An Investor Brief on Impacts
that Drive Business Risks:

DAIRY

ENGAGE *the* CHAIN

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Ceres

This brief provides a summary of the main environmental and social factors that affect dairy production *worldwide*; however, it spotlights key players in the U.S. value chain, and provides examples of actions being taken by companies operating or headquartered in the U.S.

KEY TAKEAWAYS

- Global demand for dairy is expected to increase by approximately 60 percent by 2050, driven by population growth and rising incomes.
- The greenhouse gas emissions from dairy production are significant. In the U.S., the dairy industry accounts for around 2 percent of the country's total GHG emissions. More than half of dairy's GHG emissions are generated from crop production for animal feed, from methane produced by cows digesting their feed and from their manure.
- Dairy production can contribute to water pollution when manure and synthetic fertilizer (used for crops to feed cows) are not managed properly.
- Producing milk uses a lot of water and water scarcity poses risks to dairy production. In the U.S., the dairy industry accounts for 5 percent of total water withdrawal, over 90 percent of which is used to produce feed for cows.
- Investors should address risks in the dairy supply chain through direct engagement with their portfolio companies and support of relevant policies and multi-stakeholder collaborations. Effective implementation of a company's policies requires promoting commodity traceability and having a clear approach to supplier engagement, verification and disclosure of progress.

COMMODITY OVERVIEW

Processed Milk, Butter, Cheese and Curd Dominate the Global Dairy Market[1]

In the U.S., the three biggest dairy product segments (based on revenue) are cheese (about 40 percent), milk and milk products (35 percent) and dry and condensed milk products (20 percent).[2]

Other common products sold in the U.S. include butter, ice cream, cottage cheese and yogurt.[3]

Given the importance of freshness, consumers primarily buy domestically raised milk—less than 10 percent of global milk output is traded globally.[4]

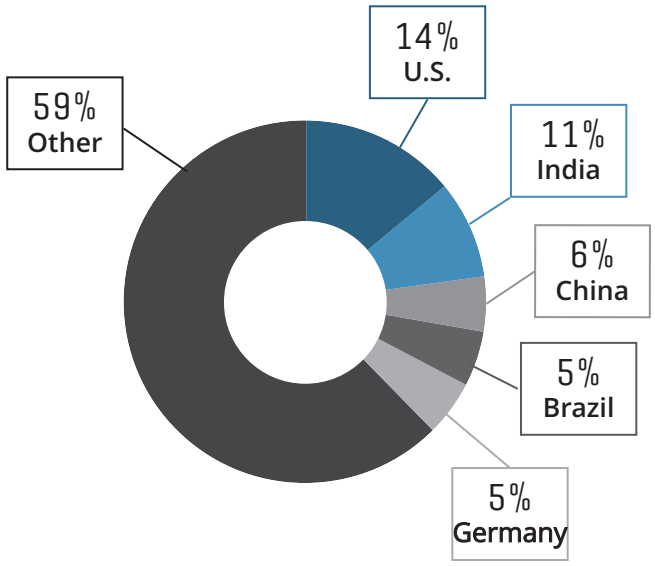
U.S. DAIRY REVENUE BY SEGMENT[5]

GLOBAL PRODUCTION DATA

The U.S. and India are the Two Biggest Producers of Fresh Milk

(though together they account for only 25 percent of total production).

TOP FIVE PRODUCTION REGIONS[6]



661 MILLION METRIC TONS

Average global production of whole fresh milk, 2014-2016[7]

$287 BILLION

Global production value of whole fresh milk[8]

<10 PERCENT

Proportion of global milk output traded[9]

Rising Global Dairy Consumption Drives Demand

Global demand for dairy is expected to increase (by approximately 60 percent by 2050) in large part due to population growth, rising incomes, urbanization and the westernization of diets in countries such as China and India.[10] There are approximately 270 million dairy cows worldwide.[11] In 2017, 811 million metric tons of milk were produced,[12] and worldwide, per capital annual consumption of dairy products (fresh milk equivalent basis, not including butter), is expected to increase on a per capita basis by over one-third by 2067.[13]

THE DAIRY VALUE CHAIN

Some Segments in the U.S. Dairy Products Value Chain are Highly Concentrated

STAGE OF VALUE CHAIN	SIMPLIFIED DAIRY VALUE CHAIN	SOME KEY COMPANIES IN U.S. FOOD VALUE CHAIN
AGRICULTURAL PRODUCTION	MILK PRODUCTION (AND PRODUCTION OF ANIMAL FEED)	**Feed Companies** ADM Alltech Cargill Purina Animal Nutrition/ Land O'Lakes Tyson Foods
TRANSPORT, PROCESSING, PACKAGING & DISTRIBUTION	MILK & DAIRY PROCESSING FACILITIES FLUID MILK DAIRY PRODUCTS	**Milk & Dairy Processors** California Dairies Dairy Farmers of America Danone USA Dean Foods Great Lakes Cheese Kraft Heinz Kroger Land O'Lakes Nestle USA Schrieber Foods
RETAIL & CONSUMPTION	FOOD RETAILERS & OTHER OUTLETS	**Restaurants** McDonald's Restaurant Brands Int'l Starbucks Yum! Brands (Taco Bell, Pizza Hut, KFC) **Retailers** Ahold Delhaize USA Albertsons Companies Kroger Walmart

KEY PLAYERS

The following provides additional information about some of the companies in the U.S. dairy value chain. While the focus is on publicly traded companies headquartered in the U.S., some of the companies mentioned are headquartered outside the U.S. and/or are privately held.

FEED COMPANIES

Feed rations for U.S. dairy cows are made up of around 33 ingredients though the majority are corn (including a by-product called distiller's grains) and alfalfa.[14] About 35 percent of feed is grown by the dairy farmers themselves and the rest is purchased from other farmers, commodity markets and feed companies. The five largest U.S. animal feed producers are Cargill (privately held), Purina Animal Nutrition (subsidiary of Land O' Lakes, a member cooperative), Tyson Foods, Alltech (privately held) and Archer Daniels Midland (ADM). Collectively, these companies produce approximately 50 million metric tons of feed annually.[15]

DAIRY FARMERS

The vast majority of U.S. dairy farms are family-owned and managed and are often members of producer cooperatives.[16] In 2018, there were over 41,000 dairy farms.[17]

MILK AND DAIRY PROCESSORS

There are more than 1,000 U.S. processing plants that turn raw milk into milk and dairy products, but these operations are highly concentrated.[18] For example, the 50 largest fluid milk processors account for about 90 percent of segment revenue.[19] The 10 largest processors operating in the U.S. are listed in the table below. Of these, five are publicly held with three of these headquartered in the U.S. (Dean Foods, Kraft Heinz and Kroger). The other five are cooperatives or privately held.

RESTAURANTS AND RETAILERS

Retailers and restaurants play an important role in the dairy supply chain. These companies can indirectly influence production practices and supplier standards within their supply chain. Moreover, they are sensitive to external pressures as well as responsive to market trends and consumer preferences. Restaurants use high volumes of milk, cheese and cream for meals and beverages. The four largest quick-service and fast-casual restaurants in the U.S. are McDonald's, Yum! Brands (Taco Bell, Pizza Hut, KFC), Starbucks and Restaurant Brands International.[20] The four largest supermarkets in the U.S. are Walmart, Kroger, Albertsons and Ahold Delhaize USA.[21]

LARGEST U.S.-BASED DAIRY PROCESSORS, 2018[22]

**Revenue is in USD (000,000)*

RANK	COMPANY	TYPE OF OWNERSHIP	REVENUE*
1	Nestle USA	Publicly Traded Company (CH)	14,079.0
2	Dean Foods	Publicly Traded Company	7,795.0
3	Danone USA	Publicly Traded Company (FR)	6,000.0
4	Kraft Heinz	Publicly Traded Company	5,482.0
5	Schreiber Foods	Privately Held Company	5,000.0
6	Dairy Farmers of America	Cooperative	4,082.8
7	Land O'Lakes	Cooperative	3,900.0
8	Kroger	Publicly Traded Company	3,581.0
9	California Dairies	Cooperative	3,201.9
10	Great Lakes Cheese	Privately Held Company	3,100.0

U.S. SPOTLIGHT

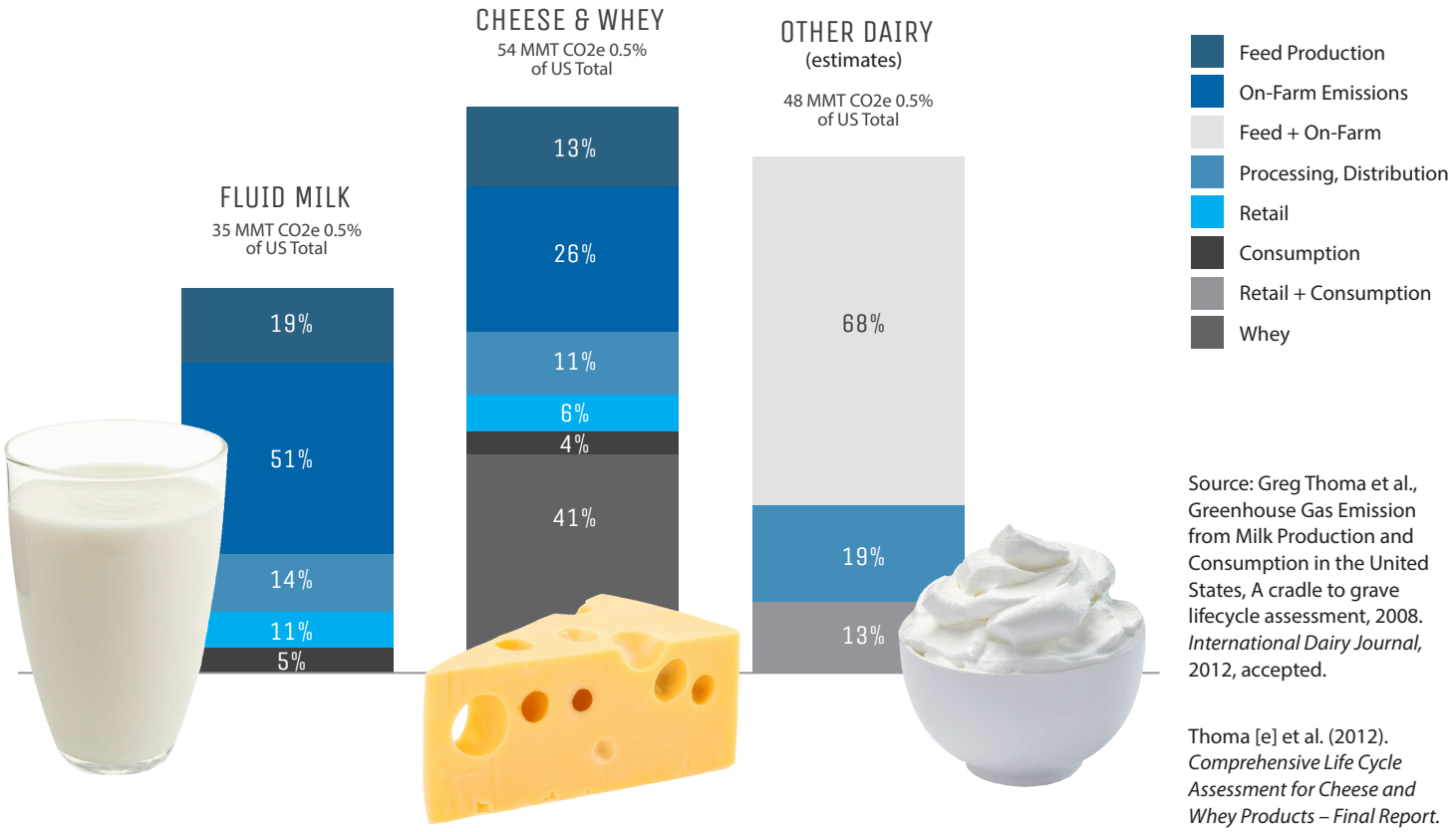
U.S. milk production has steadily increased over the past several decades. At the same time, the number of dairy operations has declined and the number of cows per operation has risen.[23] In 2017, there were 9.4 million dairy cows in the U.S., producing over 214 billion pounds of milk.[24] While milk is produced in all 50 states, the top five dairy states —California, Wisconsin, New York, Idaho and Pennsylvania— produce more than half.[25] The state of California alone accounts for about 20 percent of production. The farm value of milk production is significant, equaling that of corn production,[26] and the industry provides a significant source of revenue and jobs in several states.[27]

The Innovation Center for U.S. Dairy summarized the national environmental footprint of U.S. dairy in U.S. Dairy's Environmental Footprint: A Summary of Findings, *2008-2012, noting that:*

- *GHG emissions of the entire dairy industry total approximately 137 million metric tons CO_2 eq per annum, or about 2 percent of total U.S. GHG emissions.*
- *More than half of the dairy industry's GHG emissions arise during on-farm activities and from feed production. The visual below details where in the value chain these emissions occur across several products.*
- *The dairy industry accounts for approximately 5 percent of U.S. water withdrawals (excluding thermal power), with more than 90 percent of this use linked to growing feed for cows (irrigation).*

U.S. DAIRY CARBON FOOTPRINT – ALL PRODUCTS[28]

Total emissions = 137 MMT (The entire dairy industry – farm to manufacturer's gate - contributes approximately 2% of total U.S. GHG emissions)



Source: Greg Thoma et al., Greenhouse Gas Emission from Milk Production and Consumption in the United States, A cradle to grave lifecycle assessment, 2008. *International Dairy Journal,* 2012, accepted.

Thoma [e] et al. (2012). *Comprehensive Life Cycle Assessment for Cheese and Whey Products – Final Report.*

ENVIRONMENTAL AND SOCIAL FACTORS

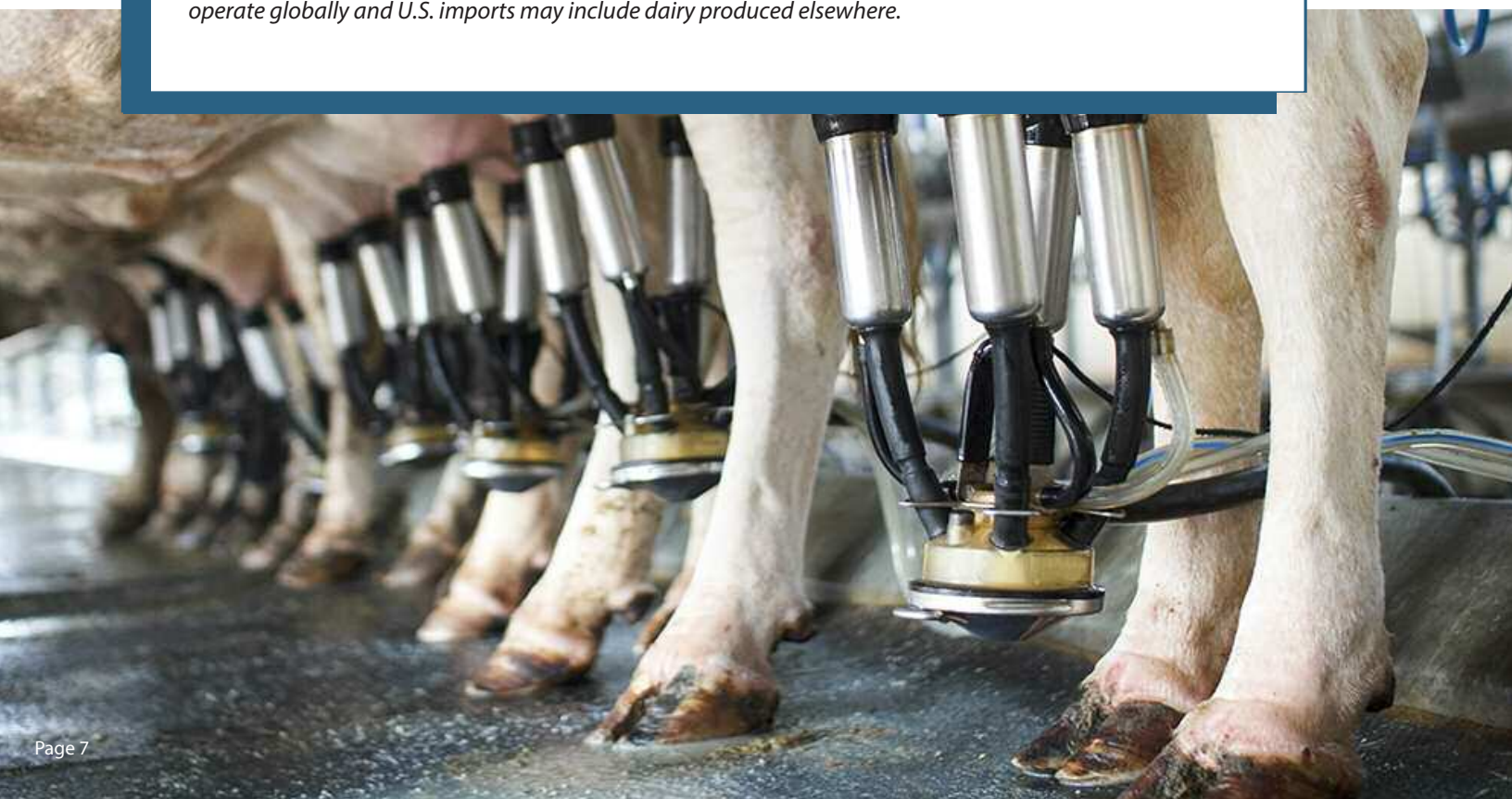
CLIMATE CHANGE	WATER USE & POLLUTION	WORKING CONDITIONS	LAND USE & BIODIVERSITY	LIVELIHOODS	LAND RIGHTS	DEFORESTATION
●	●	◑	◑	◑	○	○

● High Impact ◑ Medium Impact ○ Low Impact

Globally, the environmental and social issues linked to dairy production include GHG emissions, water pollution and groundwater depletion. The scale of the impacts depends on the practices used by individual dairy farmers and feed growers, as well as regional and local conditions.

REGIONAL CONTEXT MATTERS

When assessing risks to U.S. companies, it is important to keep in mind that most milk and dairy products are produced and consumed in the U.S. However, the impacts from dairy cows raised outside the U.S. are also relevant to U.S.-based companies that operate in other markets. U.S.-headquartered dairy processors operate globally and U.S. imports may include dairy produced elsewhere.



1. DAIRY COWS AND THEIR MANURE GENERATE SIGNIFICANT AMOUNTS OF GHG EMISSIONS

Dairy production has a significant impact on climate change. Dairy cows contribute directly to greenhouse gas emissions when they digest their feed and produce manure. Fertilizers and energy used to grow feed also contribute to greenhouse gas emissions.[30]

More than half of the global emissions from the livestock sector are related to beef and cattle milk production (dairy cows account for 20 percent; beef for 41 percent). Globally, milk produced by dairy cows generates 1.42 gigatons of CO_2 eq per annum, representing approximately 2.9 percent of human-induced GHG emissions.[31] When the emissions of meat produced from dairy related culled and fattened animals are included, this number rises to approximately 4 percent.[32]

When calculating a greenhouse gas footprint for a particular operation, it is important to consider how the dairy cows are raised, since changes in their feed composition and other management practices considerably affect the amount and type of greenhouse gas emissions generated.[33]

2. POOR HANDLING OF MANURE AND FERTILIZERS CAN POLLUTE LOCAL WATER RESOURCES

Dairy operations can significantly contribute to water pollution when manure and fertilizers for feed crops are poorly managed or used. The nitrogen and phosphorus nutrients from manure storage, handling and land application, and from synthetic fertilizers used to grow crops, can run off fields to surface water or leach into groundwater, contaminating local drinking water supplies and posing serious human health risks.

These issues are particularly relevant in places such as California, where the nearly 2 million dairy cows produce 65 billion pounds of manure each year. The resulting nitrates from dairy farms are a significant contributor to groundwater contamination in California and can pollute water sources on which millions of people depend.[34]

Companies that fail to understand and manage impacts related to water pollution may face operational, reputational and regulatory risks (see more at Ceres' *Feeding Ourselves Thirsty*). For example, in Ohio, a toxic algae bloom on Lake Erie in 2014 caused primarily by agricultural runoff poisoned the water supply for nearly half a million people in Toledo. In response, the governor of Ohio signed legislation requiring dairies and livestock producers to change the way they handle manure.[35]

Runoff contributes to "dead zones,"[36] areas of water bodies where aquatic life cannot survive because of low oxygen levels. In the Gulf of Mexico (into which runoff from production in the Mississippi River watershed flows), the National Oceanic and Atmospheric Administration (NOAA) reported that the dead zone in July 2017 was the largest ever measured, covering an area about the size of New Jersey.[37] The economic impact is significant with NOAA estimating that the harmful algae blooms causing the dead zones cost the seafood, restaurant and tourism industries about $82 million every year.[38]

To minimize pollution worldwide, dairy producers need robust nutrient management plans as well as the basic infrastructure and tools for tracking nutrient flows. They also need innovative technology to more precisely apply manure nutrients and clear options for exporting excess manure.[39]

FINANCIAL IMPACTS

A number of dairy farmers have been fined for contributing to water pollution and harming aquatic ecosystems.

In Iowa, one dairy operator was fined $24,000 in 2018 when manure leached from his facility killing more than 60,000 fish.[40] In 2017, another farmer was found by the U.S. Department of Justice to have violated the Clean Water Act multiple times and fined $160,000.[41] Dairy operators in Wisconsin, Washington and other states have also faced financial penalties from polluting local waterways.

3. HIGH WATER DEMAND FOR ANIMAL FEED CONTRIBUTES TO DROUGHT VULNERABILITY AND GROUNDWATER DEPLETION

Milk production typically requires a lot of water to grow the feed, nourish cows, manage manure and process dairy products. Since pasture and crops used as feed could have significant water demands, efficient use of water to produce these commodities is important, especially if the feed is grown in areas of water stress.[42]

In the U.S., among the potential feed crops (corn, alfalfa, other hay, pastureland, soybeans), corn and alfalfa use the largest amounts of irrigation water. Corn-based feed is particularly vulnerable since 35 percent of global production is grown in regions of high or extremely high water stress, meaning that existing water supplies face intense competition.[43] In California, for example, dairy cows eat a lot of locally grown corn silage. Most of this corn is grown using flood irrigation, which relies on highly stressed surface and groundwater resources (and also results in the over-application of water and nutrients, increasing the risk of nitrate leaching to groundwater).

Companies that fail to understand and manage impacts related to the water demand associated with dairy production may face operational, reputational and regulatory risks (see more at Ceres' *Feeding Ourselves Thirsty*).

It Takes
949 LITERS OF WATER

To Produce
1 LITER OF MILK

(Weighted Global Average)[44, 45]

It Takes
4,703 LITERS OF WATER

To Produce
1 KG OF CHEESE

(Weighted Global Average)[46, 47]

4. DAIRY FARMING AND ANIMAL FEED PRODUCTION CAN LEAD TO THE LOSS OF ECOLOGICALLY IMPORTANT AREAS AND LEAD TO SOIL EROSION

Poor dairy farming and animal feed production practices can damage ecologically important areas as prairies, wetlands and forests are converted for pasture and crop production. Land conversion is a particular concern in South America, since land is often converted to farms to grow commodity crops such as soybeans and corn for export to Europe and China as meal to feed dairy herds. For example, in the Chaco mixed grass and woodlands of Paraguay and Argentina, between 1976 and 2011, more than 29 million acres of habitat were converted largely first for production of beef and then soy, a feed source for livestock.[48] The U.S. dairy sector buys corn and soy from South America; the majority of feed crops for U.S. dairies are grown in the U.S.

Overgrazing, soil compaction from cow's hooves and poor agricultural practices can lead to loss of topsoil and organic matter, which can take decades or even centuries to replace. Conversely, dairy cows can contribute to healthy habitats and soils through well-managed grazing and manure applications, which can help to control flooding, protect wetlands, conserve open spaces, sequester carbon and revive degraded lands.[49] Companies that fail to understand and manage impacts related to land conversion and soil health may face market, litigation and reputational risks (see more at Ceres' *Agricultural Supply Chains as a Driver of Financial Risks*).

5. ANIMAL HEALTH AND WELFARE[50] ISSUES SPUR CONSUMER AND PUBLIC HEALTH CONCERNS

In addition to environmental issues aforementioned, several dairy-related animal health and welfare[51] issues can create major reputational and regulatory risks for companies:

- Poor care for dairy cows can result in lameness and mastitis and not only decrease the productivity of cows due to stress and ill health, but also lead to increased greenhouse gas emissions.[52] A majority of consumers care about animal welfare, according to surveys in Europe and North America, which creates a risk of contracts by corporate customers being terminated to meet consumer pressure.[53] In addition to the possible reputational risk, issues related to animal welfare link to food safety and drug use and are therefore critical for companies to take into account as part of a comprehensive operational risk management strategy.[54]
- Routine, nontherapeutic use of antibiotics in food animal production is contributing to a growing crisis of antibiotic-resistant infections in humans,[55] prompting regulatory action to limit the use of medically important human antibiotics for growth promotion in animals.[56] In the U.S., for example, 75 percent of all antibiotics are given to farmed animals. The misuse of these drugs for nontherapeutic purposes poses a business risk not only from a reputational perspective but also with respect to emerging regulatory and trade restrictions.[57]
- The use of the artificial growth hormone known as recombinant bovine somatotropin (rBST), or recombinant bovine growth hormone (rBGH), may contribute to consumer concern and therefore pose reputational risk.[58] Some companies publish policies on their use of rBST in the production of milk products they sell or provide labels on products stating that no rBST was used in milk production.

6. HEAVY RELIANCE ON MIGRANT LABOR POSES MARKET RISKS TO COMPANIES

Migrant workers are essential to the dairy industry in a number of countries (e.g., the U.S. and New Zealand).[59] In the U.S., a 2016 survey reported that one-third of all dairy farms (producing nearly 80 percent of the nation's milk) employ foreign-born workers, but seven in ten survey respondents reported having only moderate confidence in the employment documents of those workers. This study also estimated that a complete loss of immigrant labor could cause the loss of one-in-six dairy farms and cost the U.S. economy more than $32 billion.[60]

Migrant agricultural workers are at a particular risk for exploitation by labor brokers who may employ unethical practices such as high recruitment fees, passport retention and contract fraud to lure them into forced labor schemes, and use threats of deportation to keep them from reporting abuses.[61,62] A 2014 survey of migrant dairy workers in Vermont found that 40 percent of respondents were not making minimum wage; 40 percent reported working seven or more days in a row; and 20 percent stated they had no access to bathrooms or water at work.[63]

7. FARM ACTIVITIES CAN CREATE HAZARDOUS WORKING CONDITIONS AND CONTRIBUTE TO AIR QUALITY CONCERNS

On the farm, the greatest safety concerns for workers stem from operating heavy equipment and handling animals. In the U.S., 46 people were killed in 2016 while working on U.S. dairy farms, representing 11 percent of fatal injuries taking place in the agricultural sectors.[64] According to Occupational Safety and Health Administration statistics, the rates of injuries on dairy farms have declined,[65] though some risks and injuries to migrant workers may not be documented if workers feel unable to seek medical or legal help for fear of losing employment or facing immigration-related consequences.

Moreover, dust generated from animals and their feed as well as gases from animal wastes can be hazardous to human and animal health.[66] Particulate matter and odor from on-farm activities can negatively impact air quality.

8. SMALL-SCALE PRODUCERS LACK ACCESS TO RESOURCES WHICH LIMITS THEIR LIVELIHOODS AND PRODUCTIVITY

It is estimated that around 750 million people are engaged in small-scale milk production worldwide, the majority of them in developing countries.[67] Small-scale producers may lack access to resources needed to sustain their livelihoods, such as grazing and resource rights, affordable quality inputs (feed and medicine), fair pricing, credit, extension services and technology. For example, in some developing countries, a lack of proper cooling infrastructure results in up to 30 percent of milk being wasted.[68] Although in many countries small-scale dairy producers have very competitive production costs and the potential to compete with larger, high-tech producers, lack of access often limits their ability to invest in the productivity and sustainability of their farms and participate in the growing global dairy market.[69]

COLLABORATIVE INITIATIVES

Many players, including buyers, producers, governments, NGOs and communities understand the business risks at play and are collaborating to ensure the long-term sustainability of dairy production.

MULTISTAKEHOLDER SUSTAINABILITY EFFORTS

For the dairy industry, examples of multistakeholder efforts include:

- Innovation Center for U.S. Dairy provides a national forum for the dairy industry to work together: the US Dairy Sustainability Alliance.[70] The Center is leading several greenhouse gas reduction projects to help the dairy industry meet a voluntary goal set in 2009 to reduce GHG emissions by 25 percent by 2020.

  In early 2018, the Center's *Stewardship and Sustainability Guide for U.S. Dairy* evolved into the U.S. Dairy Stewardship Commitment. The Framework's metrics have been renamed the Stewardship Commitment Metrics and are a set of indicators that are aligned with the National Milk Producers Federation's FARM: Farmers Assuring Responsible Management™ program, Field to Market (with respect to dairy feed production), and the Dairy Sustainability Framework (see below).[71]

- A global Dairy Sustainability Framework (DSF), developed by the Global Dairy Agenda for Action (GDAA), outlines 11 global criteria that provide high-level aspirational objectives for desired improvement across the dairy sector. Existing dairy initiatives in geographical regions can align with these global DSF criteria so that progress can be aggregated globally. The DSF tracks initiatives being implemented among its members in order to promote collaboration and the sharing of good practices. In 2017, the greatest number of initiatives (51) were all focused on quantifying and reducing greenhouse gas emissions.[72]

- Twelve dairy cooperatives and two industry associations collaborated to form Newtrient LLC. This coalition's goal is to bring together manure management technologies and providers with dairy farmers, researchers and other stakeholders in order to promote adoption of manure management and nutrient recovery technologies and practices.[73]

SUSTAINABILITY STANDARDS

In the U.S., the National Milk Producers Federation's FARM Program™ has developed a voluntary program setting minimum standards for animal care and environmental stewardship. It is the only program in the U.S. exclusively focused on dairy cows. More than 98 percent of the U.S. milk supply comes from participating farms.[74]

In 2017 a new farm worker-led program, Milk with Dignity, was launched in the U.S. focused on supporting compliance towards labor standards that protect workers' human rights.[75]

There are several third-party standards relevant for dairy production, including:

- The USDA National Organic Program's standards include that milk is from cows that get fresh grass, spend at least four months a year grazing in pastures and eat feed that is grown without chemical fertilizers, pesticides or genetically modified seeds. Milk from cows treated with hormones or antibiotics cannot be branded organic.[76]
- The Animal Welfare Approved as well as Certified Humane Raised and Handled® labels apply to dairy products (as well as a range of meat products) that come from farm animals raised in line with animal welfare and environmental standards.
- The Standard for Sustainable Cattle Production Systems was developed in 2010 by the Rainforest Alliance/ Sustainable Agriculture Network and applies to beef and dairy production systems in the tropics.[77]

TRACEABILITY AND SUPPLY CHAIN MANAGEMENT

In order to understand and address supply chain risks, dairy companies should have broad policies in place and a commitment to traceability. In order to mitigate reputational risk in supply chains, a company's policy and commitments to traceability should apply to all members of the supply chain (i.e., to direct suppliers as well as the extended supply chain). Companies are therefore increasingly collaborating with suppliers as well as other stakeholders. This includes finding ways to support suppliers as they take the steps needed to uphold the company's policy.

Supplier support can include education and technical support, support in goal setting or financial incentives to meet new standards. When supply chains are transparent, companies can work with suppliers and supporting industries (e.g., farm equipment, soil amendment or irrigation companies) to promote better management practices. Opportunities to engage include providing loans and other financial incentives for dairy farmers to adopt new technologies and solutions that help them reduce their impacts (e.g., investments in anaerobic digesters, efficient irrigation systems that can handle manure, solar and wind power; upgrades to farm equipment and electronics; nutrient recovery technologies). This is particularly important where the price of milk is regulated (for example, in the U.S.) and producers have limited ability to pass on the cost of investments in the prices they charge.

To be effective in achieving their policies, companies are also increasingly establishing a monitoring and verification process to confirm that suppliers are following through on the company's commitments. Without verification, even the strongest policy leaves a company exposed to reputational and market risks. Verification can be conducted by the company or by a third-party certifier. Leading companies include a protocol for supplier non-compliance that facilitates time-bound action plans for suppliers to return to compliance.

COMPANIES IN ACTION

- General Mills committed to purchasing 100 percent of its directly sourced fluid milk by 2020 from producing regions that demonstrate continuous improvements as measured by the FARM module in the U.S. and other comparable environmental metrics globally. As of fiscal 2017, 83 percent of this milk was sustainably sourced.[78] In California, General Mills is addressing declining groundwater quality and supplies by supporting the California Water Action Collaborative and partnering with its members and local dairy farmers to demonstrate a drip irrigation system that aims to reduce water use, nutrient use and GHG emissions.[79]
- Danone's goal is to have at least 80 percent of its fresh milk supply in compliance with its sustainable agricultural practices by 2020. In 2017, 90 percent of conventional fresh milk from U.S. producers came from farms receiving certification that demonstrates compliance with standards related to proper animal handling and management, food and water quality, as well as housing that promotes animal comfort.[80]
- Unilever committed to sustainably sourcing all of its agricultural raw materials by 2020, a commitment that includes the milk it uses in ice creams—such as Ben & Jerry's—and margarines. At the end of 2017, 74 percent of its dairy products were sustainably sourced globally. Unilever helps suppliers comply with its Sustainable Agriculture Code (SAC) and is moving this program from one based on self-assessment to third-party certification.[81]

  Through its Ben & Jerry's Caring Dairy™ program (using indicators equivalent to the SAC), the company works with dairy farmers in the U.S. and Europe to develop a tailored action plan based on a self-assessment of their operations and provides financial incentives to farmers who participate in the program.[82] In 2016, 85 farms were participating in Caring Dairy with more than half meeting requirements beyond the program's basic standard. Starting in 2018, Caring Diary farms will be certified to a new set of labor standards established through the Milk With Dignity program.
- Dean Foods committed that by 2018 it would require on-farm assessments of all farms that deliver milk to its plants. Through its Dairy Stewardship program, farms are asked to meet certain animal welfare standards and resolve deficiencies within a specific time frame or demonstrate a plan of action for doing so.[83]

ADDITIONAL RESOURCES

- The USDA conducts research on multiple commodities, including dairy.This includes data on production and consumption, prices and trade and is published through the Economic Research Service, Foreign Agricultural Service, and National Agricultural Statistics Service.
- Both The Sustainability Consortium and World Wildlife Fund offer high-level insights and analysis about potential risks and opportunities across a number of commodities, including dairy.
- Several benchmarking and evaluation tools provide insights about companies involved in dairy production. These include:
    - The Coller FAIRR Protein Producer Index by the Farm Animal Investment Risk & Return (FAIRR) investor network assesses how some of the world's biggest publicly listed producers and processors of meat, dairy and fish (a $300 billion group of 60 companies) are managing critical sustainability risk factors.
    - *The Business Benchmark on Farm Animal Welfare Report* (2017) provides an annual evaluation of food company's actions on farm animal welfare. In the 2017 report, 110 companies were assessed. Of the companies with significant operations in the U.S., McDonald's and Unilever are ranked as having the strongest commitments to farm animal welfare.
- The nonprofit Sustainable Conservation has partnered with the dairy industry for over fifteen years to identify, test and promote management practices and technologies that protect air and water quality and reduce greenhouse gases with a particular focus on California. Recommendations are provided in *Greenhouse Gas Mitigation Strategies for California Dairies* (2015) and *Compost: Enhancing the Value of Manure* (2017).
- *Good Practice Note: Improving Animal Welfare in Livestock Operations* (2014) by the International Finance Corporation (IFC), highlights the business case for improved animal welfare and describes good management practices.
- *Tackling Climate Change through Livestock: A Global Assessment of Emissions and Mitigation Opportunities* (2013) by the UN Food and Agriculture Organization (FAO) provides an in-depth analysis of issues and practical solutions for reducing greenhouse gas emissions related to livestock, including dairy cows. This report provides more recent data than the oft quoted 2006 FAO report, *Livestock's Long Shadow*.
- The National Milk Producers Federation has developed several resources including an Environmental Stewardship Continuous Improvement Handbook that focuses on greenhouse gas (GHG) emissions and energy utilization for dairy producers.
- The International Dairy Federation regularly publishes bulletins on issues of concern to dairy sustainability.
- The Innovation Center for U.S. Dairy provides information on studies related to dairy sustainability.
- The Vital Capital Index, produced by Manomet with support from the Innovation Center for U.S. Dairy, consists of 40 field-tested, science-based, practical indicators for on-farm application.

Engage the Chain offers briefs on seven other key commodities, a compelling case for sustainable agriculture and opportunities for action that cut across all types of agricultural commodities.

ENDNOTES

1 Global Milk and Dairy Products Market Report: Industry Size, Share, Growth, Trend and Forecast, Industry Analysis, Overview, Research and Development for 2014. – MarketResearchReports.Biz (accessed at: https://www.linkedin.com/pulse/20141009071241-269904646-milk-and-dairy-products-market)

2 Hoovers, Dairy Products Manufacturing Industry Overview, http://www.hoovers.com/industry-facts.dairy-products-manufacturing.1354.html

3 Hoovers, Dairy Products Manufacturing Industry Overview, http://www.hoovers.com/industry-facts.dairy-products-manufacturing.1354.html

4 International Dairy Federation, Bulletin of the International Dairy Federation 485/2016, The World Dairy Situation 2016

5 Hoovers, Dairy Products Manufacturing Industry Overview, http://www.hoovers.com/industry-facts.dairy-products-manufacturing.1354.html

6 FAO 2018, FAOSTAT database collections, Food and Agriculture Organization of the United Nations. Rome. Data average of 2014-2016 URL: http://faostat.fao.org

7 FAO 2018, FAOSTAT database collections, Food and Agriculture Organization of the United Nations. Rome. Data average of 2014-2016 URL: http://faostat.fao.org

8 FAO 2018, FAOSTAT database collections, Food and Agriculture Organization of the United Nations. Rome. Data average of 2014-2016 URL: http://faostat.fao.org

9 International Dairy Federation, Bulletin of the International Dairy Federation 485/2016, The World Dairy Situation 2016

10 FAO, World Livestock 2011 – Livestock in food security, Table 16. Rome, FAO, http://www.fao.org/docrep/014/i2373e/i2373e.pdf
Note: This definition of dairy is for liquid milk equivalents and excludes butter.

11 FAO 2018, FAO STAT database collections, Food and Agriculture Organization of the Unied Nations. Rome. Livestock primary, producing animals, 2016 URL: http://faostat.fao.org

12 FAO 2018, Dairy Market Review, April 2018

13 Dairy Global, A glimpse at the dairy sector in 2067, April 2018, https://www.dairyglobal.net/Market-trends/Articles/2018/4/A-glimpse-at-the-dairy-sector-in-2067-274710E/

14 Tricarico, Juan M., "A descriptive analysis of how dairy cows convert feed into food in the US", Innovation Center for U.S. Dairy, 2015, www.usdairy.com/-/media/USD/Public/How-dairy-cows-convert-feed-into-food.pdf

15 Watt Global Media, Top 11 US feed-producing companies, Nov 2017, https://www.wattagnet.com/articles/32280-top-11-us-feed-producing-companies

16 United States Department of Agriculture Economic Research Service. Dairy, Overview, http://ers.usda.gov/topics/animal-products/dairy.aspx

17 Dairy Good, Overview, https://dairygood.org/about-us

18 Innovation Center for U.S. Dairy's, "U.S. Dairy's Environmental Footprint: A Summary of Findings", 2008-2012, www.usdairy.com/-/media/USD/Public/DairysEnvironmentalFootprintpdf.pdf

19 Hoovers, "Dairy Product Manufacturing Industry Overview", http://www.hoovers.com/industry-facts.dairy-products-manufacturing.1354.html

20 *Note: Ranking is based on 2016 U.S. system-wide sales.* Data from: QSR, "The QSR 50", Aug 2017, https://www.qsrmagazine.com/content/qsr50-2017-top-50-chart?sort=2016_us_systemwide_sales_millions&dir=asc

21 *Note: ranking is based on sales, as reported in Progressive Grocer*, May 2018, https://progressivegrocer.com/top-50-grocers-amazon-7th-place-while-rest-industry-restrategizes-reshuffles

22 Dairyfoods, Top 100 companies, 2018, https://www.dairyfoods.com/topics/2712-top-100

23 United States Department of Agriculture Economic Research Service. Dairy, Background. http://ers.usd.gov/topics/animal-products/dairy/background.aspx

24 USDA Economic Research Service, Livestock, Dairy, and Poultry Outlook, July 18, 2018, p. 28

25 USDA NASS. "Milk Production Disposition and Income; Bureau of Census", (Dairy Forecasts, July 2016), http://ers.usda.gov/publications/ldpm-livestock,-dairy,-and-poultry-outlook/ldp-m-265.aspx

26 United States Department of Agriculture Economic Research Service. Dairy, Overview, http://ers.usda.gov/topics/animal-products/dairy.aspx

27 Contributions of the California Dairy Industry to the California Economy: http://aic.ucdavis.edu/publications/CMABReport2015.pdf

28 Image adapted from "U.S. Dairy's Environmental Footprint: A Summary of Findings", 2008-2012

30 Emissions from enteric fermentation by ruminants, from agricultural soils and from manure management together represent about 80 percent of annual total non CO2 emissions from agricultural production. Source: IPCC, Fifth Assessment Report 2014, accessible at: https://www.ipcc.ch/report/ar5/wg3

31 Gerber, P.J. Et. Al. "Tackling climate change through livestock - A global assessment of emissions and mitigation Opportunities", 2013. Food and Agriculture Organization of the United Nations (FAO), Rome. http://www.fao.org/news/story/en/item/197623/icode/ Note: These figures exclude emissions from cow manure and cattle used as draught power

32 Dairy Sustainability Framework, GHG Emissions Indicator - Baseline Establishment, October 2017, https://dairysustainabilitynetwork.org/dsf-membership/global-criteria/

33 Agriculture and Agri-food Canada, "Reducing Methane Emissions from Livestock", Dec 17, 2012, http://www.agr.gc.ca/eng/science-and-innovation/science-publications-and-resources/technical-factsheets/archived-content-reducing-methane-emissions-from-livestock/?id=1305058576718; California GHG Emission Inventory, 2016 Edition, http://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_trends_00-14_20160617.pdf

34 Center for Watershed Sciences, University of California, Davis, "Addressing Nitrate in California's Drinking Water", Jan 2012, http://groundwaternitrate.ucdavis.edu/files/138956.pdf

35 Ceres, Feeding Ourselves Thirsty. May 2015, https://www.ceres.org/resources/reports/feeding-ourselves-thristy-how-the-food-sector-is-managing-global-water-risks

36 "Dead zones" are created when a body of water becomes enriched by inorganic plant nutrients, especially phosphates and nitrates, and the resulting growth of algae reduces oxygen for aquatic plant and animal life.

37 National Ocean Service, National Oceanic and Atmospheric Administration (NOAA), "Gulf of Mexico 'dead zone' is the largest ever measured", August 2017, http://www.noaa.gov/media-release/gulf-of-mexico-dead-zone-is-largest-ever-measured

38 National Ocean Service, National Oceanic and Atmospheric Administration (NOAA), "Why do harmful algal blooms occur?", https://oceanservice.noaa.gov/facts/why_habs.html

39 Sustainable Conservation, Dairies. http://www.suscon.org/dairies

40 Jordan, Erin; "2 agree to fines for animal manure discharges that killed fish", AGRINEWS, May 17, 2018, https://www.postbulletincom/agrinews/news/midwest/agree-to-fines-for-animal-manure-discharges-that-killed-fish/article_089650fa-52de-11e8-be2e-fbc1764552d7.html

41 United States Department of Justice, "United States Reaches Settlement With Meadowvale Dairy of Rock Valley, Iowa, for Clean Water Act Violations", Jan 29, 2017, https://www.justice.gov/opa/pr/united-states-reaches-settlement-meadowvale-dairy-rock-valley-iowa-clean-water-act-violations

42 Herron, Seanicaa E. "2018 Outlook for the U.S. Livestock and Poultry Sectors", presentation to World Agricultural Outlook Board, USDA Agricultural Outlook Forum, February 23, 2018, page 12

43 Ceres, Feeding Ourselves Thirsty, May 2015, https://www.ceres.org/resources/reports/feeding-ourselves-thirsty-how-the-food-sector-is-managing-global-water-risks

44 Mekonnen, M. M., & Hoekstra, A. Y., "The Green, Blue and Grey Water Footprint of Crops and Derived Crop Products" Twente Water Center, University of Twente, Netherlands, May 25th, 2011, http://wfn.project-platforms.com/Reports/Mekonnen-Hoekstra-2011-WaterFootprintCrops.pdf (crops; Mekonnen, M.M., & Hoeksra, A. Y., "A Global Assessment of the Water Footprint of Farm Animal Products", Department of Water Engineering and Management, University of Twente, Netherlands, 2012, http://wfn.project-platforms.com/Reports/Mekonnen-Hoekstra-2012-WaterFootprintFarmAnimalProducts.pdf (beef and dairy)

45 Note: Represents the combined "blue" and "green" footprints of dairy

46 Mekonnen, M. M., & Hoekstra, A. Y., "The Green, Blue and Grey Water Footprint of Crops and Derived Crop Products" Twente Water Center, University of Twente, Netherlands, May 25th, 2011, http://wfn.project-platforms.com/Reports/Mekonnen-Hoekstra-2011-WaterFootprintCrops.pdf (crops; Mekonnen, M.M., & Hoeksra, A. Y., "A Global Assessment of the Water Footprint of Farm Animal Products", Department of Water Engineering and Management, University of Twente, Netherlands, 2012, http://wfn.project-platforms.com/Reports/Mekonnen-Hoekstra-2012-WaterFootprintFarmAnimalProducts.pdf (beef and dairy)

47 Note: Represents combined "blue" and "green" footprints of dairy

48 WWF, "WWF Living Forests Report: Chapter 5 - Saving Forests at Risk", 2015; https://www.worldwildlife.org/amazon

49 WWF, "The 2050 Criteria: Guide to Responsible Investment in Agricultural, Forest, and Seafood Commodities", Sept 2012. http://awsassets.panda.org/downloads/the_2050_criteria_report.pdf

50 Note: While there is no common definition of animal welfare, the concept of the "five freedoms" form a widely accepted set of principles or targets: (1) Freedom from Hunger and Thirst (2) Freedom from Discomfort (3) Freedom from Pain, Injury or Disease (4) Freedom to Express Normal Behavior (5) Freedom from Fear and Distress.

51 While there is no common definition of animal welfare, the concept of the "five freedoms" form a widely accepted set of principles or targets: (1) Freedom from Hunger and Thirst (2) Freedom from Discomfort (3) Freedom from Pain, Injury or Disease (4) Freedom to Express Normal Behavior (5) Freedom from Fear and Distress

52 WWF, "The 2050 Criteria: Guide to Responsible Investment in Agricultural, Forest, and Seafood Commodities", Sept 2012. http://awsassets.panda.org/downloads/the_2050_criteria_report.pdf

53 IFC, "Improving Animal Welfare in Livestock Operations", Dec 2014, http://www.ifc.org/wps/wcm/connect/67013c8046c48b889c6cbd9916182e35/IFC+Good+Practice+Note+Animal+Welfare+2014.pdf?MOD=AJPERES

54 FAIRR, "Coller FAIRR Protein Producer Index Report", 2018

55 The PEW Charitable Trust, Antibiotics Use in Food Animals. http://www.pewtrusts.org/en/projects/antibiotic-resistance-project/about-antibiotic-use-in-food-animals

56 Helen Branswell, "Tightened rules for antibiotics for food livestock go into effect", STAT, January 3, 2017 https://www.statnews.com/2017/01/03/fda-livestock/antibiotics/

57 FAIRR, "Responding to resistance: Investor exposure to antibiotic risk, and FAIRR's engagement with the restaurant sector", November 2017

58 Julie Calderone, "The way some meat producers fatten up cattle is more bizarre than you might think", Business Insider, 2016, https://www.businessinsider.com/farmers-fatten-cattle-hormone-implants-2016-4; Andrea Young, "The beef with beef: Use of hormone implants in cattle", Indiana Prairie Farmer, 2016, https://www.indianaprairiefarmer.com/animal-health/beef-beef-use-hormone-implants-cattle

59 Poulter, Catherine; Sayers, Janet. "Retention of Skilled Migrants in the New Zealand Dairy Industry", New Zealand Journal of Employment Relations. May 2015

60 Center for North American Studies, Texas A&M Agrilife Research, "The Economic Impacts of Immigrant Labor on U.S. Dairy Farms", Aug 2015, http://www.agweb.com/article/losing-immigrant-workers-on-dairy-farms-would-nearly-double-retail-milk-prices-naa-news-release/

61 Verite & Manpower Group, "An Ethical for Cross-Border Labor Recruitment", Feb 09, 2012, http://www.verite.org/sites/default/files/ethical_framework_paper_20120209_PRINTED.pdf

62 Verite, "Immigration Workers in US Agriculture: The Role of Labor Brokers in Vulnerability to Forced Labor", June 2010, http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=2174&context=globaldocs

63 www.migrantjustice.net/resources

64 U.S. Department of Labor, Bureau of Labor Statistics, 2016 Census of Fatal Occupational Injuries (final data)

65 Innovation Center for U.S. Dairy, Sustainability Report, 2014, http://www.usdairy.com/sustainability/reporting/us-dairy-sustainability-report

66 National Ag Safety Database, "Livestock confinement dust and gases", http://nasdonline.org/1620/d001501/livestock-confinement-dust-and-gases.html; Washington Post, "National deaths of farmworkers in cow manure ponds put oversight of dairy farms into question", September 2017, https://www.washingtonpost.com/national/deaths-of-farmworkers-in-cow-manure-ponds-put-oversight-of-dairy-farms-into-question/2017/09/24/da4f1bae-8813-11e7-961d-2f373b3977ee_story.html

67 FAO, "Status and Prospects for Smallholder Milk Production: A Global Perspective", 2010, http://www.fao.org/docrep/012/i1522e/i1522e00.html

68 WWF, "The 2050 Criteria: Guide to Responsible Investment in Agricultural, Forest, and Seafood Commodities", Sept 2012, http://awsassets.panda.org/downloads/the_2050_criteria_report.pdf

69 FAO, "Small-scale dairy production: a way out of poverty", Sept 29, 2010, http://www.fao.org/news/story/en/item/44582/icode/

70 The Innovation Center for U.S. Dairy was established through Dairy Management Inc., the nonprofit organization that manages the national diary checkoff program on behalf of America's more than 45,000 dairy farmers as well as dairy importers.

71 Innovation Center for U.S. Dairy, https://www.usdairy.com/sustainability/commitment

72 Dairy Sustainability Framework, Annual Report 2017, https://dairysustainabilityframework.org/wp-content/uploads/2017/10/DSF-2017-Annual-Report-Online-October-2017.pdf

73 Newtrient LLC, http://www.newtrient.com/

74 National Dairy Farm Program, http://www.nationaldairyfarm.com/animal-care#standardsapp

75 Milk with Dignity, https://milkwithdignity.org/about

76 P.J. Huffstutter, "USDA imposes new standards for milk to qualify as organic," Los Angeles Times. Feb 13, 2010, http://articles.latimes.com/2010/feb/13/business/la-fi-dairy13-2010feb13

77 Rainforest Alliance, Sept 2016, http://www.rainforest-alliance.org/work/agriculture/cattle

78 General Mills, https://www.generalmills.com/en/Responsibility/Sustainability/sustainable-sourcing

79 California Water Action Collaborative, http://cawateraction.org/actions

80 Danone, https://www.danone.com/impact/planet/regenerative-agriculture.html

81 Unilever, Sustainable Dairy, https://www.unilever.com/sustainable-living/the-sustainable-living-plan/reducing-environmental-impact/sustainable-sourcing/our-approach-to-sustainable-sourcing/sustainable-dairy.html; Performance in 2017, https://www.unilever.com/sustainable-living/reducing-environmental-impact/sustainable-sourcing/

82 Ben & Jerry's, Caring Dairy, http://www.benandjerry.co.uk/values/how-we-do-business/caring-dairy

83 Dean Foods Dairy Stewardship, http://www.deanfoods.com/dairystewardship/

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