



Invited review: Sustainability of the US dairy industry

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ABSTRACT

The US dairy industry has realized tremendous improvements in efficiencies and milk production since the 1940s. During this time, farm and total cow numbers have decreased and average herd size has increased. This intensification, combined with the shift to a largely urban public, has resulted in increased scrutiny of the dairy industry by social and environmental movements and increased concern regarding the dairy industry's sustainability. In response to these concerns, a group of scientists specializing in animal welfare, nutrient management, greenhouse gas emissions, animal science, agronomy, agricultural engineering, microbiology, and economics undertook a critical review of the US dairy industry. Although the US dairy system was identified as having significant strengths, the consensus was that the current structure of the industry lacks the resilience to adapt to changing social and environmental landscapes. We identified several factors affecting the sustainability of the US dairy industry, including climate change, rapid scientific and technological innovation, globalization, integration of societal values, and multidisciplinary research initiatives. Specific challenges include the westward migration of milk production in the United States (which is at odds with projected reductions in precipitation and associated limitations in water availability for cattle and crops), and the growing divide between industry practices and public perceptions, resulting in less public trust. Addressing these issues will require improved alignment between industry practices and societal values, based upon leadership from within the industry and sustained engagement

with other interested participants, including researchers, consumers, and the general public.

Key words: environment, social, economic, public attitude

INTRODUCTION

Over the past century, the US dairy industry has realized tremendous improvements in efficiencies of production (Martin and Mitra, 2001), achieved in part by investing in technology and productive assets, and paid for by economies of scale. The intensification of the industry is such that farms with more than 500 milking cows now account for 63% of the milk supply in the United States (USDA-NASS, 2012a), up from 39% a decade ago (USDA-NASS, 2002). When combined with concerns regarding the world's population growth (Godfray et al., 2010a,b; Parker 2011; United Nations Population Division, 2012), potential pressures and associated challenges with food security, economic growth, social concerns, and environmental issues (Steinfeld et al., 2006), urgent need exists for a critical assessment of the sustainability of the US dairy industry.

The current review was performed by a group of individuals representing many aspects of the dairy industry, who met for three 2-d meetings in June 2011, January 2012, and June 2012. The paper, which arose as a consequence of our discussions, has been divided into 3 components: (1) a working definition of sustainability and a broad characterization of the present US dairy industry; (2) identification of each of the pillars of sustainability, emphasizing the current state of the dairy industry as well as identifying weaknesses, opportunities, and areas requiring more research; and (3) a discussion of the limitations of our review and general conclusions.

We recognize that many groups are attempting to address this issue. Our goal is to offer insights and pos-

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sible conclusions so that others may build upon our efforts. We encourage readers to partake in further discussions on this topic, where possible engaging a variety of academic disciplines and stakeholders. The Letters to the Editor section of this journal can be used as a vehicle to submit thoughts and opinions in response to our ideas presented below.

DEFINING SUSTAINABILITY

The word sustainability always includes an aspect that considers social values (Thompson, 1997). The current US legal definition (US Code Title 7, Section 3103) is as follows: “an integrated system of plant and animal production practices having a site-specific application that will over the long-term: satisfy human food and fiber needs, enhance environmental quality and the natural resource base upon which the agriculture economy depends, make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls, sustain the economic viability of farm operations, and enhance the quality of life for farmers and society as a whole.”

We used this definition as a framework for our discussions. The 3 pillars of sustainability (Figure 1; GNU Free Documentation License) also provided a framework, and we were guided by the Thompson (2007) conclusion that “We will never have a complete understanding of sustainability; we must always be willing and eager to think it through again.”

THE CURRENT STATE OF THE US DAIRY CATTLE INDUSTRY

Intensification of Dairy Production

Advances in genetics, nutrition, and herd management have resulted in a 4-fold increase in milk yield between 1944 and 2007 (Capper et al., 2009) and an associated reduction in numbers of both farms and cows. In 1940, there were approximately 21 million cows on 4,663,431 dairy farms in the United States, but by 1980, farm and cow numbers decreased 93 and 48%, respectively, to 334,180 farms with just under 11 million cows (Blayney, 2002). Farm numbers decreased to approximately 53,000 licensed dairies in 2012 and cow numbers have decreased a further 16%, leading to increases in cows per farm during this period (Figure 2A and B). Milk yield averaged 2,361 kg/cow in 1950 (Blayney, 2002) compared with 9,702 kg/cow in 2011 (USDA-NASS, 2012b). Today’s dairy industry produces 59% more milk with 64% fewer cows, consuming 77% less feed and 65% less water per liter of milk produced

compared with dairy production in 1944 (Capper et al., 2009). Presently about 88.5% of the milk solids produced are consumed within the United States (NMPF, 2012), with the majority (81%) by consumers living in urban areas (>50,000 people/city; US Census Bureau, 2010).

Reliance on Immigrant Labor

Employment practices are an important component of both the economic and social dimensions of sustainability. The US dairy industry relies heavily on foreign-born workers (Martin, 2002). Of about 138,000 full-time dairy farm employees nationwide, estimates indicate that 57,000 are foreign born (Rosson et al., 2009). In a national survey of 5,005 dairy farms in 17 states, 50% of farms used immigrant labor and 62% of the US milk supply came from dairy farms using immigrant labor (Rosson et al., 2009).

Land Use Changes

The structural changes within the dairy industry have affected land use. Between 1945 and 2007, cropland acreage decreased almost 10% (Nickerson et al., 2011), with the majority of today’s cropland concentrated in the Northern Plains (North Dakota, South Dakota, Nebraska, and Kansas) and the Corn Belt

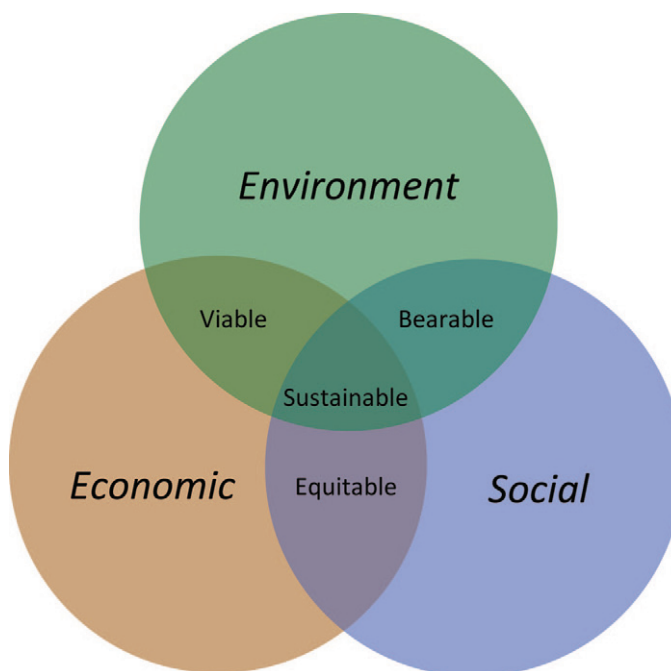


Figure 1. The 3 pillars of sustainability (used with permission under the GNU Operating System Free Documentation License). Color version available in the online PDF.

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