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More production per cow, not less, is the most environmentally friendly strategy

By Dr. Jude Capper
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All food production systems have an environmental impact, regardless of whether the product eaten by the consumer is organic lettuce, ground beef, or prepackaged cupcakes. As the global population increases we need to produce more food, while minimizing effects upon the environment. When faced with a situation where we need to produce more, using fewer resources, the obvious answer is to improve efficiency. However, 'efficiency' is often regarded as being undesirable and as conjuring images of 'factory farms'.

The U.S. Federal Accounting Office recently released a report entitled *"Livestock's Long Shadow"* that attributes 18 percent of total global greenhouse gas emissions to animal agriculture. This figure is widely quoted in the media, in literature from non-government organizations, and in activists' publicity materials as being proof that animal agriculture is a major contributor to global warming. While it's true that 18 percent is a shockingly high proportion of total greenhouse gases and is therefore a real attention-grabber, it's simply not representative of U.S. agriculture.

According to Environmental Protection Agency figures the entire U.S. agricultural industry only contributes 6.4 percent to U.S. greenhouse gas emissions, and dairy production contributes less than 1 percent of the total U.S. carbon footprint (the amount of carbon dioxide and other greenhouse gases released into the atmosphere each year). Although 1 percent is a very small contribution, as the consumers become more concerned about the environmental impact of dairy production, it's an area where, as an industry, we can make significant improvements.

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The big difference between global and national effects of animal agriculture on greenhouse gas emissions can simply be explained by differences in the efficiency of production systems. To investigate this further let's consider the environmental impact of historical dairying:

The number of cows in the U.S. dairy herd peaked at 25.6 million head in 1944 (Figure 1). Back then the average herd contained six cows, each animal yielded just under 4,600 pounds per year and the diet was based on pasture and hay with occasional grain supplementation.

Antibiotics and artificial hormones were not yet available for use in animals and all available nitrogen and phosphorus went to munitions manufacture. This bucolic ideal fits perfectly with the consumer ideal of traditional, local food production and the perception that there were no environmental concerns in the 'good old days'.

Total milk production in 1944 was 117 billion pounds, yet in 2007 we produced 59 percent more milk (186 billion pounds) from 64 percent less cows (9.2 million). This amazing increase in efficiency has been achieved by advances in nutrition, genetics, management and welfare that allow us to understand and care for cows in modern systems far better than we did in the past.

It seems obvious that efficient modern dairy systems are more environmentally sustainable – producing more milk using fewer cows also means less feed, land, water, energy and fertilizer are needed to maintain the dairy population. Nonetheless, we often hear that the carbon footprint per cow has doubled, because modern cows are bigger, they eat more feed, and produce more waste and methane. This is true, but it's only part of the story.

To allow true comparisons between different dairy systems we need to look at the entire production process, which means ac-

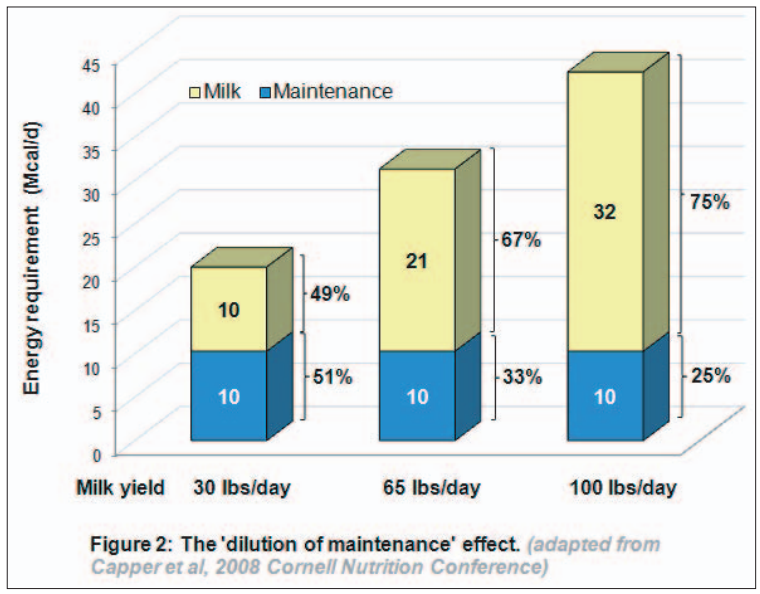

Figure 2: The 'dilution of maintenance' effect. *(adapted from Capper et al, 2008 Cornell Nutrition Conference)*

counting for the resource requirements to maintain all animals (milking cows, dry cows, heifers and bulls) in the population, and to express the carbon footprint per gallon of milk produced, not per cow or per acre. When we account for improvements in efficiency over the past 60 years, we see that the carbon footprint per gallon of milk has been reduced by 63 percent between 1944 and 2007.

The dairy industry, therefore, faces a considerable challenge: How do we continue to produce enough milk to supply both domestic and export markets, while also making the most efficient use of resources?

We can improve energy efficiency in our homes by turning off lights and appliances when we're not using them, but we can't 'turn off' a dairy herd at the end of the day; it has a fixed nutrient cost for maintenance for all cows within that population, regardless of their stage of lactation or pregnancy. Electronic appliances can also be instantly replaced as needed, with no investment in the new machine prior to purchase, but each cow has an associated heifer replacement that has nutrient requirements for maintenance and growth.

The nutrients required to maintain the dairy animal population (cow, dry cow and heifer) can therefore be considered as the fixed costs of milk production. To improve efficiency and reduce resource use it is therefore essential to spread those "fixed costs" over more units of milk production by increasing milk yield per cow.

The effect of improved efficiency is shown in Figure 2 on the previous page. Three cows managed under the same system and each weighing about 1,400 pounds will all have the same maintenance energy requirement (10 Mcals per day), but their total daily energy requirement will increase according to milk yield.

A low-producing cow giving 30 pounds of milk per day will require a total of 20 Mcals/day, whereas a high-producing cow yielding 100 pounds of milk per day will require 42 Mcals/day. This equates to a total energy cost of 0.67 Mcal/lb. milk for the 30 pounds/day cow compared to 0.42 Mcal/lb. milk for the 100 pounds/day cow, i.e. reduced feed cost per unit of milk.

To produce a set quantity of milk, such as 4,500 pounds/day, we would need 150 low-producing cows or 45 high-producing cows. Using high-producing cows would result in feedstuff savings not only equivalent to the maintenance requirement of 105 cows, but also the feed required to maintain their associated population: 17 dry cows and 119 replacement heifers. Reductions in feedstuff use are accompanied by decreases in land, water, fertilizer and fossil fuel use. Regardless of production system, in these difficult financial times reducing resource cost per unit of feed through improved efficiency is crucial to ensure economic sustainability.

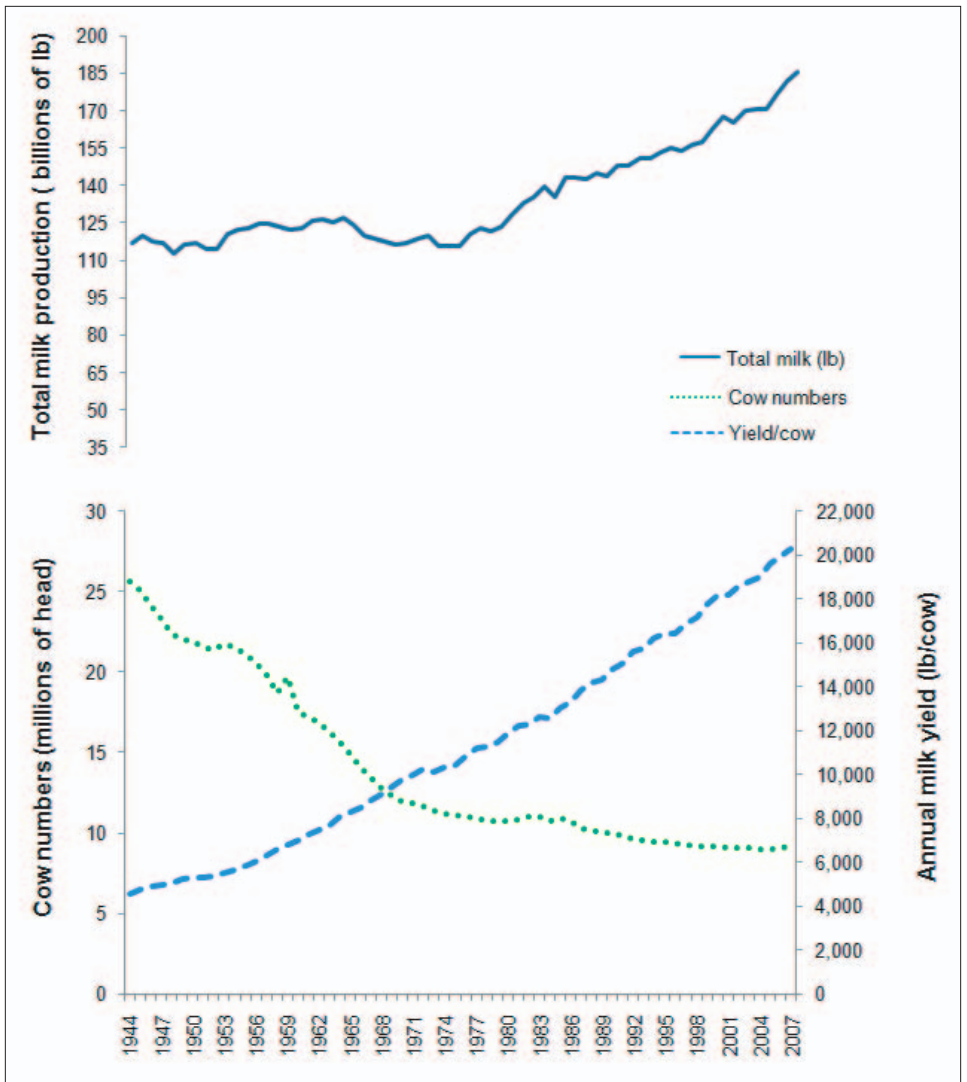

Figure 1: U.S. milk supply, cow numbers, and annual milk yield per cow from 1944 to 2007. *(Capper et al., 2008 Cornell Nutrition Conference)*

Some environmental technologies (methane digesters, low-carbon packaging, etc.) are already being adopted by the dairy industry, but with 80 to 95 percent of the total carbon footprint occurring on-farm we have a huge potential to reduce the carbon footprint through improved efficiency. Our group at Cornell University has recently investigated the effect of using rbST to increase milk yield by 10 pounds per cow, thus improving productive efficiency. This increase allows annual milk production to be maintained using fewer resources, reducing total environmental impact by 9 percent.

For the average 150-cow herd this means producing the same amount of milk using 245 fewer tons of feed, 53 fewer acres of cropland, and 132,000 fewer gallons of water. A 10-lb. improvement in yield per cow in the herd also reduces manure output by 297 tons per year and reduces the carbon footprint by the equivalent of removing 38 cars from the road or planting about 28,000 trees.

It is important to note that this improvement in milk yield and mitigation of environmental impact may be achieved through technology use (e.g. rbST, 3x milking, etc.) or any combination of technology use and improved management practices, including feed additives, mastitis control, cow comfort, genetic selection, or employee training programs.

The carbon footprint of food production is increasingly cited as a component of consumers' food-buying decisions. However, the commonly-held view that extensive, lower-yielding food production systems are more environmentally sustainable is false.

If the average U.S. family of four buys its annual milk supply from herds that use technologies or improved management practices to produce 10 pounds more milk per cow per day, the reduction in its carbon footprint is equal to planting 25 trees. In a society where every airline flight, car trip, or train journey comes with the option to offset carbon emissions, improving the efficiency of dairy production can make a contribution to reducing global warming.

As the global population increases it is essential that, as an industry, we continue to use technologies and management practices that make the most efficient use of resources to produce milk. If these technologies are made unavailable to us through activist lobbying we have to add more cows to the U.S. dairy herd to make up for lost efficiency in order to produce sufficient safe, healthy, nutritious milk for the increasing human population. The take-home message we need to communicate to retailer sand consumers is that true environmental and economic sustainability means making more milk using fewer resources.

The author is currently a Post-Doctoral Research Associate at Cornell University in Ithaca, NY, but beginning May 1 she will be an Assistant Professor of Dairy Science at Washington State University in Pullman.

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