015, these small farms only accounted for 24% of production (McDonald & Hoppe, 2017). However, larger and/or corporate farms account for more of the economic production of the agriculture industry and often receive more government subsidization. Piloting an enteric emissions standard on a corporate farm that produces a high volume of enteric methane will help policymakers and researchers understand the plausibility of applying subsidy standards to smaller farms. This is due to the sheer size and significant emissions of larger family and corporate farms. Similar to the Australian approach to their policy, utilizing research and experimentation on large farms provides the USDA opportunities to learn how to better transpose the policy to fit smaller farms. While there is no one solution to this issue, a fluid and flexible process of implementation, though difficult, is achievable.

The European Union, New Zealand, and Australia are clear case studies of successful government subsidization of the agriculture industry that reduces enteric emissions. Taking the direct government-to-farm subsidy program from CAP incentivizes farmers to reform farming practices and encourages clean farming. The United States currently houses scientific research institutions that would benefit from increased subsidy programs similar to those seen in Oceanic States. Through this, the United States could potentially move to the forefront of research and progressive environmental policies that benefit both farmers and the economy.

VII. Conclusion

Enteric methane emission reduction techniques are available and plausible for implementation in the United States. A program focused on livestock emissions that joins CAP's direct abatement technology subsidies program, combined with scientific research subsidization as seen in Australia and New Zealand, can work in the United States. Implementing standards on current subsidization programs is not only possible, but is the most likely solution to reduce enteric emissions standards in the United States. Requiring new technology, reducing emissions, and funding new research will only help the agriculture industry in the United States prepare for the inevitable consequences of climate change.

References

Bonnet, C., Bouamra-Mechemache, Z., & Corre, T. (2016, April). An environmental tax towards more sustainable food consumption: empirical evidence of the French and marine food consumption. Toulouse School of Economics. https://www.tse-fr.eu/fr/publications/environmental-tax-towards-more-sustainable-food-consumption-empirical-evidence-french-meat-and.

Center for Climate and Energy Solutions, C2ES. (n.d.). *Global Emissions*. https://www.c2es.org/content/international-emissions/.

Charles, D. (2019, December 31). *Farmers got billions from taxpayers in 2019, and hardly anyone objected*. NPR. https://www.npr.org/sections/thesalt/2019/12/31/790261705/farmers-got-billions-from-taxpayers-in-2019-and-hardly-anyone-objected.

Delayen, C. (2007, September). *The common agriculture policy: A brief introduction*. Institute for Agriculture and Trade Policy. https://web.archive.org/web/20100823103612/http://www.iatp.org/iatp/publications.cfm?refid=100145.

Department of Primary Industries and Regional Development. (2019, November). *Managing manure to reduce greenhouse gas emissions*. https://www.agric.wa.gov.au/climate-change/managing-manure-reduce-greenhouse-gas-emissions.

DSM. (n.d.) *Farm wise, climate friendly: Minimizing methane from cattle*. https://www.dsm.com/corporate/solutions/climate-energy/minimizing-methane-from-cattle.html.

Environment Foundation. (2018, February 19). *Environment guide: Agriculture*. http://www.environmentguide.org.nz/activities/agriculture/.

Environmental Protection Agency. (n.d.). *Overview of greenhouse gasses*. https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

European Commission. (n.d.-a). *The CAP and climate change*. https://ec.europa.eu/info/food-farming-fisheries/sustainability-and-natural-resources/agriculture-and-environment/agriculture-and-climate-change_en.

European Commission. (n.d.-b). *EU climate action*. https://ec.europa.eu/clima/policies/strategies/progress_en.

European Commission.(n.d.-c). *Rural development programs*. https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development_enagricultural-policy/rural-development_en.

European Commission. (2020, February 7). *Urban and rural living in the European Union*. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200207-1.

Food and Agriculture Organization, FAO. (n.d.). *Global livestock environmental assessment model*. http://www.fao.org/gleam/results/en/.

FAO. (2013). *Statistical yearbook: 2013*. http://www.fao.org/3/i3107e/i3107e01.pdf.

FAO. (2017). *Livestock solutions for climate change*. http://www.fao.org/3/a-i8098e.pdf.

Gerber, P., Key, N., Portet, F., & Steinfeld, H. (2010). Policy options in addressing livestock's contribution to climate change. *Animal, 4*(3), 393-406. https://doi.org/10.1017/S1751731110000133.

Hamel, L., Lopes, L., Muñana, C. & Brodie, M. (2019, November 27). *Views on the Green New Deal*. The Kaiser Family Foundation/Washington Post Climate Change Survey. https://www.kff.org/report-section/the-kaiser-family-foundation-washington-post-climate-change-survey-green-new-deal/.

Jones, M. (2014). *Ways to reduce methane production in cattle*. UNL Extension. https://beef.unl.edu/reduce-methane-production-cattle.

Kennedy, M. (2018, July 3). *Surf and turf: To reduce gas emissions from cows, scientists look to the ocean*. NPR. https://www.npr.org/sections/thesalt/2018/07/03/623645396/surf-and-turf-to-reduce-gas-emissions-from-cows-scientists-look-to-the-ocean.

Key, N., & Tallard, G. (2012). Mitigating methane emissions from livestock: a global analysis of sectoral policies. *Climatic Change, 112*, 387-414. https://doi.org/10.1007/s10584-011-0206-6.

Matthews, A. (2020, March 26). *Climate measures in agriculture*. CAP Reform. http://capreform.eu/climate-measures-in-agriculture/.

McDonald, J., & Hoppe, R. (2017, March 6*). Large family farms continue to dominate U.S. agricultural production*. United States Department of Agriculture. https://www.ers.usda.gov/amber-waves/2017/march/large-family-farms-continue-to-dominate-us-agricultural-production/.

Meat & Livestock Australia. (n.d.). *National livestock methane program*. https://www.mla.com.au/research-and-development/Environment-sustainability/national-livestock-methane-program/#.

Roy, E. (2019, December 31). *From red seaweed to climate-smart cows: New Zealand leads the fight against methane*. The Guardian. https://www.theguardian.com/world/2020/jan/01/from-red-seaweed-to-climate-smart-cows-new-zealand-leads-the-fight-against-methane.

Russell, S. (2014, May 29). *Everything you need to know about agricultural emissions*. World Resources Institute. https://www.wri.org/blog/2014/05/everything-you-need-know-about-agricultural-emissions.

Smee, B. (2019, 30 November). *New Zealand begins genetic program to produce low methane-emitting sheep*. The Guardian. https://www.theguardian.com/world/2019/dec/01/new-zealand-begins-genetic-program-to-produce-low-methane-emitting-sheep.

Stats NZ. (2020). *New Zealand's greenhouse gas emissions*. https://www.stats.govt.nz/indicators/new-zealands-greenhouse-gas-emissions.

Watts, G. (2019, August 6). *The cows that could help fight climate change*. BBC. https://www.bbc.com/future/article/20190806-how-vaccines-could-fix-our-problem-with-cow-emissions.