Emerging Issue: Sustainability: Dairy Scale for Good

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Abstract

U.S. dairy collectively commits to achieve greenhouse gas **(GHG)** neutrality, optimize water use while maximizing recycling, and improve water quality by optimizing utilization of manure and nutrients by 2050. The farm and field strategy to achieve these goals is termed the Net Zero Initiative **(NZI)**. Dairy Scale for Good will contribute to NZI efforts by partnering with commercial operating dairies to demonstrate the ability to significantly reduce greenhouse gas emissions and improve water quality and quantity, while increasing and diversifying on-farm revenue. Nestle and Starbucks have both launched on-farm pilots within the Dairy Scale for Good workstream to pursue new technology and practice change due diligence, profit and loss modeling, de-risking through demonstration, and ecosystem services market building. Enteric methane mitigation is the key area of focus for the 2050 Environmental Stewardship Goals, NZI, and Dairy Scale for Good that is relevant to the dairy nutrition field.

Introduction

In 2008, the U.S. dairy industry was the first in the food agricultural sector to conduct a full life cycle assessment at a national scale (Thoma et al., 2013). Since then, the U.S. dairy community has built a collaborative effort that unites the assets and expertise of trade, professional and industry organizations to create a path forward. The Innovation Center for U.S. Dairy® (Innovation Center) is a leadership forum that brings together the dairy community and third parties to address the changing needs and expectations of consumers and customers. Initiated in 2008 by dairy farmers through the dairy check-off, Innovation Center leaders and members collaborate on important areas like the environment, nutrition and health, animal care, food safety, and community contributions. Through the Innovation Center, the U.S. dairy community demonstrates its commitment to continuous improvement from farm to table, striving to ensure a socially responsible and economically viable dairy community. For the past decade, the Innovation Center has led efforts to help the dairy community understand and manage its most significant social, environmental, and economic impacts. The Innovation Center developed the U.S. Dairy Stewardship Commitment (Stewardship Commitment) to support dairy farmers, cooperatives and processors who voluntarily choose to work across the industry to advance sustainability leadership and transparently report progress. Retailers and other dairy buyers can adopt and use the Stewardship Commitment to track their suppliers' sustainability and continuous improvement efforts and are encouraged to share this story with consumers.

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The Innovation Center, in consultation with industry and external stakeholders, developed the first national materiality assessment for U.S. dairy to substantiate industry-wide priorities and to serve as a guide to individual companies as they identify their own priorities. The materiality assessment was first published in May 2019 and applied Global Reporting Initiative **(GRI)** Sustainability Reporting Standards principles. The assessment considered three key items. First the impact dairy production has on social, environmental, and economic factors. Second, the importance of sustainability to stakeholders for informing their assessments and decisions. And third, the degree of operational control that dairy farmers, cooperatives, and processors have over sustainability. The results are summarized in a materiality matrix with two thresholds for materiality. Topics falling beyond the first threshold, set at 2.5, are material for reporting, while topics beyond the upper threshold, which is set at 4.5, represent the highest-rated priorities, which are: Product Safety and Quality, Health and Nutrition, GHG Emissions, Animal Care, Water Quality, Water Conservation, and Nutrient Management. The materiality assessment results have been used in many beneficial ways to inform and support industry efforts, such as the prioritization of national goal setting, including the 2050 Environmental Stewardship Goals.

2050 Environmental Stewardship Goals

Setting industry-wide goals helps accelerate collective action. Following a year-long consultation process and more than 12 years of collaborative action on environmental topics, the Innovation Center announced an ambitious new vision of dairy as an environmental solution, with goals in areas where dairy collectively has the greatest impact. The environmental stewardship voluntary and collective goals are to: 1) **achieve GHG neutrality,** 2) **optimize water use while maximizing recycling**, and 3) **improve water quality by optimizing utilization of manure and nutrients** by 2050. As collective goals, not every farm, cooperative or processor is expected to reach these goals individually, but together, the industry can leverage its diversity to meet them collectively. These goals will help dairy build upon and quantify industry progress towards its vision to be an environmental solution.

The 2050 environmental stewardship goals build on a decades-long commitment to producing nutritious dairy foods that can sustainably feed a growing global population. Representative leadership across the dairy value chain, including farmers, cooperatives, processors, retailers and other stakeholders, led the 2050 Environmental Stewardship Goals development process, which included an extensive stakeholder and public comment period. The 2050 Environmental Stewardship Goals encompass the field, dairy farm and processing stages of the supply chain collectively and represent the industry's commitment to reducing GHG footprint and water impacts. The goals focus on the most pressing areas of environmental sustainability and are consistent with the 2019 materiality assessment and the U.S. Dairy Stewardship Commitment.

Progress against each of the 2050 environmental stewardship goals will be reported out every five years, beginning in 2025. This reporting will not only document progress but also identify technological and other advancements that can accelerate improvements, enabling nimble adaptation and focus on what can be scaled for maximum impact. The industry's comprehensive GHG accounting and reporting guidance was thoroughly reviewed and recently endorsed by the World Resources Institute.

The U.S. dairy community is leveraging advances in technologies and practices and working to make these innovations accessible and affordable for farmers and companies. Dairy companies and farms across the country are already contributing to the goals individually, and the U.S. Dairy Stewardship Commitment helps the industry document and demonstrate social responsibility efforts. Additional metrics will be developed through the Stewardship Commitment as needed to track progress.

The U.S. dairy community is working together to identify multiple economically viable pathways for reaching these goals collectively, leveraging the strength of U.S. dairy's diversity in size, region and practice. Initially, these strategies include: 1) attracting investment and partners to ignite new technology and innovation, 2) creating new revenue sources, such as manure-based product development and ecosystem services markets, 3) expanding science-based research and data collection that closes knowledge gaps, improves analysis and advances practices and technologies that reduce environmental impact in dairy production, and 4) increasing the utilization and expansion of best practices, resources and tools for farmers, cooperatives, and processors.

Net Zero Initiative

The U.S. Dairy NZI is an industry-wide collaboration with key stakeholders to help farmers collectively achieve the 2050 Environmental Stewardship Goals by making sustainable practices and technologies more accessible and affordable to U.S. dairy farms of all sizes and geographies. The initiative is led by six U.S. dairy organizations working on behalf of their member constituents: Dairy Management Inc., Innovation Center for U.S. Dairy®, International Dairy Foods Association, National Milk Producers Federation, Newtrient, and U.S. Dairy Export Council®. The initiative also includes Nestlé and Starbucks as corporate partners and The Foundation for Food & Agriculture Research, the Soil Health Institute and The Nature Conservancy, along with leading dairy research institutions, as project partners.

The intention of NZI is addressing barriers and investing in research and partnerships to make it more accessible and economically viable for farms of all sizes and geographies to adopt practices and technologies that can provide environmental benefits on the farm, in the field and within the broader community. The U.S. Dairy NZI concentrates on four key areas to reduce dairy's environmental footprint, while delivering benefits on farms and beyond. The four key areas of focus are: 1) feed production and agronomic practice changes, 2) enteric methane reduction, 3) manure handling and nutrient management, and 4) on-farm energy efficiency and renewable energy use. At the same time, these efforts will advance new revenue streams, such as clean energy and carbon sequestration. The primary expected outcomes of NZI include: 1) the collective U.S. dairy industry advances toward carbon neutrality and significant improvements in water use and quality, 2) in addition to nutrient-dense foods and beverages, dairy farms provide products and services that enable other industries and communities to be more sustainable, and 3) farmers can realize untapped value on the farm, making the system of continuous improvement self-sustaining.

Success requires addressing the affordability of technology and practice solutions, closing the gaps on data and research for more quantifiable outcomes, and making solutions accessible to farms of all sizes to scale. This is achievable through research, on-farm pilots, development of manure-based products and ecosystem markets, and other

farmer technical support and opportunities. There are three distinct workstreams within NZI to organize the collaborative efforts on research (**Groundwork**), on-farm demonstration (**Dairy Scale for Good**) and reporting the positive impact of adopting solutions (**Collective Impact**). Groundwork research provides foundational scientific evidence and knowledge, fills in data gaps, improves the models used to estimate environmental outcomes, and identifies areas for largest potential benefits. Dairy Scale for Good (**DS4G**) is focused on implementing the full suite of best practices and technologies on pilot farms to prove the economic viability of reaching GHG neutrality on-farm. Collective Impact will support broad, voluntary farmer adoption of proven best practices and technologies. An industry-wide network will share the positive collective impact that farms of varying geographies, sizes, and capabilities are making on the environment to support learning and adoption.

Dairy Scale for Good

The DS4G workstream of NZI is focused on working with partners to create on-farm pilots that implement economically viable technology and best practices. Its main objective is to find pathways for U.S. dairy to reach net zero GHG emissions while improving farm livelihoods. DS4G will allow dairy industry stakeholders to collaboratively address technology implementation questions and develop pilots to determine which practices and technologies are viable at different scales. Through investment by partners, grants, and the participating farms, the pilots will focus on four key areas: 1) cow care and comfort, 2) manure handling and use, 3) feed production, and 4) on-farm energy generation and use. These four areas represent the key contributors to the environmental footprint of dairy farms when considered in aggregate.

Proving that dairy is an environmental solution and showcasing the benefits dairy production and consumption can bring on farm and in local and global communities is an important expected contribution from DS4G. It is intended to test pathways toward sustainable markets and affordability for farms of all sizes in all regions by verifying the economic and environmental benefits of the implementation of practices and technologies in the pursuit of net zero. The NZI partners will take lessons learned about the economics and environmental improvements to develop sustainable markets that all farmers can tap into. For example, if DS4G can quantify how a change in a practice or technology improves water quality, farmers can potentially sell that impact as verified credits within a water quality market. Without the development of new products and markets (eco-system services, carbon, manure-based products, etc.), it will be challenging to offer a self-sustaining solution for all farms to participate in NZI pathways. It's important to remember that not all farms will be expected to implement the technologies and practices on DS4G pilot farm partners, but the expectation is that all farms will benefit from the lessons learned and find their own path to benefit from the markets in some way.

The DS4G team visited farms across the country to meet with farmers and learn what practices and technologies are already in use and identify regional opportunities and challenges. In addition to farmers, the DS4G team met with cooperatives, state and regional checkoff teams and other stakeholders, including commercial partners such as Nestle and Starbucks, to identify potential pilot farm partners. Informed by an initial desktop analysis of a hypothetical farm, DS4G relies on partner farm participation to prove that reaching net zero GHG emissions and improving farmer livelihood is possible beyond calculations on paper. As an example

of this process, Nestlé USA and the Innovation Center announced that California's Trinkler Dairy Farm, a CARNATION® supplier, is the first pilot farm within NZI's DS4G workstream.

The various lessons learned from DS4G pilot farms will be shared broadly with the dairy community to: 1) provide full-scale proof-of-concept to other farmers, the dairy value chain, non-government organizations, and the general public that dairy can be an environmental solution, 2) measure and quantify the environmental outcomes at scale, setting the stage for new on-farm revenue streams derived from non-traditional dairy products like manure-based fertilizers and ecosystem services, in connection with the Groundwork Pillar, and 3) decrease the risk of investment and set the stage for widespread adoption across the dairy industry, in connection with the Collective Impact Pillar.

Dairy Nutrition Practices Applicable to DS4G

Dairy nutrition practices and technologies have a direct impact in the DS4G focus area referred to as cow care and comfort. Formulating and feeding balanced diets is critical to dairy cattle care and influences nutrient use efficiency, nutrient excretion, and enteric methane emissions. Some of these practices are already used widely, but their on-farm emissions reductions are not necessarily routinely quantified. Other practices, such as enteric methane inhibitors, haven't been tested thoroughly yet for effectiveness on commercial dairy herds. The focus of the enteric methane mitigation component of DS4G will initially be placed on testing the effects of feed additives.

Feeding Balanced Diets Reduce Dairy Farm GHG Emissions

Dairy nutrition has already contributed significantly to historical reductions in farm-gate GHG emissions intensity (g of methane per unit of milk produced) reported by Capper et al. (2009) and more recently by Capper and Cady (2019) simply by formulating balanced rations that meet nutrient requirements for growth and lactation and promote health and reproductive success. Many of the nutrition and feeding management practices that contributed to these historical reductions are described in the online resource "Considerations and Resources on Feed and Animal Management" published by the Innovation Center in 2014. Over 40 dairy professionals from industry and academia contributed to the report. The easy-to-use manual also includes 257 supporting resources that are accessible by hyperlinks for those seeking additional information. This resource continues to serve as an important tool for: 1) dairy farmers and their advisors working to improve dairy cattle efficiency and health, 2) academic and government researchers and educators interested in sustainability and dairy nutrition research, 3) undergraduate and graduate curricula (and textbook) in dairy science and nutrition, 4) agriculture journalists and media as a background source or primary content of a dairy management article emphasizing best practices, and 5) dairy co-ops, processors, and brands for an easy one-stop, science-based resource to validate specific examples of best management practices on U.S. dairy farms. It serves as the trusted resource for users of the Farmers Assuring Responsible Management – Environmental Stewardship (**FARM-ES**) program and a basis for Chapters 3, 4 and 5 of its Environmental Stewardship Continuous Improvement Reference Manual. This resource will continue to provide important guidance in the future for dairy nutritionists whose

objectives are to improve business value for dairy farmers while reducing enteric methane emissions intensity.

Feed Additives to Mitigate Enteric Methane Emissions

New enteric methane inhibitors, primarily in the form of feed additives, are ready to enter the marketplace. Feed additives are commonly included in dairy diets to improve feed-use efficiency, animal health and performance, and milk composition and quality. Development of feed additives that mitigate enteric methane emissions has been a very active area of research during the last decade. The scientific evidence for feed additives with potential for mitigating enteric methane emissions from cattle is growing actively with new information becoming available almost every week. Honan et al. (2021) recently reviewed primarily in vivo data to provide a concise summary of feed additives currently available, or in development, that offer potential to reduce methane emissions from ruminants. These authors summarized the available information on mode of action, efficacy, safety, and readiness for adoption of various anti-methanogenic feed additives. Average reductions in enteric methane between 3 and 104 g/day (1 to 48%) resulting from cattle feed supplementation are documented in this review. These reductions exemplify the potential promise that feed additives represent for enteric methane mitigation, NZI, and making progress towards the 2050 Environmental Stewardship Goals. The DS4G pilot farm partners will be a critical component to evaluate the effectiveness of these compounds when fed to commercial dairy cattle.

The difference between potential and actual enteric methane mitigation rests on the possibilities for dairy farmers to include these additives in dairy cattle feed. Mitigating enteric methane is not the only requirement for dietary inclusion. Including these feed supplements in balanced cattle diets requires other considerations. For example, the U.S. food industry can't risk exchanging GHG reductions for decreased food productivity within the current scenario of growing global food demand; rather, the challenge is to do more with less on both fronts. Successful feed supplements must provide both enteric methane mitigation and production benefits, or at least an acceptable trade-off between these two outcomes. Furthermore, either potential or known animal, food and/or environmental safety risks are associated with some feed supplements (Honan et al., 2021). These potential and known risks need to be further characterized and managed to increase the chances for feed additives inclusion in dairy diets. Finally, the practical aspects of feed additives use by dairy farmers, such as ease of use and availability, also need consideration to turn potential into actual enteric methane reductions.

Solid evidence is needed to ensure feed additives effectively reduce enteric methane with sustained and positive outcomes on various other attributes important throughout the dairy value chains. It will be only through value chain collaboration and partnerships that the main challenges facing the adoption of feed additives to mitigate enteric methane will be solved. The Innovation Center identified at least three challenges that need to be addressed by the dairy value chain: 1) more research is needed because the current quality of evidence for enteric methane mitigation by feed additives varies widely, 2) methane-reducing feed additives must be economically advantageous for dairy producers, either enhancing milk or meat production and efficiency, and 3) feed additives must ensure consumer safety and cow health.

The Innovation Center already started conversations within the dairy value chain on the considerations listed above. For example, a stakeholder panel discussed how the dairy value chain – producers, co-ops and associations, scientists, feed companies, and food processors – share common goals and can take action to align on a "wish list" of desired attributes and standards for evaluating feed additives and supplements for environment, economic, productivity, cow health and human safety considerations. The main goal of this effort is to provide guidance to the dairy value chain that instills confidence and best decision-making for broad adoption of effective, enteric methane-reducing interventions.

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