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## Minnesota Milk Production: Fewer, Bigger Farms Expected to Come

Jerome W. Hammond

Highly volatile milk prices and production levels have characterized Minnesota's dairy industry throughout the decade. Both characteristics are likely to continue for the foreseeable future and have major implications for producers, especially smaller dairy farmers.

The variability of monthly Minnesota milk prices for the past 10 years is shown in figure 1. Annual price variations ranged from about \$2/cwt in earlier years to more than \$6/cwt in recent years. Milk prices set an industry record early this year when prices fell in two months from \$19/cwt in December to \$13.50/cwt in February. This decline translated into a 30 percent reduction in gross income for most dairy farmers.

Industry observers aren't surprised by the price swings over the past several months. The drop was generated by increased milk production in several of the major milk producing states, especially California, Wisconsin, and Minnesota. This increase was encouraged by very high milk prices and very low feed prices in 1998. However, the jump in milk prices this summer is expected to be short lived.

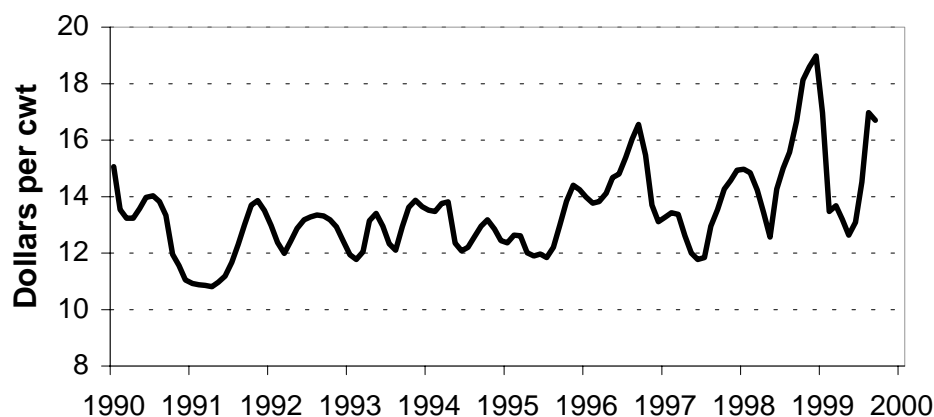
If production continues to increase at recent rates, low milk prices will return and the price of milk for manufacturing use could approach the federal price support level. This will lead to higher herd culling because it will no longer be profitable to retain low producing cows. This will lead to even more Minnesota dairy farmers leaving the industry. (They might remain in crop farming.)

Over the past 30 years, whether milk prices are rising or falling, the number of dairy farms in Minnesota has declined (figure 2). Since 1993, the number of

dairy farms in the state declined at an average annual rate of 6.4 percent. This

(See *Milk Production*, page 2)

Figure 1. Minnesota milk prices from 1990 to present



## How Do Economists Value the Environmental Effects of Livestock Production?

Carl V. Phillips

The state of Minnesota recently commissioned a large literature review on the physical, societal, and economic effects of animal agriculture in the state. The literature review is intended to serve as a basis for a large-scale Generic Environmental Impact Statement (GEIS) on the subject. A GEIS, as spelled out under Minnesota law, is supposed to examine the cumulative effects that a

series of incremental decisions, such as the permitting of feedlots, may have on the environmental well-being of the state.

This article draws from our contribution to the GEIS and outlines some of

(See *Livestock* page 3)

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decline in farm numbers, however, hasn't resulted in a similar drop in milk production. The number of cows declined at an average annual rate of only 2.8 percent over the same period—and even that decline was offset by a 1.2 percent increase in the annual average milk production per cow. Thus, although Minnesota has fewer and fewer dairy farms, it produces about the same amount of milk as in the past.

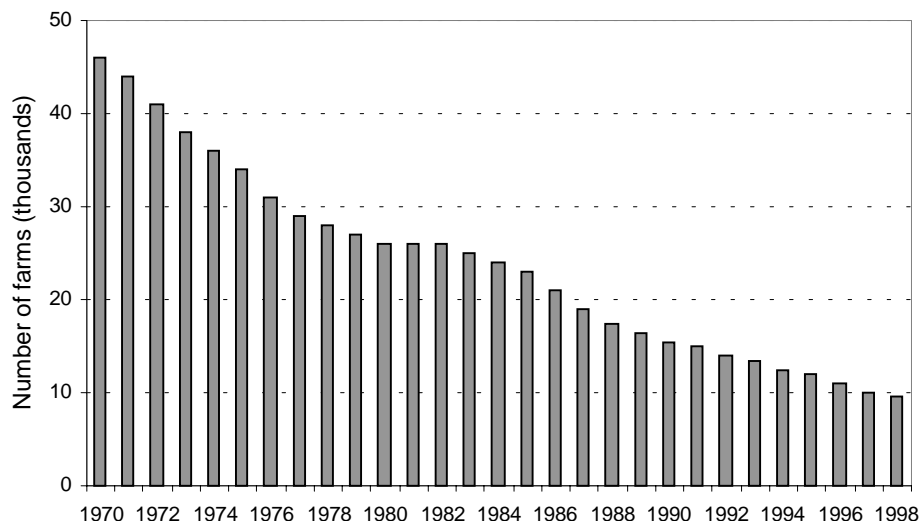
Figure 3 shows in more detail what's been happening over the past five years, and what I project for 2005. It's the smaller farms (measured by the number of milking cows) that are disappearing the fastest. Since 1993, the number of farms with 1 to 29 cows declined at an average annual rate of 13.5 percent and today account for only 16.5 percent of all dairy farms. At the other extreme, farms with more than 200 cows, which currently account for 3.1 percent of all farms, increased by 33 percent annually during the period 1993–98.

The distribution of milk production by herd size (figure 4) highlights the growing importance of farms with larger herds. In 1998, farms with 200 or more cows produced 17.8 percent of the state's milk—even though they account for only 3.1 percent of the total number of dairy farms. Conversely, in 1998 the 16.5 percent of farms with fewer than 30 cows accounted for only 4 percent of the state's milk production.

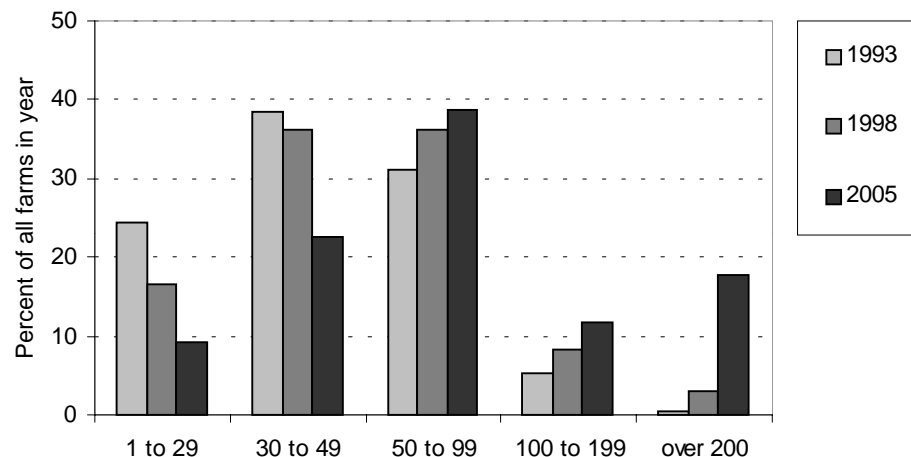
This disparity in per-farm production also stems from the higher milk productivity per cow on larger farms. I don't show it here, but the average annual milk production per cow is lowest on farms with fewer than 30 cows (11,600 lbs. of milk per cow per year); on farms with more than 100 cows, per-cow milk production increases to over 18,000 lbs. per year.

In the projections for the year 2005 (figures 3 and 4), I've based my calculations on the changes during 1993–98. My calculations show that the total number of dairy farms will decline from 9,700 today to about 7,300 by 2005. The number of farms with fewer than 50 cows will decline to 32 percent of the total, while 18 percent of the state's farms will have 200 or more cows. Though continuing to decline in number, farms with 50 to 99 cows will still

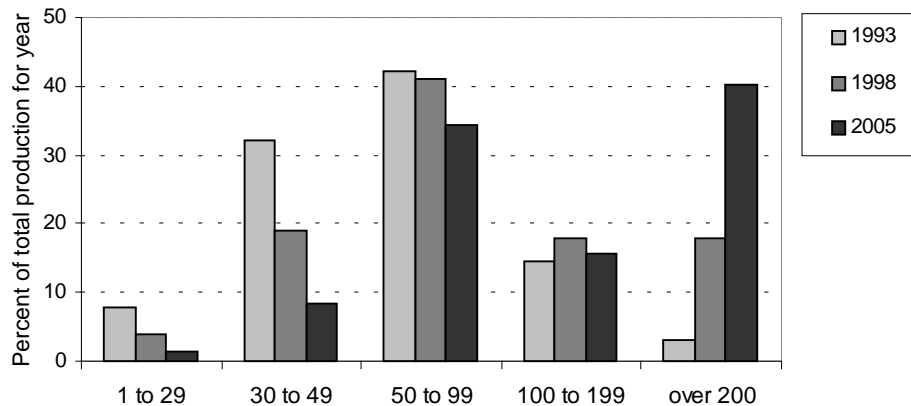
**Figure 2. Number of dairy farms in Minnesota, 1970–98**



**Figure 3. Herd size as a percentage of all Minnesota dairy farms**



**Figure 4. Minnesota milk production by herd size**



account for about one-third of the total number of dairy farms in Minnesota.

Other projections for 2005 suggest that while total milk production for the state will hold stable at about 9 billion lbs., important shifts will occur in the percentage of milk production contributed by each farm size group (figure 4). In 2005, because of larger numbers of farms with more than 100 cows and because of higher productivity on larger farms, 56 percent of the state's milk will be produced on these farms. By 2005, only about 10 percent of the state's milk will come from farms having fewer than 50 cows.

Unless we see a return to high levels of federal price protection, Minnesota dairy farmers will continue to face highly volatile milk prices. This will encourage producers to use pricing strategies to reduce the impacts of adverse price changes. Such strategies may include long-term pricing contracts with milk buyers and direct use of futures markets for milk and dairy products. In addition, structural changes at the producer level will continue to change the industry from the small single-family enterprises with little hired labor, to partnerships of several families, and to large dairy enterprises with regularly employed non-owner workers.

Minnesota's future dairy industry will have fewer, larger producers with different business challenges than those faced by their predecessors. Communities will have to adjust, once again, to changes in their local agricultural economy.

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*Livestock, continued from page 1*

the factors to consider when placing an economic value on the environmental effects of animal agriculture. While we did find a number of economic studies that partially addressed this issue, we found none that did a complete job. In our view, any study of animal agriculture must examine both on-farm and off-farm economic systems. Our full study did so, but we focus here only on some of the off-farm costs and benefits that are not typically considered by livestock producers. The complete study, which includes our own findings about job and income effects, will be available on the Web at <http://www.mnplan.state.mn.us/eqb/geis/index.html>.

## Setting Dollar Values Is Important

In assessing the environmental impact of animal agriculture, how can we quantify some of those externalities—that is, attach dollar values to them? Quantification is important because virtually any policy or practice results in externalities, both positive and negative. But just how big are these externalities? And are they worth worrying about?

Externalities are defined as any impacts felt by people who are not party to a particular decision or transaction. For example, a farm has both internalized costs (purchases of inputs) and internalized benefits (from sale of outputs). But any farm management decision also results in external costs (for example, feedlot effluent that is not paid for) and external benefits (such as contributions to a worthwhile way of life).

Externalities are only one source of what economists refer to as “market failure,” conditions that prevent the “invisible hand” of market forces from resulting in maximum societal welfare. Were it not for external costs and benefits, the need for government intervention would be dramatically reduced and much of the concern that led the state to consider a GEIS in the first place would not exist.

So, how are externalities measured? Analyzing how an action leads to a measured cost or benefit follows two distinct and sequential paths: 1) the path from the action to some change in the physical world (such as an injury to the

environment); and 2) the path from the change in the physical world to a change in human well-being (such as a reduction in human health).

## Defining Real Costs

In assessing environmental impacts, it is important to distinguish between real costs (something that is totally lost to the world) and pecuniary costs (something that is related only to the movement of money around the economy).

Real costs include 1) the consumption of actual resources such as the land used in a production process, 2) capital goods used to produce other things people want, and 3) the time people devote to labor. Real costs also include someone's loss of happiness when, for example, an environmental amenity is destroyed—even if this does not show up in any direct financial or commercial transaction.

Real costs are pecuniary in the sense that they are often (but not always) measurable in terms of dollars. For example, the cost of labor, land, or other inputs is typically valued using the price paid. This is logical since the price paid can be thought of as that amount of money that is just high enough to bid the resource away from its next-most-valuable use. The value lost from the alternative use, as reflected in the purchase price, is the real cost that accrues to society from using the resource in this manner.

More concretely, when economists measure the real costs (or benefits) of a policy by looking at the flow of money, we recognize that real costs are properly measured as the *change* in consumer or producer surplus—where surplus is defined as the extra benefit or profit a buyer gets from something, over and above the resources he or she is spending.

For example, if you spend \$100 for a day of recreation that is actually worth \$300 to you, your consumer surplus is \$200 (that is, \$300 of worth minus the \$100 you actually spent). Your cost of not being able to enjoy that day would not be the whole \$300 but only the lost \$200 of surplus.

Similarly, if a farm makes an annual profit of \$1,000 on revenues of \$3,000, the producer surplus is \$3,000 in revenues minus \$2,000 in costs. How-

ever, if the farm goes out of business, the farmer's real loss is \$1,000, not \$3,000.

Let's look at another example. Imagine you are prevented (by a new government policy on apple consumption) from eating your one "apple a day." If you could buy an apple for \$1.00 but would have paid as much as \$1.40 for it, your consumer surplus is \$0.40. By keeping you from buying and consuming that apple, the government's new ban costs you \$0.40.

The amount you *actually* spend on the apple reflects neither the real benefit nor the real cost to you. If the producer spends only \$0.75 growing the apple and shipping it to you, then the producer surplus (profit) of \$0.25 is how much the new policy costs the producer. The other \$0.75 of your payment, the real cost of getting the apple to market, is actually now a savings to society since it now won't have to be spent in growing and shipping the now unobtainable apple.

Adding it all up, the government's (in this example, fictitious) ban on apples saves society \$0.75 but results in a net real cost of \$0.65—the sum of the \$0.25 loss of producer surplus and the \$0.40 loss of consumer surplus.

## Defining Local versus Non-Local Costs

Pecuniary costs and benefits, which reflect changes in total expenditures, are quite different from the real costs and benefits discussed above. Most pecuniary costs are "real" (in the colloquial sense) because someone makes less money, even if there is no real (in the economic sense) cost. Regional economic analyses look at the money flowing within particular boundaries. Geographic area is thus a critical parameter in determining whether or not a pecuniary cost is considered. For example, if a policy change results in a firm buying its supplies from the other side of the state rather than locally, there is a net (pecuniary) cost only if the area under study is the county. If the geographic unit under consideration is the state, however, the change in suppliers does not matter from a real cost accounting perspective.

So who decides the appropriate area of analysis? Sometimes it depends upon what it is we want to put a value on. If we are interested in the external costs of

global warming or increases in antibiotic resistance, say, looking only within the state is improper because most of the net effect is spread around the world. In contrast, policy changes such as increases in surface water pollution, increases in food-borne disease, or losses of recreational areas, are mostly felt within the state.

## Putting Numbers on Non-Use Values

Most economists agree that putting a value on something is tantamount to figuring out how much it is worth to someone. This, in turn, is tantamount to describing what a person would exchange for it. Certain costs and benefits are relatively easy to measure and identify such as the benefits consumers derive from the things they buy and the profits producers make from selling items to the consumer. Other benefits, such as those associated with environmental recreation or good public health, are more difficult to measure because they are not directly tied to a market.

Values that are not associated with any activity or observable state of being are known as "non-use values" and are particularly difficult to measure. Non-use values (such as the pleasure of knowing that wilderness exists or the unhappiness of knowing an ecosystem was injured) are important and should be quantified—even though the numbers we get are imperfect. If we are honest about the inevitable flaws in the numbers and careful about how they are derived, it is better to have imperfect numbers than no numbers at all.

A major problem with current environmental valuation methods is the widespread practice of taking information from one study and applying it to other contexts. This is known as *benefits transfer* analysis. It is commonly used when making policy decisions because the cost of making accurate benefit estimates is usually very high. Using benefit transfers, however, often results in misleading—if not outright incorrect—value estimates because errors in one study are frequently transferred to another.

In summary, all valuation methods are imperfect, but having *some* data is better than having *no* data—especially if we recognize (and are honest about) the flaws in our methodology.

## Quantifying the External Costs of Animal Agriculture

Some external costs of animal agriculture can be calculated using observed market mechanisms, such as the cost of treating certain illnesses or the extra costs of purifying drinking water, while other costs must be quantified indirectly because they involve non-market components concerning human welfare.

Injury costs to the natural environment include damage to aquatic ecosystems (from eutrophication and water removal), damage to terrestrial ecosystems (from land use), global warming (from carbon dioxide, methane, and other gaseous emissions), acid rain (from SO<sub>2</sub> and NO<sub>x</sub> deposition), and direct human-health impacts.

Measuring these impacts involves the dual challenge of quantifying environmental injury and determining how much of the injury is attributable to animal agriculture. Our thorough review of the existing literature suggests, unfortunately, that very little has been accomplished to date.

Although economists have, in some instances, identified a direct link between a particular agricultural practice and an adverse effect on human health, such studies are few and far between. Unfortunately, most studies have used *indirect* links and examined the path either from Point A (an agricultural action) to Point B (damage to the environment) or, instead, only from B to C (decrease in human welfare); few have gone directly and consistently from A to C.

## Human Health Issues

For the reasons discussed above, directly estimating the risk (or benefit) to human health and welfare of a particular agricultural practice is not an easy task. The best way to value these effects is first to have engineers or natural scientists estimate exposure levels and then have health scientists estimate how these translate into morbidity and mortality outcomes. From there we can use economists' measured valuations for morbidity and mortality.

Human health effects resulting from animal agriculture fall into three categories: 1) direct health effects as a

(See *Livestock* page 7)

# Crop Data Don't Reveal Much about Farmer Prosperity

Steven J. Taff

Heightened media concerns about the plight of Minnesota farmers are generally accompanied by claims that crop prices are at an all-time low. A glance at figures 5 and 6 shows that this is indeed true—if one looks only at inflation-adjusted prices. But so called “nominal” prices, those actually seen by buyers and sellers and not adjusted for inflation, tell a more complicated story.

Clearly, the market price of these two crop mainstays has fluctuated dramatically since 1970, demonstrating that the root cause of the “farm problem” is not low crop prices but rather price variability. The real challenge for farmers now, as it has always been, is how to take advantage of high-price periods, such as 1996–97, while minimizing the effects of low-price periods, such as 1998–99.

Even a correct assessment of crop data can mislead. For example, figures 7 and 8 point out the danger of too casual a use of production and price data as indicators of farm prosperity. These two figures demonstrate that neither price nor yield—the two most widely reported indicators of financial conditions on the farm—are especially good at that task. Not all periods of low prices or low yields are marked by low farm income. Furthermore, when prices or yields are high, farmers are not necessarily prospering (look at 1998, for example).

Two economic fundamentals are in evidence here. The first concerns simple farm economics. High prices and low yields frequently occur at the same time. Indeed, high prices often result from low yields, especially when crop shortfalls are widespread. Low yields can pull down the positive effects of high prices. The reverse is also true; high yields may produce moderate farm income when prices are low. This simple inverse relationship is sometimes forgotten when only one or the other measure is used to anticipate eventual farmer prosperity.

The second lesson highlights the role of government farm subsidies. While some subsidies are independent of crop yield or price (for example, the transition payments farmers will receive until

2002), others are inversely related to yield or price. This type of subsidy includes crop yield or revenue insurance and the discretionary (but often very much larger) federal disaster payments that Congress provides on an almost annual basis.

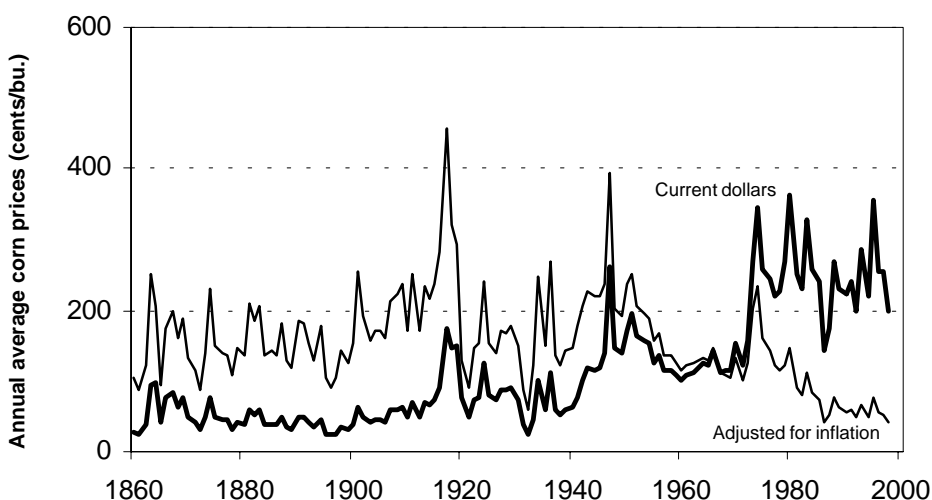
So, what is the outlook for farmers in Minnesota for the remainder of 1999?

Our farm management association

records for southwestern Minnesota show that federal subsidies added an average \$30,000 to members' net farm income in 1998. If 1999 ends up looking like last year (and current agricultural and economic indicators suggest that it will), net farm income in 1999 is going to depend as much on the actions of Congress as it will on widely reported, but frequently misleading, crop prices and yields.

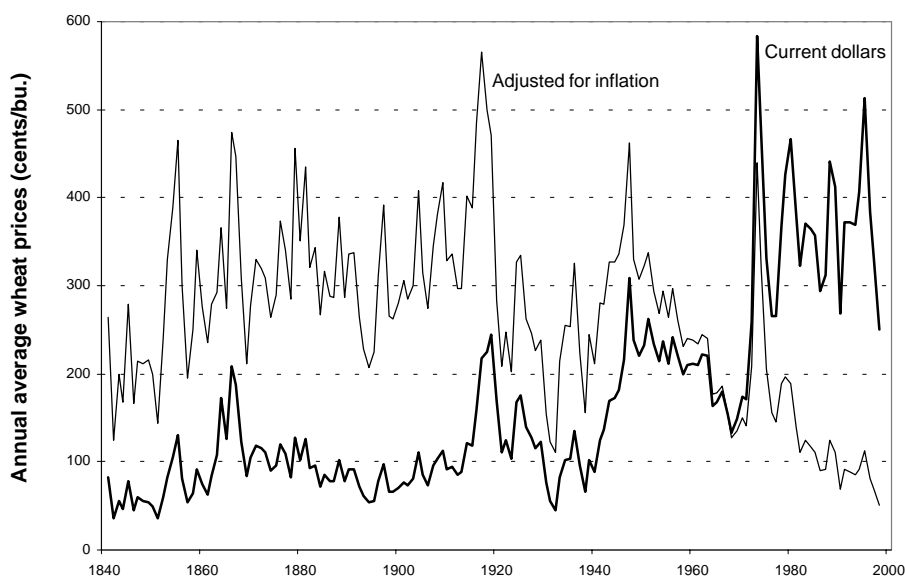
*Steven J. Taff is an associate professor and extension economist in the Department of Applied Economics, University of Minnesota.*

Figure 5. U.S. annual average corn prices



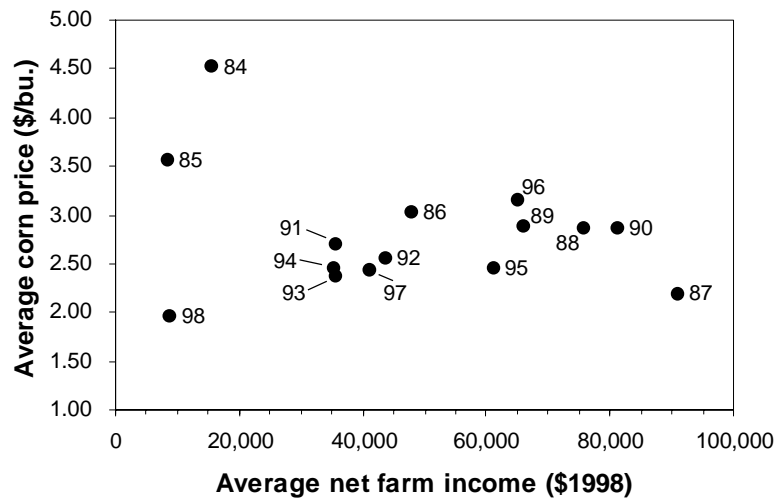
Source: Global Financial Data; inflation adjusted in 1967 dollars.

Figure 6. U.S. annual average wheat prices



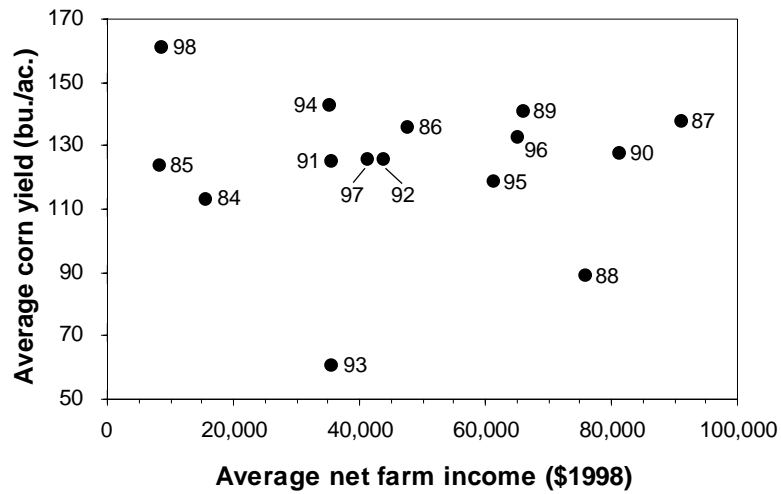
Source: Global Financial Data; inflation adjusted in 1967 dollars.

**Figure 7. Corn prices versus average net farm income for 1984–98**



Source: Southwestern Minnesota Farm Business Management Association.

**Figure 8. Corn yields versus average net farm income for 1984–98**



Source: Southwestern Minnesota Farm Business Management Association.

*Livestock*, continued from page 4

result of consuming animal products such as animal fat; 2) adverse health effects to those who work in animal agriculture; and 3) food-borne pathogens that affect the public at large. In what follows, we summarize what the issues are and where economic analysis might contribute something rather than simply list findings from actual studies. As we noted above, there simply aren't that many studies.

### **Consumption of Animal Fats**

To date, few studies have calculated the direct costs to human welfare of any increases in disease caused by consumption of animal products such as animal fat. In any case, these costs are largely internal (using the term in its economic rather than gastronomic sense) because the costs are borne by the consumer as a consequence of his or her own actions. To the extent that these food consumption-related diseases result in socially borne medical costs, there may be an externality—though there may be no real net cost because studies have shown that people who die prematurely actually reduce overall medical costs.

### **Occupational Health Effects to Agricultural Workers**

Exposure to occupational hazards by workers in animal agriculture probably accounts for a substantial portion of the non-dietary health impacts of the industry. These costs are also internal because the employee assumes these risks as part of his or her employment in the animal agriculture industry.

There is an external cost, however, in the unhappiness the public sometimes expresses about unpleasant and unhealthy conditions faced by agricultural workers. This is a legitimate external cost and should be quantified, but we found no study to date that has done so. Public dissatisfaction with the industry usually takes the form of making political statements in favor of protective regulations, buying products directly from farmer cooperatives, and similar behaviors.

### **Food-Borne Pathogens**

The costs to human health and welfare of farm-derived pathogens are similar to those described above in the "Consumption of Animal Fats" section.

Many of the costs of food-borne pathogens are internal to those buying the food but some costs are undoubtedly externalized in the form of increased public medical costs. Pathogens, in common with other types of farm effluent, produce external costs if producers sell contaminated products to the public and do not pay the cleanup costs, for example by reimbursing consumers for the medical expenses of treating their food-derived illnesses.

### **What Next?**

We hope we've shown in this article that placing an economic value on the environmental effects of animal agriculture is both important and feasible. Economic science has developed an impressive array of valuation techniques that could be brought to bear, given sufficient budgetary resources.

Proper economic analyses, of the sort we describe in this article, take time and money but the end results are well worth the effort; legislators and members of the public are better placed to make responsible and informed decisions about how best to increase the well-being of the people of Minnesota.

Unfortunately, this is an area of policy analysis where there are sizeable incentives to take shortcuts, do quick-take studies, or pull numbers out of studies done for other purposes. Such "efficiencies" could end up leading to worse public decisions than would no economic studies at all.

*Carl V. Phillips is an assistant professor in the School of Public Health, Division of Environmental and Occupational Health, University of Minnesota.*



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