The environmental and economic impact of removing productivity-enhancing technologies from U.S. beef production[1]

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SUSTAINABLE BEEF RESOURCE CENTER

Safe, affordable beef through socially and environmentally responsible practices

Executive Summary

What would happen if U.S. beef farmers and ranchers no longer used productivity-enhancing technologies to raise beef cattle? To produce the same amount of beef they do today, every year:

↘ MEANING IF ALL BEEF WAS PRODUCED ORGANICLY & GRASS FED!

- 10 million more cattle would be required in the U.S. beef herd
- 3 million more fed cattle would need to be harvested
- 81 million more tons of feed would be needed
- 17 million more acres of land would be needed for grazing and growing feed
- 138 billion more gallons of water would be required for producing feed and maintaining animals
- 18 million more metric tons of carbon dioxide equivalent (CO_2eq) would be released in the United States alone

These effects would be equivalent to imposing an 8.2 percent tax on U.S. beef farmers and ranchers. This tax would reduce domestic beef production by 17 percent. If global demand for beef were maintained, within 15 years…

- These countries would increase beef exports:
  - Canada — 36 percent increase
  - Brazil — 24 percent increase
  - Argentina — 11 percent increase
  - Australia — 5 percent increase
- Brazil would lose 16.9 million acres of forest
- 3.1 billion more metric tons of CO_2eq would be released into the atmosphere, primarily in these countries:
  - 2.1 billion metric tons — Brazil
  - 283 million metric tons — Canada
  - 143 million metric tons — Argentina
  - 139 million metric tons — Australia

Introduction and Objective

Thanks to the adoption of innovative management practices and technologies during the last 30 years, U.S. beef farmers and ranchers have increased productivity dramatically.[2] Much of this increase would disappear if farmers and ranchers no longer used management practices and technologies that improve efficiency, making it difficult to meet the world's growing demand for animal protein.

Animal scientist Jude Capper, Ph.D., and economist Dermot Hayes, Ph.D., teamed up to publish a paper to answer the question, "What would be the environmental and economic effects of removing productivity-enhancing technologies from the U.S. beef production system?"

Materials and methods

A whole-system environmental and natural resource model was used to determine the resource use and waste output from animals within all sectors of two U.S. beef-production systems. Both systems were identical except in one critical area: the use of productivity-enhancing technologies.

In the Conventional System (CON), productivity-enhancing technologies were used at current market adoption rates and where approved by the U.S. Food and Drug Administration (FDA) in accordance with label instructions. Productivity-enhancing technologies included ionophores, steroid implants, melengestrol acetate (MGA) and beta-adrenergic agonists.

Conversely, all productivity-enhancing technologies were excluded from the No-Technology System (NOT).

The whole-system model was built using the principles of life-cycle assessment (LCA) accounting. It incorporated all relevant agricultural inputs (e.g., pasture land, cropland, fertilizers, pesticides, drinking water for cattle, irrigation water, electricity, fuel), extending from the manufacture of cropping inputs to the arrival of finished cattle at the processing plant. Animals within all sectors of beef production were considered in the analysis, including inputs from the U.S. dairy herd in terms of calves and cull cows. Commodity/input prices were derived from U.S. Department of Agriculture data; industry professionals provided market-penetration and market-share estimates as well as market prices for productivity-enhancing technologies. The average live weight at harvest across all animal categories was 1,265 pounds for CON and 1,148 pounds for NOT. The projected increased cost of U.S. beef produced without productivity-enhancing technologies was the equivalent of an 8.2 percent tax on the beef industry.

This information then was fed into the Center for Agricultural and Rural Development (CARD) model — a global agricultural production and trade model that includes a greenhouse-gas model — to assess the global consequences of the loss of technology for U.S. beef production. These are the same models used to prepare briefings for U.S. Congressional leaders and trade representatives regarding the implications of their decisions.

Results and discussion

Producing beef that is environmentally sound, socially responsible and economically viable is critical to meeting the world's growing demand for animal protein. If U.S. beef producers no longer use FDA-approved productivity-enhancing technologies, they will need significantly more inputs and resources to produce the same amount of beef, and waste output will be increased (Table 1).

This loss of efficiency would increase U.S. beef producers' cost of production by 8.2 percent, driving down their competitiveness in the global market. This would cause other countries to expand beef production, ultimately shifting global trade patterns (Table 2).

These global shifts in beef production would cause land-use changes in specific regions and, in combination with regional variation in cattle productivity, would cause a cumulative increase in carbon emissions of more than 3.1 billion metric tons CO_2eq during a 15-year period (Table 3). The largest single impact would come from destruction of 16.9 million acres of Amazon Rainforest and forests in the West Central Cerrado region of Brazil, with the vast majority occurring in the Amazon.[3]

Conclusion

The loss of FDA-approved productivity-enhancing technologies in the U.S. beef system would have environmental and economic effects on the United States and the rest of the world that are both significant and undesirable.

Table 1. Additional inputs, resources and waste output required to produce an equivalent amount of beef without the use of productivity-enhancing technologies.

Animals	Per year impact
Cattle herd maintained (no. of head)	+10,006,000
Cattle harvested (no. of head)	+2,859,000

Resources	
Land (acres)	+17,000,000
Feedstuffs (tons)	+81,000,000
Water (gallons)	+138,276,000,000
Fertilizer (tons of nitrogen, phosphorus & potassium)	+289,000
Energy (megajoules)	+8,135,000,000

Waste output	
Manure (tons)	+51,541,000
Nitrogen excretion (tons)	+659,000
Phosphorus excretion (tons)	+55,800
Greenhouse-gas emissions (CO_2eq, metric tons)	+18,571,000

Table 2. Effect of withdrawing productivity-enhancing technologies from U.S. beef production on production and trade over a 15-year period.

U.S. market	2023 vs. 2009
U.S. beef production	-17.1%
U.S. net beef imports	+352%

International markets	
Canada's net beef exports	+36.3%
Brazil's net beef exports	+24.8%
Argentina's net beef exports	+10.9%
Australia's net beef exports	+5.4%

Table 3. 15-year cumulative change in carbon emissions resulting from discontinuing use of productivity-enhancing technology in U.S. beef production.

Country	Cumulative CO_2 eq. due to land use change (metric tons)
Brazil	+2,157,000,000
Canada	+283,000,000
Argentina	+143,000,000
Australia	+139,000,000
Rest of world	+413,000,000
Total	**+3,135,000,000**

[1]Capper, J.L., D.H. Hayes. 2012. The Environmental and Economic Impact of Removing Growth-Enhancing Technologies from United States Beef Production. *Journal of Animal Science*. 90(8).
[2]Capper, J.L. 2011. The environmental impact of beef production in the United States: 1977 compared with 2007. *Journal of Animal Science*, 89(12):4249-4261.
[3]Dumortier, J., D.J. Hayes, et al. The effects of potential changes in United States beef production on global grazing systems and greenhouse gas emissions. Environmental Research Letters.
[4]All numbers have been rounded to the nearest three digits.