Sustaining Agriculture: The Role of Policy, Technology, and Science

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ABSTRACT

The agricultural industry faces the challenge of balancing environmental sustainability, public health, economic stability, and food security amid a growing global population. U.S. agricultural policies, particularly farm subsidies and legislation, have shaped food production in ways that prioritize large-scale industrial farming, often at the expense of sustainable practices. This paper examines the broader implications of these policies, focusing on key issues such as the dominance of commodity crops, the environmental and public health risks associated with pesticides and CAFOs, and the role of genetically modified organisms (GMOs) in food production.

Through an analysis of policy-driven agricultural trends, this study highlights the need for reform in four critical areas: (1) revising farm subsidies to support diverse and sustainable farming practices, (2) reducing pesticide use and promoting alternative pest control methods, (3) improving public education on GMOs and implementing transparent labeling, and (4) advancing organic farming and humane livestock practices. Evidence suggests that these reforms can help mitigate environmental damage, reduce health risks, and promote a more resilient and ethical food system.

By integrating scientific research with policy analysis, this paper presents a framework for transitioning to an agricultural model that prioritizes ecological integrity, human health, and long-term food security. The recommendations outlined provide a roadmap for policymakers, farmers, and consumers to work toward a more sustainable and equitable agricultural future.

INTRODUCTION

The U.S. Farm Bill, first enacted in 1933, was designed to support farmers and stabilize food production during economic downturns. Over time, the legislation has evolved to address changing agricultural needs, including subsidies, conservation programs, and food assistance. However, modern agricultural policies continue to raise concerns regarding economic efficiency, environmental sustainability, and public health impacts. In particular, the selective allocation of subsidies has shaped farming practices in ways that influence food production, environmental quality, and the availability of certain crops.

One major issue is the emphasis on commodity crops such as corn, wheat, and soybeans, which receive significant financial support compared to fruits and vegetables. This policy structure has been linked to shifts in dietary patterns, the rise of processed food industries, and environmental concerns such as soil degradation and water pollution (Desjardins, 2014). Additionally, advancements in agricultural biotechnology, including genetically modified crops and lab-grown meat, have introduced new ethical, economic, and ecological considerations. Understanding how these policies and technologies interact is essential for shaping a more sustainable and equitable agricultural system.

This paper examines the broader implications of U.S. agricultural policies by analyzing key case studies, including pesticide use, transgenic crops, and lab-grown meat. The goal is to assess how current policies influence food production, public health, and environmental sustainability, ultimately identifying potential areas for reform.

RESULTS & DISCUSSION

Water Pollution and Ecosystem Damage

Expanding Concentrated Animal Feeding Operations (CAFOs) in Farmville raises significant concerns due to their environmental and public health impacts. Although CAFOs are often promoted as an efficient solution to meet growing food demand, their environmental costs—particularly in pollution, health risks, and ecological harm—are substantial. Expanding CAFOs in Farmville would likely exacerbate these issues. CAFOs produce large amounts of waste, which frequently overwhelm local ecosystems. Unlike human sewage, CAFO waste is not treated and often contains excess nutrients such as nitrogen and phosphorus. These nutrients can seep into groundwater or be washed into local rivers, resulting in algal blooms and hypoxic zones that severely affect aquatic life and reduce biodiversity (Hribar, 2010). The U.S. Environmental Protection Agency (EPA) recognizes CAFOs as a primary source of water pollution due to these nutrient overloads, which harm both drinking water quality and local ecosystems (Daniels, 2023).

Air Quality and Greenhouse Gas Emissions

In addition, CAFOs emit various pollutants, including methane, ammonia, and particulate matter, which contribute to greenhouse gas emissions and degrade air quality. Communities near CAFOs often experience higher rates of respiratory issues and other health problems due to exposure to these contaminants.

Public Health Concerns and Antibiotic Resistance

According to the Centers for Disease Control and Prevention (CDC), antibiotic-resistant bacteria are also more prevalent in areas surrounding CAFOs, as these facilities routinely administer antibiotics to prevent disease outbreaks among densely packed animals. This practice has significant public health implications, as it contributes to the rise of antibiotic-resistant infections (Hribar, 2010).

Impact on Small Farmers and Rural Communities

From an economic standpoint, while CAFOs may appear to provide low-cost meat, they often drive small farmers out of business, concentrate profits among large corporations, and reduce overall rural economic resilience. Moreover, the environmental cleanup costs associated with CAFO-related pollution are typically borne by taxpayers, undermining the economic benefits these facilities claim to offer. Given these concerns, I argue against the expansion of CAFOs in Farmville. Rather than continuing to invest in a system that harms communities and ecosystems, the focus should shift toward sustainable agricultural practices that support biodiversity and prioritize human health. Policies should be considered to limit CAFO expansion, promoting agricultural systems that are more environmentally responsible and resilient to climate and public health challenges.

The Case for Restricting Pesticide Use in Montgomery County

In 2014, Montgomery County, Maryland, imposed significant restrictions on pesticide use, including a ban on certain pesticides, a decision that sparked considerable debate among various stakeholders. If I were the commissioner, I would vote to heavily restrict pesticide use in the county, balancing pest management needs with long-term

environmental and public health considerations. This approach would prioritize both community health and environmental sustainability, ensuring effective pest control without compromising future resilience.

The negative impacts of pesticide use on the environment and human health are well-documented. Pesticides can contaminate soil, water, and air, and harm beneficial organisms such as pollinators and other wildlife (Montgomery County Council, 2014). The widespread use of pesticides has also been linked to various health issues, including cancer and developmental disorders, particularly among farm workers and children (Parendes & Burris, 2005).

Integrated Pest Management (IPM) as a Sustainable Alternative

While pesticides may provide short-term benefits in controlling pests, their long-term effects could pose significant risks to public health and ecosystems. As such, pesticide use should be carefully regulated. Integrated Pest Management (IPM) offers an effective alternative by combining biological, cultural, and chemical control methods, reducing the reliance on harmful pesticides (Parendes & Burris, 2005). IPM can also help reduce pesticide residues on food, a growing concern for consumers (Montgomery County Council, 2014). By adopting IPM and other sustainable practices, we can mitigate the harmful impacts of pesticides while ensuring effective pest control and safeguarding both public health and the environment.

Future Directions: Reducing Pesticide Use and Exploring Alternatives

Looking to the future, pesticide use should be minimized through stricter regulations and the development of safer, less toxic alternatives. One promising alternative is the use of treated human waste, which, when processed properly, can serve as an effective

fertilizer and pest control agent. Human waste, processed through methods like hot composting or nitrification, provides essential nutrients to the soil while reducing the need for synthetic chemical fertilizers. This approach offers a way to recycle waste and improve soil health sustainably, reducing the environmental burden of pesticide use.

As a commissioner, I would vote to heavily restrict pesticide use in Montgomery County. A policy that prioritizes public health, environmental protection, and sustainable agricultural practices is essential. Restricting pesticide use while supporting farmers in adopting safer alternatives, such as human waste-based fertilizers, would contribute to a healthier community and a more resilient agricultural system.

CONCLUSION

As the global population continues to rise, the agricultural industry faces the complex challenge of balancing environmental protection, human health, economic stability, and food security. Achieving these often-conflicting goals requires a fundamental shift in policies, farming practices, and public education. The following recommendations provide a framework for moving forward to address these challenges and create a sustainable food system.

Updating Farm Subsidies and Legislation

Farm subsidies play a significant role in shaping the agricultural landscape, yet current programs often prioritize large-scale industrial agriculture at the expense of sustainable practices. Revising the U.S. Farm Bill to support sustainable farming methods—such as promoting fruit and vegetable production over row crops—can encourage healthier diets

and reduce environmental harm. By fostering diverse agricultural practices, we can also help curb the oversupply of crops like corn, which are frequently processed into unhealthy additives like high-fructose corn syrup. Furthermore, stricter regulations on Concentrated Animal Feeding Operations (CAFOs) would mitigate their environmental impact, promoting more sustainable, pasture-based farming systems and capping emissions.

Reducing Pesticide Use and Exploring Alternatives

Pesticides, essential to large-scale agriculture, present serious risks to human health and ecosystems. Chronic exposure to pesticides has been linked to various health problems, including cancer and neurological disorders, and they also harm beneficial organisms like pollinators. Integrated Pest Management (IPM) offers an alternative by combining biological, cultural, and chemical control methods to reduce reliance on pesticides while maintaining crop productivity. Research demonstrates that IPM practices minimize environmental damage and ensure safer food production. Additionally, promoting alternatives such as processed human waste as fertilizer can further reduce the use of synthetic chemicals, improving soil health and reducing environmental impacts. Stricter pesticide regulations and incentives for adopting safer alternatives can help protect both human health and the environment.

Educating the Public on GMOs and Labeling

Genetically modified organisms (GMOs) often face public skepticism despite their potential to enhance food security and reduce the need for chemical inputs. Transparent labeling and public education are essential to bridging this knowledge gap. GMOs like Golden Rice, designed to combat vitamin A deficiency, offer significant public health

benefits but are frequently misunderstood. By educating consumers about the safety and environmental benefits of GMOs—such as their role in reducing pesticide use—the agricultural industry can build trust and encourage the adoption of these technologies. Additionally, promoting local food systems and reducing dependence on GMO-derived oils, like soybean oil, can improve dietary quality while supporting sustainable agricultural practices.

Promoting Organic Farming and Animal Welfare

While organic farming is often criticized for lower yields, it offers substantial environmental benefits by avoiding synthetic chemicals and emphasizing natural processes. Policies should support organic farming through research aimed at improving its efficiency and offering financial incentives to farmers transitioning to organic methods. Organic practices can preserve biodiversity and improve soil health, making them a crucial solution to environmental degradation. Moreover, addressing ethical concerns in livestock farming is essential. Factory farming practices often lead to animal suffering and environmental damage. By adhering to the Five Freedoms framework, which ensures animals have space, freedom from discomfort, and the ability to express natural behaviors, farmers can improve animal welfare. Although humane farming practices may come at higher costs, these can be offset through ethical labeling that attracts premium consumers, reduced veterinary costs, and improved productivity from healthier animals.

Final Thoughts

To create a sustainable and equitable food system that meets the needs of a growing population while protecting the environment, the agricultural industry must undergo

transformative changes. Updating subsidies to support diverse, sustainable practices, reducing pesticide use, educating the public on GMOs, and promoting organic farming and animal welfare are essential steps. These evidence-based recommendations offer a roadmap for a food system that prioritizes human health, environmental protection, economic stability, and global food security. By embracing these changes, we can foster an agricultural industry that works in harmony with the planet, promotes healthier diets, and supports the well-being of all.

LITERATURE CITED

American Humane. (17, October 2016). Five Freedoms: the gold standard of animal welfare. https://www.americanhumane.org/blog/five-freedoms-the-gold-standard-of-animal-welfare/

Benbrook, C. (2012). 'Superweeds' linked to rising herbicide use in GM crops, study finds. *Environmental Sciences Europe*. Washington State University. https://www.sciencedaily.com/releases/2012/10/121002092839.htm

Combs, G. F. Jr. (2001, October 5). All that glitters may not be gold: A troublesome case of transgenic rice. *Division of Nutritional Sciences, Cornell University*. https://learn.snhu.edu/content/enforced/1750457-ENV-444-19057.202486-1/Course%20Documents/ENV%20444%20Module%20Six%20Case%20Study.pdf?ou=1750457

Daniels, L. (2023, June 8). *The environmental impacts of concentrated animal feeding operations (CAFOs).* Vertex. https://vertexeng.com/insights/the-environmental-impacts-of-concentrated-animal-feeding-operations-cafos/

Desjardins, L. CNN. (2014, February 4). *5 things the farm bill will mean for you.* Retrieved from https://www.cnn.com/2014/02/04/politics/farm-bill/

Hains, B., Hains, D., & Balschweid, M. (2006). *Certified cultured beef: Raising beef without the cow?* Youth Development and Agricultural Education, Purdue University. https://learn.snhu.edu/content/enforced/1750457-ENV-444-19057.202486-1/Course%20Documents/ENV%20444%20Module%20Seven%20Case%20Study.pdf?ou=1750457

Havard T.H. Chan. (2024). Food Waste, The Big Picture. *The Nutrition Source.* https://nutritionsource.hsph.harvard.edu/sustainability/food-waste/

Hribar, Carrie (2010). *Understanding concentrated animal feeding operations and their impact on communities*. Centers for Disease Control and Prevention, CDC. https://stacks.cdc.gov/view/cdc/59792

Leroy F, Smith NW, Adesogan AT, Beal T, Iannotti L, Moughan PJ, Mann N. (15 April 2023). *The role of meat in the human diet: evolutionary aspects and nutritional value.* Anim Front. 13(2):11-18. doi: 10.1093/af/vfac093. PMID: 37073319; PMCID: PMC10105836. https://pmc.ncbi.nlm.nih.gov/articles/PMC10105836/

Luster-Teasley, S. & Ives, L., R. (2013). *Farmville Future? CAFOs and Contamination.* National Center for Case Study Teaching in Science.

https://learn.snhu.edu/content/enforced/1750457-ENV-444-19057.202486-1/Course%20Documents/ENV%20444%20Module%20Three%20Case%20Study.pdf?ou=1750457

Montgomery County Council. (24, October 2014). *Montgomery County, Maryland Pesticide Restrictions and Restrictions on Certain Pesticide Uses*. https://learn.snhu.edu/content/enforced/1750457-ENV-444-19057.202486-1/Course%20Documents/ENV%20444%20Module%20Four%20Montgomery%20County%20Council%20Memorandum.pdf?ou=1750457

Parendes, A, L. & Burris, H, S. (18, July 2005). *Pesticides: Can We Do Without Them?* https://learn.snhu.edu/content/enforced/1750457-ENV-444-19057.202486-1/Course%20Documents/ENV%20444%20Module%20Four%20Case%20Study.pdf?ou=1750457

Quinton, A. (22 May 2023). *Lab-Grown Meat's Carbon Footprint Potentially Worse Than Retail Beef: Study Finds Scaling Up Production Using Existing Processes Highly Energy-Intensive.* UC Davis. https://www.ucdavis.edu/food/news/lab-grown-meat-carbon-footprint-worse-beef

Tallmadge, K. (2013, July 11). GMOs are a grand experiment on health, environment. *LiveScience*. https://www.livescience.com/37862-gmo-health-environment-concerns.html

The Economist. (2015, February 14). *Milking taxpayers; Farm subsidies*. 414(8925), 26(US). https://link.gale.com/apps/doc/A401270932/OVIC?u=nhc_main&sid=bookmark-OVIC&xid=b9ef2a7e

Tomson, B. (2015, February 6). *Politico Pro: USDA to cut off farm subsidies to city slickers*. Retrieved from https://www.politico.com/story/2015/02/usda-city-farm-subsidies-114955

U.S. Department of Agriculture. (n.d.). The farm bill. United States Department of Agriculture. https://www.usda.gov/farmbill