

# “FARMING”—

## *It's Declining In the U.S.*

by Stew Smith

> For sixty years farm numbers have declined as “larger farms” absorbed “smaller farms.” Some people were comforted that most exiting farmers sell to neighbors who continue the farms. But the land resources were used differently. Farms became more specialized as they became larger. Larger amounts of nonfarm inputs were substituted for inputs provided by farmers. Thus, “farming”—the value added by farmers—declined. And recent projections of biotechnology developments suggest that the trend may accelerate. Technology is, in fact, the key force driving the shift of farm activities off of the farms. This relationship suggests that if this country wants to maintain farming, publicly funded research of technologies that enhance farmers’ value-added activities must be increased. Else the 80-year trend line of reduced farming activities will continue.

**T**he role of farmers in U.S. agriculture has shrunk dramatically in recent years and the trend may accelerate. Admittedly, many of the resources controlled by people leaving farming have tended to be consolidated into larger farms. However, this phenomenon has tended to obscure a reality—the secular and persistent decline in the economic contribution of all farmers on all of their farms. Over time, nonfarm entities—fertilizer manufacturers, researchers, petroleum refiners, drug manufacturers, and others—found that they could produce inputs that farmers would purchase.

And so farmers sold their work-horses, quit growing oats to feed them, and purchased machinery, petroleum, and chemicals. Similarly, marketing, processing, and distribution resources took over activities that were once performed by farmers on farms and by consumers in their homes.

### Farming Defined

Agriculture consists of three sectors. Farming is one. The input sector—suppliers of fertilizers, machinery, seed, and other goods and services to farmers—is also part of agriculture as is the mar-

keting sector—processors, distributors, transporters and retailers among others.

Most everyone agrees that farming has been altered substantially over the years. There is less agreement, however, on how best to define and measure that alteration. One approach is to divide the combined goods and services produced by all three subsectors of agriculture into the value added by each of the three subsectors. That is the approach that I used to develop the estimates presented here.

Figure 1 shows the contribution of each of the three subsectors of agriculture. From 1910 to 1990 the share of agriculture contributed by farmers dropped from 21 percent to 5 percent. The share provided by farm input processors, distributors, and marketers increased from 13

percent to 30 percent; the marketing subsector share remained about 65 percent.

These estimates provide useful insights into what has been happening. For example, when we were told that all those farmers moved off the farm because farmers were getting more efficient and society didn't need as many farmers any longer, we were told only half the truth. The whole truth would have also stated that much activity performed by exiting farmers was being absorbed by nonfarmers, primarily in input supplying firms.

Tractors, replacing animal power, and pesticides, replacing crop rotations and mechanical tillage, are obvious examples of farming activities moving off the farms. The concept, however, also applies to practically all technologies adopted by farmers in this century. The likely adoption of bST is a current example. Marion suggests

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that bST adoption will lead to increased nonfarm activity and costs equivalent to one third of the drop in farm activities associated with bST adoption.

Another insight is gained by extending the trend line of farming loss, as shown in figure 2. It suggests an agricultural system with no farming activity around the year 2020, a possibility discussed later.

### Farm-Nonfarm Shift

Understanding technology and how it is employed in farming, are key to understanding the secular decline in the contribution of farmers. Most technologies adopted by farmers result in a shift of activity from the farm to either or both of the two nonfarm subsectors. Farm returns per unit of farm production decline. Often, farmers are left with excess management capacity. For example, as farmers adopted pesticides during the past forty years, the need to rotate crops and mechanically till dropped sharply simplifying management requirements. Commercially purchased fertilizers allowed crop farmers to discontinue animal enterprises, simplifying farm operations, but not necessarily increasing farm efficiencies.

The marketing side offers similar examples. Maine farmers used to pack their own potatoes. Now many deliver their potatoes to a central packing shed or food processor. Relieving farmers of these activities allows them to focus more of their capital and management capabilities on producing commodities, but at a reduced margin since they are getting rewarded for less activity per unit of production. Farmers who adopt technologies that simplify management usually expand production to utilize their newly gained management capacity and offset lost margins. They will expand as long as their net return from doing so is positive. Limits are imposed by their management capacity, limitation on the acquisition of capital or costs.

In these cases, farmers do not expand in order to reduce out-of-pocket costs for fertilizers and other inputs or even to reduce per unit fixed costs. Rather they expand in order to reduce their opportunity costs, primarily the costs of applying their own labor, management and capital to their farm rather than to alternative uses, by spreading them over a larger quantity of production. They will expand even as their explicit costs, both fixed and direct, increase as long as their opportunity costs per unit decrease sufficiently. The private, but well distributed, annual Northeast Farm Surveys from the Farm Credit Banks of Springfield demonstrate this phenomenon. For example, the 1990 Dairy Farm Survey shows that the smallest sized herds are the most efficient in terms of explicit costs. However, when opportunity costs including an allowance for nonfarm wages foregone when working on the farm are included, the larger farms are more efficient. In terms of transforming inputs to outputs, society would be better off with the smaller farms, provided those farmers could use their excess management capabilities and labor in activities other than commodity production.

Since the inception of land grant universities (LGUs) and more recently since the publication of the Hightower book, *Hard Tomato, Hard Times*, critics and defenders of LGU research have debated the impacts of technology on the farming subsector. Critics charge that LGU research is biased towards larger farms. In contrast, defenders argue their technologies are scale neutral and that larger farms simply have better managers more attuned to adoption.

**Figure 1 - Component Shares of Agricultural System**

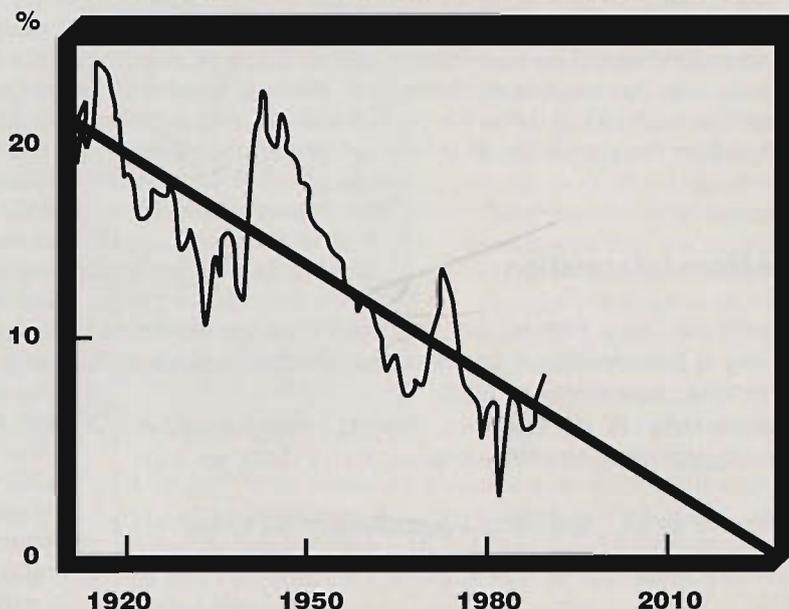


Both sides have it wrong. LGU research is not directly scale biased. Instead, it is sector biased. Most agricultural research leads to more nonfarm activity at the expense of farming activities. This shift from farm to nonfarm reduces returns to farmers to cover opportunity costs and requires farmers to either increase production or utilize their excess management and labor in nonfarm pursuits. Indirectly the technology results in fewer and larger farms (in terms of commodity production) and more part time farms, but the direct cause is the sector bias. The scale bias is an indirect outcome.

### Policies Erode Farming

Since technology is the key force driving the shift of farm activities off of the farms, it is important to understand the forces that drive technology adoption by farmers. Farmers adopt technologies because they are available and they are profitable to adopt.

**Figure 2 - Farm Share Trend Line**



The research system, public and private, determines the availability of technology. With respect to sector impact, both public and private research organizations develop similar technologies. These technologies, with only a few exceptions, have shifted activities away from farms. This outcome has been driven by two forces: first, the source of public research funding and second, the revolving door for research scientists.

Despite the preponderance of public funding, public research is strongly influenced by private funding. As universities feel squeezed by diminished funds from the public sector, they rely on monies from the private sector. Many LGUs are willing to participate with private firms in developing products and processes that can be privatized by patents and other legal protections. Biotechnology, with its ability to engineer materials that can be protected as private property, will likely lead to increases in the amount of privatized research undertaken in public institutions and have a substantial influence on the LGU research agenda. Privatization is also promoted by the close professional relationships between LGU faculty and private sector scientists. These often become stronger than the professional relationships between LGU faculty and farmers.

Thus, LGU researchers influenced by private firms significantly affect which technologies become available. However, farmers decide which technologies to adopt. Farmers adopt technologies to increase their net returns. Net returns are influenced by a number of factors including the prices of output, prices of inputs, production and market risks, transactions costs and certain tax liabilities, as well as knowledge and information about production technologies and markets. These, in turn, are affected significantly by public policies, including commodity programs, input subsidies, tax policy and technical assistance. These policies currently encourage farmers to adopt technologies that result in more specialization and purchased inputs and less farming activity.

My students recently examined the case of a dairy farmer who resisted expanding his production as a means of increasing his net income as advocated, in his view, by the public agencies. Instead, he initiated a rotational grazing program to displace much of his purchased concentrate feeds. DHIA records show that he maintained his production, halved his purchase of grain concentrates, and added nearly 25 percent to his net income from farming. In this case rotational grazing was competitive with conventional concentrate feeding and casual evidence suggests it may represent a general case. There is also evidence that rotational grazing is incompatible with bST. If that is the case general adoption of bST will foreclose the possibility of general adoption of rotational

grazing. Adoption of bST will result in substantially less farming activity and more nonfarm activity, whereas a significant shift to rotational grazing could result in more farming with no increase in the cost of producing milk.

Those interested in maintaining farming activity should ask what the outcome would have been if the money spent on bST research had been spent on rotational grazing research. Might researchers have found legumes and handling systems that made rotational grazing even more efficient? My guess is that rotational grazing would be very competitive and such research would have contributed to more farming and more farms.

It is no mystery why that alternative research was not conducted. There was no private sector to contribute funds to public research or to conduct its own research. But if there is a societal objective of maintaining farming, farms, and farming communities, we should have devoted public research to that alternative technology. This also suggests that if we want to maintain farming, publicly funded applied research on technologies that enhance farmers' value added activities must be increased.

While it may seem ludicrous to suggest that there will be no farming in the agricultural system after the year 2020, or thereabouts, the notion is not totally far fetched. Biotechnology will likely become dominant in the coming decades and will drive activities from the farm to the nonfarm sector at an increased rate. Biotechnology holds

the promise of non-soil based agriculture, the underlying technique being the economic decomposition of biomass into constituent components for use as inputs to food manufacture.

Rogoff and Rawlins, biologists and U.S.D.A. research administrators, provide the scientific basis for one such system. They visualize a three step system for which the technology will be available early in this decade. Their system requires the reduction of biomass feedstocks into syrups by enzymes, which are on the verge of availability; the production of major food components in vitro, providing the system efficiency since it produces no wasted plant material and can be located near markets; and the conversion of these components to aesthetically acceptable foods similar to the current biotechnical production of physiologically active peptides and proteins for nonfood use. They project this system will reduce farming activities by 88 percent.

Goodman, Sorj and Wilkinson conceptualize the economic structure of a similar system where biomass production feeds extraction factories which decompose plant material into component parts that supply food and drug manufacturers. With those manufacturers closely aligned with plant breeders and input suppliers, crops will be engineered for use by specific manufacturers, an arrangement also suggested by Urban in a recent edition of *CHOICES*. The farming component will require very little activity, primarily reseeded perennial crops occasionally and providing harvesting services if the extraction factory chooses not to do so itself. It would not provide adequate value added activity to support a system of substantial numbers of full time farmers.

Without substantial alteration of an array of agriculture policies, particularly technology development, the 80 year trend line of reduced farming activities will continue.

Biotechnology being developed today with the support of the LGUs will lead to a more industrialized system, with most farming activity conducted by part time farmers and nonfarm firms performing much of the production activity away from the soil. Full time, family-owned and managed farming, as we have known it, will cease to exist. 

## ***Most agricultural research leads to more nonfarm activity at the expense of farming activities.***

### **For More Information**

Goodman, David, Bernard Sorj, and John Wilkinson, *From Farming to Biotechnology: A Theory of Agro-Industrial Development* (Oxford: Basil Blackwell, 1987).

Rogoff, Martin H. and Stephen L. Rawlins, "Food Security: A Technological Alternative," *Bio Science*, 37(11)(1987), pp. 800-807.

Urban, Thomas, "Agricultural Industrialization: It's Inevitable," *CHOICES* 6(4) (Fourth Quarter 1991), pp. 4-6.