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Reconsidering the Industrialization of Agriculture

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Keynote Address†

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Most agricultural production in the United States occurs on large commercial farms that employ an industrialized model of production. Increasingly, the industrialized model is being adopted in, or in some cases imposed on, other countries. What is this model, and how do we assess its performance? What problems cloud its long-term success?

The industrialized model focuses on both economies of scale and on the application of an industrial manufacturing model to an agricultural setting. Industrialized farming seeks to capture increased profitability through the standard incidents of the industrial model. It is characterized primarily by three attributes: first, by the large scale production of a specialized and uniform product; second, by the use of technology to achieve increased production, decreased per unit production costs, and product uniformity; and third, by vertical integration, with processor control over all stages of production. In crop production, these characteristics are reflected in large farms: the cultivation of one crop or with minimal crop rotation; the use of large,

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specialized farm equipment; and a reliance on chemical and biological technology, including chemical fertilizers, pesticides, and specialized seed. Vertical integration is evidenced by concentrated control over inputs, concentrated markets for commodity sales, or more directly, by production contracting.

In livestock production, industrialization is reflected in the intense raising of a single species of animals in very close confinement. Product uniformity is ensured through limited genetic diversity and targeted breeding for exaggerated characteristics. Breeding, feedstuffs, production techniques, facilities, and growth enhancement techniques all involve reliance on advanced technology. Concentrated markets reflect evidence of vertical integration in the production of all livestock species, although poultry production provides the clearest example of such integration, with all aspects of production controlled by the poultry processor.

Firms called integrators own hatcheries, processing plants, and feed mills. Integrators then contract with farmers to "grow out" broiler chicks to market weight and to produce replacement breeder hens for hatcheries. Under a production contract, the integrator provides the farmer/grower with chicks, feed, and veterinary and transportation services, while the farmer provides labor, capital in the form of housing and equipment, and utilities. The birds are sent to slaughter after five to nine weeks on the farm, and the farmer is paid for the growing services provided.[1]

The main goal of industrialized agriculture is increased production.[2] Considering this single goal, the USDA Economic Research Service data indicate unparalleled success.

> Gains in productivity have been a driving force for growth in U.S. agriculture. The effects of these changes over the second half of the 20th century were dramatic: between 1950 and 2000, the average amount of milk produced per cow increased from 5,314 pounds to 18,201 pounds per year, the average yield of corn rose from 39 bushels to 153 bushels per acre, and each farmer in 2000 produced

1 JAMES M. MACDONALD & WILLIAM D. MCBRIDE, ECON. RESEARCH SERV., U.S. DEP'T OF AGRIC., EIB-43, THE TRANSFORMATION OF U.S. LIVESTOCK AGRICULTURE: SCALE, EFFICIENCY, AND RISKS 6 (2009), *available at* http://www.ers.usda.gov/Publications/EIB43/EIB43.pdf.

2 G. TYLER MILLER & SCOTT SPOOLMAN, LIVING IN THE ENVIRONMENT: PRINCIPLES, CONNECTIONS, AND SOLUTIONS 279 (16th ed. 2009).

> on average 12 times as much farm output per hour worked as a farmer did in 1950.[3]

There are, however, significant problems that are not reflected in these positive numbers. First, there are environmental problems associated with such intense production. Given industrialized agriculture's highly consumptive nature as well as its negative effect on the environment, maintaining industrialized production at current levels may well be unsustainable.

In addition, however, there is a fundamental economic problem associated with the widespread adoption of the industrial model. This problem concerns the true cost of this increased production and the failure of the price of the goods produced to reflect the societal costs incurred.

Underlying both categories of environmental and economic problems is the inherent difficulty applying a model developed for the manufacturing sector to agricultural production. Agriculture is not manufacturing. It is the production of a living product through reliance on natural processes. Simply put, it is a different thing to grow a living plant or animal than to manufacture an inanimate object. The products themselves are part of our overall ecosystem. Moral and ethical responsibilities are evoked. Furthermore, production itself is dependent on natural processes.

For example, it is often said that nature favors diversity, yet industrialization represents the exact opposite approach. All efforts are made to eliminate diversity in production. The product is standardized and replicated in exact form, in as many multiples as can be created. Natural processes are to be controlled and modified for improved efficiency. The intense specialization that is key to the industrial model—making a lot of one identical product—runs counter to the forces of nature, which rely on nonindustrial attributes such as genetic diversity and crop rotation for natural sustainability. It is no surprise that nature has reacted strongly against some of the main tenets of industrialized production. Pests attack monocultural crops with increased ferocity; insects and plant pests develop resistance to pesticides; bacteria develop resistance; and disease threatens animals raised in stress and close confinement.

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3 KEITH O. FUGLIE, JAMES M. MACDONALD & ELDON BALL, ECON. RESEARCH SERV., U.S. DEP'T OF AGRIC., EB-9, PRODUCTIVITY GROWTH IN U.S. AGRICULTURE 1 (2007), *available at* http://www.ers.usda.gov/publications/EB9/eb9.pdf.

Rather than refine our approach and recognize that a pure industrialized model works against nature, we have reacted with increased reliance on technological fixes for the problems that arise. Chemical inputs replace depleted soil nutrients. New and more powerful pesticides are applied to combat animal and plant pests that have become resistant to the old pesticides. Antibiotics are used extensively in livestock production, not just to treat disease but as a preventative measure. There is a new and ever faster moving technological treadmill, with new chemicals and biologics constantly in need.[4] Short-term fixes may be found, but there is much to suggest that we are losing the battle in the long run. A production system that runs counter to the natural processes on which it ultimately depends will always face serious challenges.

As Michael Pollan noted in his widely circulated article *Farmer in Chief*:

> [C]hemical fertilizers (made from natural gas), pesticides (made from petroleum), farm machinery, modern food processing and packaging and transportation have together transformed a system that in 1940 produced 2.3 calories of food energy for every calorie of fossil-fuel energy it used into one that now takes 10 calories of fossil-fuel energy to produce a single calorie of modern supermarket food. Put another way, when we eat from the industrial-food system, we are eating oil and spewing greenhouse gases. This state of affairs appears all the more absurd when you recall that every calorie we eat is ultimately the product of photosynthesis—a process based on making food energy from sunshine. There is hope and possibility in that simple fact.[5]

It should not be surprising that an agricultural system that works against nature, rather than in concert with it, is associated with environmental problems. The intense production associated with industrialized agriculture is increasingly recognized for its environmental degradation. The contamination of surface and ground waters, the depletion of fresh water sources, soil erosion, habitat loss, and air pollution are all problems that have been linked to concentrated and intense agricultural production.

Similarly, the contributions of agriculture to global climate change are well documented and significant. It is estimated that agricultural production represents 8.6% of the United States' total greenhouse gas

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4 *See* Richard A. Levins & Willard W. Cochrane, *The Treadmill Revisited*, 72 LAND ECON. 550 (1996).

5 Michael Pollan, *Farmer in Chief*, N.Y. TIMES MAG., Oct. 12, 2008, http://michaelpollan.com/articles-archive/farmer-in-chief/.

emissions, eighty percent of U.S. nitrous oxide emissions, and thirty-one percent of U.S. methane emissions.[6]

Additionally, industrialized agriculture has had social ramifications that are widely recognized, but not easily quantified.

> Although the number of farms with hogs dropped over 70 percent from more than 240,000 in 1992 to fewer than 70,000 in 2004, the U.S. hog inventory remained stable at about 60 million head. Thus, hog production consolidated considerably during this period as fewer and larger farms accounted for an increasing share of total output.[7]

These statistics hide the loss of income to small and mid-sized farms, the collapse of many of those farms, and the loss of economic vitality to the rural communities where those farms were located.

Considering the environmental costs and the social costs, why is industrialized agriculture our agricultural model of choice? The answer is that industrialized agriculture produces cheap food at a significant profit. However, a full consideration of the source of its profitability must be undertaken.

There is clear economic efficiency associated with the economies of scale of larger farming operations. Under any business model, such efficiencies are recognized and reflected in the market. Similarly, a variety of technologies offer opportunities for increased production at a reduced cost. And, as vertical integration minimizes certain risks and allows a company to capture its supply and its market, it offers an opportunity for increased profits for the company.

The profitability of industrialized agriculture, however, is more complex. It is buoyed by a host of external costs that are borne by society but not passed on to the sector or incorporated into the cost of production. And, in addition, it is enhanced both directly and indirectly by government policies that focus only on the value of increased production. Given that economic efficiency is the rationale that underlies the industrialized model, it is imperative that these artificial influences be adequately considered.

The significant environmental costs associated with industrialized agriculture are often economic externalities, that is, costs that are not

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6 U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 71 (Thomas R. Karl et al. eds., 2009), *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

7 Nigel Key & William D. McBride, *Technology, Larger Farm Size Increased Productivity on U.S. Hog Farms*, AMBER WAVES, Apr. 2008, at 16, 18, *available at* http://www.ers.usda.gov/AmberWaves/April08/PDF/USHogFarms.pdf.

reflected in the marketplace.[8] Externalities such as pollution impose costs on others without being factored into the economic model or the decision making of the industry; they are costs that are not reflected in the per-unit price of the goods produced.

Industrialized agriculture provides numerous examples. The environmental cost of the dead zone in the Gulf of Mexico is not factored into the cost of the commodity crops grown in the upper Midwest, even though the fertilizer runoff from those crops is a direct cause.[9] Soil fertility loss and topsoil erosion are not reflected in the price of monocultural row crops, even though we are losing soil at a rate ten times greater than soil can be replenished. The impact of antibiotic resistance is not included in the cost of meat production, even though experts warn of significant public health concerns. All of these costs are associated with the basic tenets of industrialized production, but they are not considered in the economic analysis of the overall model. They are externalities with costs spread throughout society over the long term and not factored into the cost of production.[10]

In addition to the failure of the government and the marketplace to account for external costs, industrialized agriculture has also benefited from governmental policies that have long focused almost exclusively on the goal of increased production. Increased production lowers the cost of food domestically, providing cheap food for consumers. Additionally, it increases our exports, easing the United States' trade deficit. Government has, in effect, an economic incentive both to ignore external costs and to enhance the profitability of

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8 *See, e.g.*, DOUG GURIAN-SHERMAN, UNION OF CONCERNED SCIENTISTS, CAFOS UNCOVERED: THE UNTOLD COSTS OF CONFINED ANIMAL FEEDING OPERATIONS (2008), *available at* http://www.ucsusa.org/assets/documents/food_and_agriculture/cafos-uncovered.pdf (examining the hidden cost of concentrated animal feeding operations as well as the government policies that favor this production method and advocating for alternative production methods). *See also* PEW COMM'N ON INDUS. FARM ANIMAL PROD., PUTTING MEAT ON THE TABLE: INDUSTRIAL FARM ANIMAL PRODUCTION IN AMERICA (2008), *available at* http://www.ncifap.org/_images/PCIFAPFin.pdf (identifying problems created by concentrated animal feeding operations involving public health, the environment, animal welfare, and rural communities).

9 David Biello, *Fertilizer Runoff Overwhelms Streams and Rivers—Creating Vast "Dead Zones,"* SCI. AM. (Mar. 14, 2008), http://www.scientificamerican.com/article.cfm?id=fertilizer-runoff-overwhelms-streams.

10 *See, e.g.*, J.B. Ruhl, *Farmland Stewardship: Can Ecosystems Stand Any More of It?*, 9 WASH. U. J.L. & POL'Y 1, 9–10 (2002) (discussing pollution problems associated with U.S. agricultural production).

industrialized agriculture, shifting costs and long-term problems aside. Common problems with this approach include:

- Farm subsidies have consistently rewarded large landowners, with larger industrialized farming operations reaping the most benefit. The USDA acknowledges this reality in its assessment of the federal farm program funds: "Among recipients, payment levels increase with production levels, and so payments disproportionately go to farm households operating larger farms, with their higher average incomes and wealth."[11]
- Federal farm programs have specifically encouraged the production of commodity crops used for livestock feed, most notably corn. The majority of the corn produced in the United States is used for livestock feed,[12] making industrialized livestock operations economically viable and undercutting pasture-based livestock farming.
- Government loan programs have been important in the shift to industrialized contract farming in the livestock industry. In an industrialized system, farmers invest significant amounts of money in livestock facilities in order to obtain a production contract with the processor. Many of these investments, however, are based on short-term contracts that are fraught with risk. Government lending policies have, nevertheless, encouraged the shift to production contracting. Particularly in the poultry industry, government-guaranteed USDA loan programs have long provided loans for contract poultry operations when the financial projections would not support a commercial loan.
- Industrialized agriculture is not subject to the same environmental regulations as its role model, the manufacturing industry. Therefore, environmental costs are not factored into production costs.
- Government incentive programs have been developed to provide government funds for cost-share and remedial cleanup of

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11 CAROL A. JONES, HISHAM EL-OSTA & ROBERT GREEN, ECON. RESEARCH SERV., U.S. DEP'T OF AGRIC., EB-7, ECONOMIC WELL-BEING OF FARM HOUSEHOLDS 4 (2006), *available at* http://www.ers.usda.gov/publications/eb7/eb7.pdf.

12 *Briefing Rooms: Corn*, ECON. RESEARCH SERV., http://www.ers.usda.gov/Briefing/Corn/ (last updated Sept. 23, 2010).

environmental contamination. The cleanup is good for the environment, but the incentives skew the market by effectively rewarding pollution.

- Lax regulation with respect to food safety and animal welfare regulations have also encouraged industrialization. Federal and most state animal welfare laws exempt livestock production from coverage even when the intense confinement comes under welfare scrutiny.[13] Agricultural operations are allowed to use a wide variety of antibiotics in non-therapeutic use, including antibiotics used in human medicine, despite worldwide public heath concerns.[14] Without these antibiotics, the close confinement could not be sustained.[15]

The United States, as a model of agricultural success, exports its methods and models throughout the world by example, by foreign assistance, and through its multinational corporations. This makes analysis and use of the industrialized model even more critical.

In 2009, the *New York Times* reported on Smithfield's aggressive entry into the Eastern European hog market, stating that "[i]n less than five years, Smithfield enlisted politicians in Poland and Romania, tapped into hefty European Union farm subsidies and fended off local opposition groups to create a conglomerate of feed mills, slaughterhouses and climate-controlled barns housing thousands of hogs."[16] Serious environmental problems, a devastating swine fever outbreak, and a dismantling of the traditional rural economy were reported. In Romania, the number of hog farmers declined ninety percent from 2003 to 2007, from 477,030 in 2003 to 52,100 in 2007.[17] "In Poland, there were 1.1 million hog farmers in 1996. That number fell 56 percent by 2008 . . . ."[18] Reduced pork

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13 *See* Nancy Perry & Peter Brandt, *A Case Study on Cruelty to Farm Animals: Lessons Learned from the Hallmark Meat Packing Case*, 106 MICH. L. REV. FIRST IMPRESSIONS 117, 118–19 (2008), *available at* http://www.michiganlawreview.org/assets/fi/106/perrybrandt.pdf.

14 *See* GEOFFREY S. BECKER, CONG. RESEARCH SERV., R40739, ANTIBIOTIC USE IN AGRICULTURE: BACKGROUND AND LEGISLATION (2010), *available at* http://www.nationalaglawcenter.org/assets/crs/R40739.pdf.

15 *See id.* at 4.

16 Doreen Carvajal & Stephen Castle, *A U.S. Hog Giant Transforms Eastern Europe*, N.Y. TIMES (May 6, 2009), http://www.nytimes.com/2009/05/06/business/global/06smithfield.html.

17 *Id.*

18 *Id.*

prices benefit consumers but put farmers in local and in export markets out of business. What is the true price for this cheap pork? "In Eastern Europe, as in American farm states where Smithfield developed its business strategy, the question is whether the savings are worth the considerable costs."[19]

As we consider the food needs of an increased global population that is facing the effects of climate change and the reality of finite natural resources, it is imperative that all models of agricultural production be evaluated honestly and accurately. Environmental and social costs should be considered as parts of the cost of production, and sustainability—as opposed to short-term productivity—should be the measure of success. A sustainable system should work with, rather than against, natural processes. Technology should enhance, rather than replace, these processes. Government policies should favor only those models that meet these long-term tests.

Industrialized agriculture has brought us short-term bounty and long-term concerns. Looking at its true costs with its benefits is the only way that its efficiency can truly be assessed. If industrialized agriculture is not assessed, in the long run environmental problems and limited natural resources may well provide their own limitations, much to our detriment.

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19 *Id.*