

The Dairy Community's Contributions to Sustainable Nutrition

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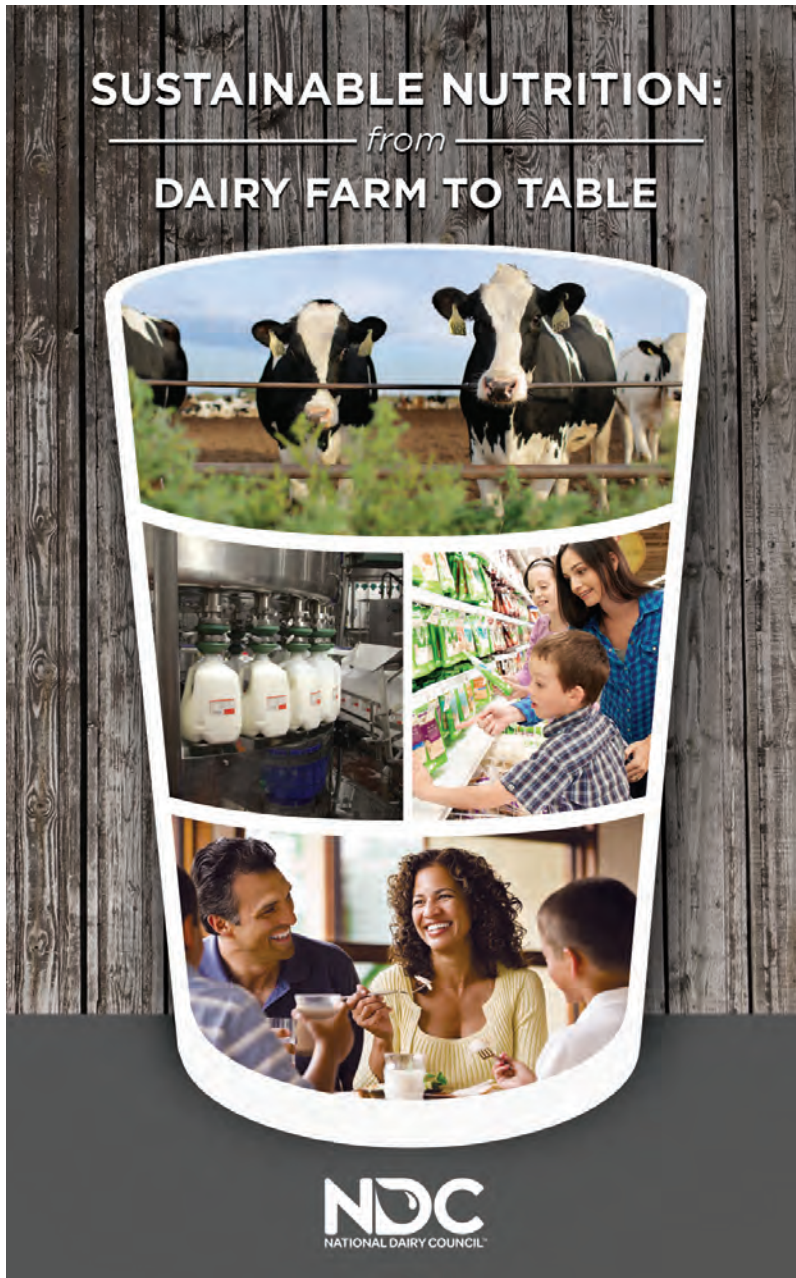
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WHAT SUSTAINABLE NUTRITION MEANS TO THE DAIRY COMMUNITY

Sustainable nutrition is the ongoing science-based pursuit for solutions that provide affordable, accessible, nutrient-rich foods that can nourish the world's growing global population, while also protecting environmental resources.



“If we want to draw the line in the sand and say, ‘this and no more,’ then we need to freeze the footprint of food. And we will have to find ways to produce more with less—more nutrition with less land, water and other inputs.”

Jason Clay, Senior Vice President, Food and Markets, World Wildlife Fund, Inc.¹

“Meeting the challenges of the food and agriculture sectors sustainably could unlock 14 major business opportunities worth U.S. \$2.3 trillion annually by 2030.”

Business and Sustainable Development Commission²

DAIRY AS A DRIVER OF THE SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals (SDGs) – launched by the United Nations in 2015 – are a transformative declaration to improve all lives around the world, while also fostering environmental stewardship. **The SDGs recognize the interconnected dimensions of sustainable development: Economic, Social and Environmental.**¹

How the Dairy Community is Championing the Sustainable Development Goals

The dairy community works to support efforts to make the SDGs vision for the future a reality by



investing in global dairy communities



tracking global sustainability commitments through the Dairy Sustainability Framework and Rotterdam Declaration



advancing research that supports dairy's role in addressing the SDGs

Dairy Embraces the 5 Ps of Sustainable Development

People, Planet, Prosperity, Partnerships and Peace



Key Issues Snapshot



The SDGs are a universal call to action. The dairy community is dedicated to being part of the solution to realizing a world free of poverty and hunger. Learn more at nationaldairyCouncil.org



¹For sources cited here, please visit <https://dairygood.org/content/2018/dairy-as-a-driver-of-the-sustainable-development-goals>
© Copyright National Dairy Council 2018 | Dairy as a Driver of the Sustainable Development Goals

¹⁴Dairy cows as well as buffalo, goats and sheep.
¹⁷Data from 2009

I. Summary: Why Sustainable Nutrition Matters To The Dairy Community

Nutrition has a central role in the global agenda for sustainable development.⁴

Between 2009-2050, the global population is expected to increase by one-third.⁵ Sustainable nutrition solutions will need to meet nutritional, environmental, economic and consumer demands while also increasing food production by 70 percent by 2050 (from 2005-2007).⁵ This requires science and insights, thoughtful explanation, broad collaboration and coordinated efforts from all stakeholders.

Coordination is underway at the global level. In 2015, 193 world leaders gathered to adopt the United Nations (U.N.) Sustainable Development Goals (SDGs).⁶ All U.N. member countries agreed to put food security, health and the protection of the planet at the forefront. The following spring, the U.N. declared 2016-2025 as the Decade of Action on Nutrition, reflecting nutrition's central role in sustainable development. Good nutrition is highly relevant to 12 of the 17 SDGs.⁴

The food and agriculture sectors have the opportunity to serve primary roles in global sustainable development efforts. As an integral part of these sectors, the dairy community has a unique opportunity to contribute to the SDGs and assume a leadership role to shape the future of sustainable nutrition.

This paper is intended to provide an overview of the global sustainable nutrition landscape and the U.S. dairy community's role and vision for sustainable nutrition.



THE DAIRY COMMUNITY'S COMMITMENT TO SUSTAINABLE NUTRITION

The dairy community has made multiple public commitments to a more sustainable future.

Together with the Food and Agriculture Organization of the U.N. (FAO), the International Dairy Federation (IDF) signed the Dairy Declaration of Rotterdam in 2016 as part of the IDF World Dairy Summit.⁷ The declaration committed the global dairy community to sustainable development for the benefit of people and the planet.⁷

The U.S. dairy community demonstrates its continuous commitment to sustainability through the Dairy Sustainability Framework (DSF),⁸ a common global platform to advance sustainability across the dairy value chain. It acknowledges dairy's role and quantifies its contributions and impacts, while setting overarching sustainability goals for the global sector. The Innovation Center for U.S. Dairy®, powered by research-based guidance from National Dairy Council, serves a governance role as the regional affiliate for the U.S. dairy value chain.

These activities are just the beginning. Creating sustainable nutrition solutions that help us all thrive will require our best ideas – and our boldest collaborative efforts.

Each of the following chapters covers key aspects of sustainable nutrition, including the triple burden of malnutrition, building sustainable food systems, agriculture's role in economic development and dietary guidance landscape. The chapters describe key challenges, opportunities and dairy's role in addressing both global and U.S. issues.

The dairy community is prepared to be part of the solution. We invite you to join us.

II. The Triple Burden Of Malnutrition

CHALLENGE

The triple burden of malnutrition (i.e., undernutrition, micronutrient deficiency and overweight and obesity) is a universal challenge felt locally and globally. Malnutrition affects nearly one in three people worldwide.^{10,11}

OPPORTUNITY

Dairy foods, like milk, cheese and yogurt, can provide important nutrients – including calcium, phosphorus, vitamin B12, pantothenic acid (B5) and high-quality protein – required for good health.^{12,13,14}

Malnutrition occurs in some form in every country in the world. The triple burden of malnutrition is one of the greatest challenges of our time. Even in the 21st century, poor diet remains a leading cause of disease.¹⁵

Proper nutrition and basic food security underpin peace and prosperity; thus, malnutrition can have negative long-term consequences.¹⁵ Undernutrition increases the risk of disease and death, drives up health care costs, burdens families and communities, limits educational potential and impedes economic progress.^{16,17}

“Numerous studies suggest that every dollar invested in well-targeted interventions to reduce undernourishment and micronutrient deficiencies can yield from five times to over 20 times as much in benefits.”

– Food and Agriculture Organization of the United Nations⁹

THE TRIPLE BURDEN OF GLOBAL MALNUTRITION

The triple burden of malnutrition – undernutrition (underweight, stunted or wasted), micronutrient deficiency, and overweight and obesity (weight that is higher than healthy for height) – is the greatest contributor to disease globally and affects every country.¹

~1 in 3 people worldwide suffer from some form of malnutrition²

Malnutrition's consequences are far reaching.

- Increases risk of morbidity and mortality with undernutrition³
- In children, can affect normal growth and development⁴
- Inhibits economic progress⁵
- Increases healthcare costs⁶
- Limits educational potential⁷
- Compromises overall health, well-being and quality of life⁸

The Triple Burden of Global Malnutrition

1. Undernutrition

Being underweight, stunted (low height-for-age) or wasted (low weight-for-age)⁹

~815 MILLION people are undernourished around the globe⁷

~3 MILLION childhood deaths (under age 5) globally related to malnutrition⁸

2. Micronutrient Deficiencies

Inadequate consumption of vitamins and minerals⁷

TWO BILLION people are affected by anemia, which is often due to iron deficiency⁹

Vitamin A, iron and iodine are micronutrient deficiencies of greatest public health concern globally.¹⁰

Vitamin D, B12, folate, calcium and zinc deficiencies are described as "important."¹¹

3. Overweight and Obesity

Weight that is higher than what is considered healthy for a given height.¹⁰ Obesity is one of the major risk factors for type 2 diabetes and other metabolic diseases.¹¹

1.9 BILLION adults are overweight or obese globally¹²

41 MILLION children (under age 5) are overweight or obese globally¹²

Malnutrition within the Sustainable Development Goals

The United Nations' Sustainable Development Goals (SDGs) boldly call for an end to malnutrition in all its forms by 2030.¹³

Sustainable Development Goal #2

End hunger, achieve food security, improve nutrition and promote sustainable agriculture¹⁴



U.S. Snapshot

Across the U.S., malnutrition – particularly in the forms of micronutrient deficiency, overweight and obesity – is a reality for adults and children.

31%

of Americans (ages 9+) may be at risk of at least one vitamin deficiency or anemia¹⁵

OVER 70%

of U.S. adults (ages 20+) are obese or overweight¹⁶

ABOUT 10%

of U.S. children ages 2-5 years are obese¹⁷



Overweight and obesity is a risk factor for cardio-metabolic diseases, including hypertension, coronary heart disease and type 2 diabetes¹⁸

The triple burden of malnutrition is a universal challenge. Achieving SDG #2 – ending malnutrition in all its forms – demands a response of unprecedented scale.

Learn more at nationaldairyCouncil.org



For sources cited here, please visit <https://dairypood.org/content/2018/the-triple-burden-of-global-malnutrition>
© Copyright National Dairy Council 2018 The Triple Burden of Global Malnutrition

¹⁸This statistic is based on NHANES 2003-2006 data.



> Undernutrition And Micronutrient Deficiencies

CHALLENGE

815 million people around the world are unable to get enough food (2016).¹¹

OPPORTUNITY

Dairy foods contribute essential nutrients (such as vitamin A and protein) important for nutrient adequacy in undernourished populations worldwide.¹⁵

GLOBAL IMPACTS

How will we nourish more people? The U.N. projects the global population will grow to nearly 10 billion by 2050.¹⁹ A growing population, combined with economic growth, is expected to increase food demand from 2005-2007 levels by about two-thirds.⁵ One-third of this increased demand will be driven by the growing world population,⁵ most of which is expected to come from developing nations.²⁰

Undernutrition affects the youngest and poorest disproportionately. Globally, about 45 percent of the deaths for children under age five are tied to undernutrition – mostly in low- and middle-income countries.²¹ Rates of childhood undernutrition vary by region. Childhood undernutrition is felt by 60 low- and middle-income countries, where fewer than one-third of infants meet minimum dietary diversity standards to ensure proper growth and development.²² Low-income populations often suffer because they lack access to a variety of nutrient-dense foods, including dairy.²³

Micronutrient deficiencies are also particularly hard-hitting in poor and developing nations. Over two billion people are anemic, largely due to iron deficiency.²⁴ Vitamin A and iodine micronutrient deficiencies are also micronutrient deficiencies of great public health concern globally. Vitamin D, B12, folate, calcium and zinc are also important deficiencies.¹⁵

U.S. IMPACTS

Some people in the U.S. are food insecure, meaning they do not have “access at all times to enough food for an active healthy life.”²⁵ In 2016, over 41 million Americans were living in food-insecure households.²⁶ Furthermore, about three-fourths of Americans do not meet the dietary recommendations for fruits, vegetables, whole grains and dairy in the 2015-2020 Dietary Guidelines for Americans (DGA), meaning they may be missing out on nutrients important for supporting health.²⁷ An estimated 31 percent of Americans over the age of nine may be at risk of one vitamin deficiency or anemia.^{i,28}

On any given day, a young child in the U.S. is more likely to get sweets or sugar-sweetened beverages than a serving of fruit or a vegetable.²⁹ Eleven percent of American toddlers don’t meet the recommended dietary allowance for calcium, on average.³⁰

PROGRESS AND OPPORTUNITIES

Addressing malnutrition is a central priority for numerous global initiatives. For example, public and private sectors have made significant progress toward achieving the U.N.’s Millennium Development Goals – the predecessors to the SDGs – of reducing poverty and hunger.³¹ Between 1990 and 2015, the number of undernourished people in developing countries not affected by conflict declined by nearly 50 percent.¹¹

There are additional goals and efforts underway. One of the World Health Organization’s (WHO) top nutrition goals for 2025 is to reduce childhood stunting.³² The World Food Programme (WFP) focuses on the first 1,000 days, a critical period of human development, which encompasses conception through the first two years of life. The WFP is working to ensure that mothers and children have access to nutritious food to help prevent malnutrition and promote healthy development.³³

WHO’S 2025 GLOBAL NUTRITION TARGETS



STUNTING

Target: 40% reduction in the number of children under-5 who are stunted



ANAEMIA

Target: 50% reduction of anaemia in women of reproductive age



LOW BIRTH WEIGHT

Target: 30% reduction in low birth weight



CHILDHOOD OVERWEIGHT

Target: No increase in childhood weight



BREASTFEEDING

Target: Increase the rate of exclusive breastfeeding in the first 6 months up to at least 50%



WASTING

Target: Reduce and maintain childhood wasting to less than 5%

i. This statistic is based on NHANES 2003-2006 data.

II. The Triple Burden Of Malnutrition

Separately, various types of fortification initiatives offer opportunities to improve nutrition. Micronutrient fortification of ready-to-use therapeutic foods (RUTF) can improve nutrition for vulnerable populations. Growers can boost crop nutrition through agronomic practices, selective breeding and biotechnology.³⁵ These advances in biotechnology applications could benefit the world's underprivileged, with biofortified staple crops such as rice, maize and wheat under development.³⁵

As an example, while millions of people depend on rice as a dietary staple, this grain lacks vitamin A, a nutrient essential for healthy vision. To address this, golden rice has been developed using biotechnology to increase its beta-carotene content to help people meet vitamin A requirements.³⁶ Another example of a biofortified crop is cassava, a dietary staple for many in sub-Saharan Africa. It is also being fortified to help prevent vitamin A deficiencies in a project known as BioCassava Plus.³⁷

Innovations in agriculture, food science, technology and other sectors may be key solutions to help end poverty and malnutrition.

► DAIRY'S ROLE

Dairy production, as well as the consumption of nutrient-rich dairy foods like milk, cheese and yogurt, can help alleviate some of the issues related to global malnutrition. Dairy production has significant poverty-reduction implications, especially for women in developing countries, and can contribute to household livelihood, food security and nutrition.³⁸ Milk supplies essential nutrients, including high-quality protein as well as vitamins and minerals required for growth and development throughout childhood.³⁹

The dairy community has the opportunity to help meet demand in developing countries – and contribute nutrients that are important for children recovering from acute malnutrition⁴⁰ – by expanding its capacity to produce and deliver safe, high-quality, nutrient-rich dairy products.⁷ For example, dairy manufacturers can scale their operations to supply wider geographic areas with their products, sharing best practices for everything from plant design and equipment to operator training, distribution methods and retailing practices. Dairy exporters can also extend their global marketing and distribution efforts to meet demand.

A 2014 network survey of Feeding America food banks revealed that milk is one of the most requested and least donated items for food banks.⁴¹ As of 2014, these food banks received an average of just one gallon of milk per person each year, compared to the 68 gallons they need to meet the recommendations of the DGA.^{ii, 42, 43} Some in the dairy community, including processors and retailers, are addressing this need by donating and distributing surplus milk through the Great American Milk Drive and other community and nonprofit initiatives.⁴⁴

Healthy eating patterns, which include low-fat or fat-free dairy foods, are linked to reduced risk of certain chronic diseases, including cardiovascular disease (strong evidence) and type 2 diabetes (moderate evidence).⁴³ Dairy food consumption is also associated with better bone health, especially among children and adolescents.⁴³ In the U.S., milk is the number one food source for three of the four nutrients of public health concern identified by the 2015-2020 DGA – calcium, vitamin D and potassium – for Americans over the age of two.^{45, 46} It can be difficult to match the nutrients in dairy foods with other non-dairy, calcium-equivalent foods in a healthy eating pattern because of dairy's unique nutrient profile.⁴⁷

ii. The 2015-2020 DGA recommends three servings (cup-equivalents) of dairy foods per day for those nine years and older as part of the Healthy U.S.-Style Eating Pattern and the Healthy Vegetarian Eating Pattern. Recommended dairy foods include low-fat or fat-free milk, cheese and yogurt. To convert the three servings per day recommendation to gallons of milk per year:

1 cup= 1 serving of milk

3 cups/d * 7 d/wk= 21 cups/wk

21 cups/wk * 52 wk/yr= 1,0902 cups/yr

(1,0902 cups/yr)/(16 cups/gal)= ~68 gallons/year needed to meet DGA recommendations for dairy food intake


MILK DELIVERS A UNIQUE NUTRIENT PACKAGE


Three Servings of Milk Deliver A Unique Nutrient Package


The Dietary Guidelines for Americans recommends three servings of dairy products each day.*





Milk's essential nutrients can be difficult to replace in a healthy dietary pattern. Three 8-ounce cups provide as much of each nutrient as:


- PROTEIN**
50% DV  4 large (50 g) hardboiled eggs


- CALCIUM**
70% DV  38 cups of raw kale


- PHOSPHORUS**
60% DV  approx. 3 cups of cooked red kidney beans


- VITAMIN B₁₂**
140% DV  approx. 1 lb pork chops

- RIBOFLAVIN (B₂)**
100% DV  0.8 cups of whole almonds

- PANTOTHENIC ACID (B₅)**
50% DV  approx. 5 cups of chopped broccoli

- VITAMIN A**
45% DV  approx. 1.8 cups of fortified ready-to-eat cereal

- VITAMIN D**
45% DV  6.5 oz of sardines (approx. 15 sardines)

- NIACIN (B₃)**
35% DV  approx. six large white mushrooms

*The 2015-2020 Dietary Guidelines for Americans recommends three servings of low-fat or fat-free dairy foods (milk, cheese, yogurt) for Americans 9 years and older.
 Source: U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 28, revised May 2016. Calculations based on low-fat milk (USDA database #01082). Some milk may be a good source of selenium and/or zinc. Other foods used: eggs (#01129), kale (#11233), kidney beans (#16031), pork chops (#10058), almonds (#12061), fortified ready-to-eat cereal (#08508), sardines (#15088), mushrooms (#11260), broccoli (#11090).
 ©2018 National Dairy Council®



Source: National Dairy Council⁴⁸



> **Overnutrition: Overweight and Obesity**

CHALLENGE

Overweight and obesity raise risk of morbidity from numerous conditions, including hypertension, type 2 diabetes, coronary heart disease and stroke.⁴⁹

OPPORTUNITY

Healthy eating patterns, which include low-fat and fat-free dairy foods, are associated with reduced risk for several chronic diseases, including cardiovascular disease (strong evidence) and type 2 diabetes (moderate evidence).⁴³

GLOBAL IMPACTS

Malnutrition also takes the form of overnutrition through overweight and obesity.¹⁵ Globally, in 2016, there were over 1.9 billion adults over the age of 18 who were overweight, and more than 650 million adults had obesity.⁵⁰

Rates of overweight, obesity and other diet-related chronic diseases – such as type 2 diabetes and hypertension – are growing in nearly every region.⁵⁰ Nearly half of the children worldwide under the age of five with overweight or obesity live in Asia (2016 data).⁵⁰ In Africa, the number of overweight children under the age of five has increased by nearly 50 percent since 2000.⁵⁰

Although economic development usually increases a country's food supply, the FAO concludes that it doesn't always improve nutritional adequacy.⁵¹ When traditional diets are displaced by calorie-rich, nutrient-poor foods, people in developing countries may suffer the consequences, such as excess calories consumed and growing rates of obesity.^{52, 53}

Obesity puts people at risk for more than 30 associated chronic health conditions.⁴⁹ By 2020, the WHO projects that the number of global deaths attributable to chronic conditions such as heart disease and diabetes will reach 44 million, an increase of 15 percent globally between 2010 and 2020.⁵²

U.S. IMPACTS

The average American's eating habits – too many calories, too few nutrients – is related to the nation's high rates of obesity and other associated chronic diseases.⁴³ Beyond their significant health impact, obesity and associated chronic diseases also have an economic impact.⁵⁴

In the U.S., five chronic conditions cost our nation nearly \$347 billion (2010).⁵⁵ This is 30 percent of total health spending. The annual loss of economic productivity due to obesity alone is projected to total between \$390 and \$580 billion by 2030.⁵⁵

PROGRESS AND OPPORTUNITIES

New tools are emerging each day that boost awareness and education about good eating habits, improved access to nutrient-rich foods and the importance of regular physical activity to help reduce rates of obesity and related non-communicable diseases. For example, people are adopting technology-driven tools to help them make good food and lifestyle choices.^{56,57} Increasingly intelligent and adaptive technology is being developed to enable better evaluation of personal nutrition and health variables – and more personalized, precise guidance for users.

Progressive consumers want information that is uniquely tailored to their own individual needs – and many are finding data-driven guidance in app-connected wearables that allow them to customize their experience.⁵⁸

Self-monitoring apps and websites, such as MyFitnessPal, help people track food and calorie intake. Other apps assist those with chronic disease management, such as blood-sugar or blood-pressure monitoring.⁵⁹

Nutrition and health-coaching apps are connecting people with nutrition counseling through smart phones or websites. Nutrition guidance provided by these tools and technologies can be used to offer the best available science-based information, including guidance on consuming adequate nutrients within calorie limits by choosing nutrient-dense foods like low-fat or fat-free milk, cheese and yogurt.

► DAIRY'S ROLE

Milk, cheese and yogurt provide nutrients like calcium and protein essential to normal growth and development⁶⁰ that make them an important part of healthy eating patterns for children and adults. Moderate- to high-quality evidence indicates that total dairy intake is associated with reduced risk of stroke, hypertension, metabolic syndrome, and type 2 diabetes, according to a 2016 systematic review.⁶¹ A 2016 analysis of prospective studies indicated that each daily serving of dairy foods was linked to a 13 percent reduced risk of childhood overweight and obesity.⁶² More research is needed to evaluate the link between dairy foods and body weight. By maintaining a dialogue with the health and wellness sector regarding nutrition, product and environmental research – as well as the nutritional value of dairy foods – the dairy community can encourage healthy eating patterns and lifestyle choices.

DAIRY: PART OF THE SOLUTION TO THE TRIPLE BURDEN OF GLOBAL MALNUTRITION



The dairy community supports and champions ongoing solutions to address the triple burden of malnutrition:

1. **Undernutrition**
(underweight, stunted or wasted)
2. **Micronutrient Deficiency**
(inadequate consumption of vitamins and minerals)
3. **Overweight and Obesity**
(weight that is higher than healthy for height)

Because the health of future generations depends on the health of our planet,² sustainable diets must be at the core of the global response to this triple burden. Considerations include:



Shifting food demands



Population growth and longer lifespans



Changing climate



Growing urbanization



Nourishing more people with fewer resources

Dairy Can Help

Dairy foods and ingredients can be a bridge to the Sustainable Development Goals (SDGs) – helping connect secure and sustainable food systems to the health, economic, environmental, and social challenges presented by malnutrition.



Up to 1 billion
People and their livelihoods depend on dairy³



4 trillion servings
Anticipated global milk demand by 2050
(8oz fresh milk equivalents)⁴

Eating nutrient-rich dairy foods like milk, cheese and yogurt can help alleviate some of the issues of global malnutrition.



Milk supplies essential nutrients, including high-quality protein, vitamins and minerals required for appropriate growth and development throughout childhood⁵



Consumption of high quality dairy proteins – including whey proteins⁶ – has been linked to better rates of weight gain among children recovering from severe acute malnutrition⁷



A 2016 analysis of prospective studies indicated that each daily serving of dairy foods was linked to a 13% reduced risk of childhood overweight and obesity.⁸ More research is needed to understand the types of dairy foods and the link to body weight

U.S. Snapshot

Dairy nourishes children and adults in the U.S. The dairy community remains committed to ensuring the affordability and accessibility of nutrient-rich dairy foods.



Milk is the number one food source of calcium, vitamin D and potassium, all of which are nutrients of concern, along with fiber in the diets of both U.S. children and adults^{9,10}



On average, school-aged children in the U.S. fall short of current milk and milk product dietary recommendations,¹¹ but school meals are considered a way to help fill this gap¹²



Milk is among the most requested and least donated food bank items in the U.S.¹³



1 gallon of milk (amount received by U.S. food banks per person per year)¹⁴ vs. 68 gallons of milk (amount needed to meet USDA recommendations per person per year)¹⁵

The triple burden of malnutrition is a universal challenge. Achieving SDG #2 – ending hunger and malnutrition in all its forms – demands a response of unprecedented scale. The dairy community is prepared to be part of this response.

Learn more at nationaldairyCouncil.org



III. Building Sustainable Food Systems

CHALLENGE

Between 2009 and 2050, the global population is projected to grow by one-third, requiring a 70 percent increase in food production (from 2005-2007 levels)⁵– in the face of fewer natural resources and climate change.

OPPORTUNITY

Dairy cows and farmers around the world can help enable the sustainable food systems of the future.

Human activities use resources and impact the environment. Agriculture requires inputs and resources like land, water and fertilizers that support the production of food for the population. At the same time, agriculture and its associated activities can also generate negative outputs, such as greenhouse gases (GHGs) and pollutants. Agriculture affects and is affected by climate and the biological interactions between coexisting plants and animals (e.g., pollinators).

Since the food and agriculture sectors depend on natural resources, their commitment to environmental stewardship – and sustainable food systems – amounts to self-preservation.

Nourishing a growing world population while reducing environmental impacts will require food and agriculture systems to integrate their conservation and efficiency efforts. These sectors will also need to collaborate closely to document impacts, while working to continuously improve their environmental footprint.⁶⁵

The linkages between dairy, its societal benefits and the environment are complex. The potential for improvement and change is recognized within the global dairy community through the establishment of a common global platform to advance sustainability across the dairy value chain.

“We need to figure out how to feed the world without depleting our natural resources.”

José Graziano da Silva,
Director-General of the Food and Agriculture Organization of the United Nations⁶⁴

III. Building Sustainable Food Systems

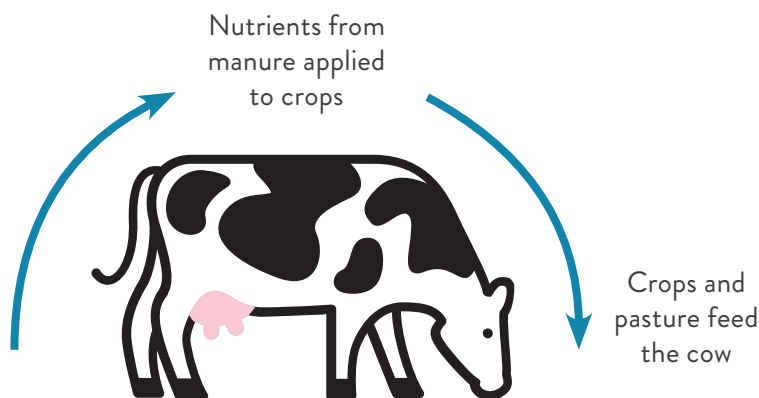
The DSF was established for dairy organizations worldwide to map and connect their sustainability activities in a credible and consistent manner.⁶⁶

Recognizing that there is no single, “best” way to produce dairy that fits every circumstance and location, the DSF enables regional setting of priorities and measures and the quantification of progress. In the U.S. market, the Innovation Center for U.S. Dairy[®] convened a multi-stakeholder group to develop the U.S. Dairy Stewardship and Sustainability Framework (U.S. Dairy Framework), which aligns with the DSF and provides the national platform for global reporting.

The Stewardship and Sustainability Framework for U.S. Dairy

The U.S. Dairy Framework was developed by the Innovation Center for U.S. Dairy[®] with input from a multi-stakeholder group of Dairy Sustainability Alliance[®] members to support dairy cooperatives, processors, manufacturers and milk marketing organizations that choose to voluntarily track and communicate sustainability progress. The U.S. Dairy Framework defines indicators and metrics that enable the dairy community to track, measure, and communicate social responsibility and continuous improvement. Metrics are based on U.S. industry-aligned measurement and reporting tools, particularly the National Dairy Farmers Assuring Responsible Management (FARM) Program and a Dairy Processor Handbook jointly developed with the International Dairy Foods Association (IDFA).

The U.S. Dairy Framework metrics are used at the international level for DSF global reporting. Dairy processors and cooperatives formally recognized as DSF members are those who participate in the Innovation Center for U.S. Dairy[®], are members of the Dairy Sustainability Alliance[®], and are enrolled in or source only from FARM program-enrolled dairy farms. DSF in turn maps to the SDGs, providing U.S. dairy with a local-to-global platform to communicate U.S. dairy’s essential role in sustainable 21st century food systems.



Source: Innovation Center for U.S. Dairy[®]⁶⁷



> Greenhouse Gases and Climate Change

CHALLENGE

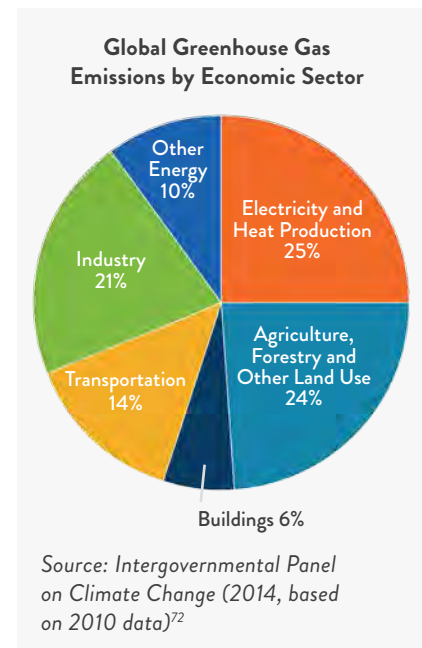
Agriculture, forestry and other land use contributed 24 percent of total GHG emissions in 2010.⁶⁸

OPPORTUNITY

Agriculture and dairy can be part of the solution to climate change.

GLOBAL IMPACTS

Agricultural practices release GHGs into the environment, which trap heat. Their accumulation in the Earth's atmosphere is linked to global warming and more extreme weather events associated with climate change.⁶⁹ A recent model predicts a 95 percent chance that the global climate will warm by at least two degrees Celsius by 2100.⁷⁰ Global animal agriculture (poultry, cattle, pigs, sheep, buffalo and others) contributes 14.5 percent of total GHG emissions related to human activity.⁷¹



U.S. IMPACTS

Sectors like transportation and industry have higher GHG footprints than agriculture alone. Agriculture contributes nine percent to total U.S. GHG emissions (2016).⁷³ Roughly two-thirds of this is the result of livestock production, with cropland agriculture, including grains like rice, contributing most of the rest.⁷⁴

Food accounts for 10-30 percent of a U.S. household's carbon footprint.⁷⁵ Other aspects of lifestyle, including travel and housing, make up a larger percentage of an individual's GHG footprint (i.e., 35-70 percent). Food waste and loss as well as overconsumption accounted for about 34 percent of an average American's food-related carbon impact in 2010. Managing portion control and eliminating food waste would reduce the average American's total carbon footprint.⁷⁶

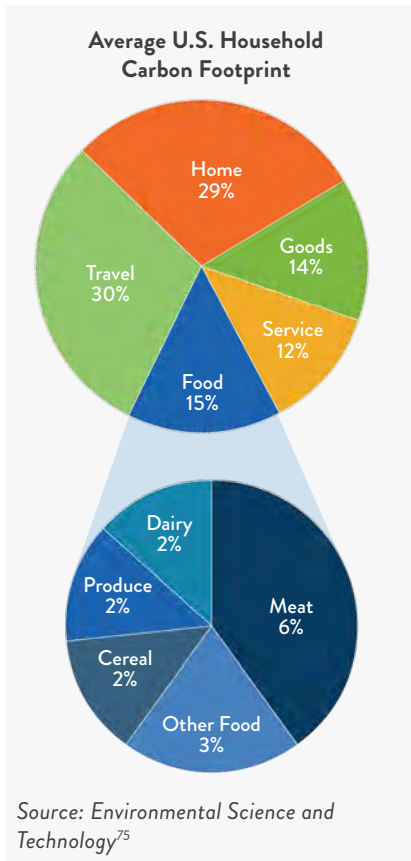
PROGRESS AND OPPORTUNITIES

While agriculture contributes significantly to GHG production, it can also be part of the solution to climate change.⁷⁷

The Intergovernmental Panel on Climate Change (IPCC) notes that until now, most of the climate change focus has been on mitigation, carbon capture and storage and reforestation – with more research needed to determine agriculture's potential.⁷⁸

Scientists estimate that on a global scale, agriculture could reduce carbon dioxide concentrations in the atmosphere by storing it in plant biomass and soils, contributing to a climate change solution. In turn, the increased soil carbon enriches the soil, potentially increasing crop yields and enhancing food security.⁷⁹ According to a 2010 USDA publication, changing farming practices could play a significant role in reducing GHG emissions from agriculture.⁸⁰

One initiative exploring this possibility is the “4 per 1000” project, which states that if soil carbon was increased worldwide by 0.4 percent (or 4 parts per thousand) annually, it would stop the increase in atmospheric carbon.⁸¹ More carbon is stored in the soil than in living plants and animals combined,⁸² and effective soil management could be a powerful weapon in the fight against climate change.



Global agriculture could contribute to a climate change solution.

Effective soil management could be a powerful weapon in the fight against climate change.

III. Building Sustainable Food Systems



► DAIRY'S ROLE

In 2008, the dairy community prioritized the reduction of GHG emissions. It began conducting lifecycle assessments (LCAs) as a way to measure carbon impact and establish an accurate baseline for fluid milk and other dairy products.

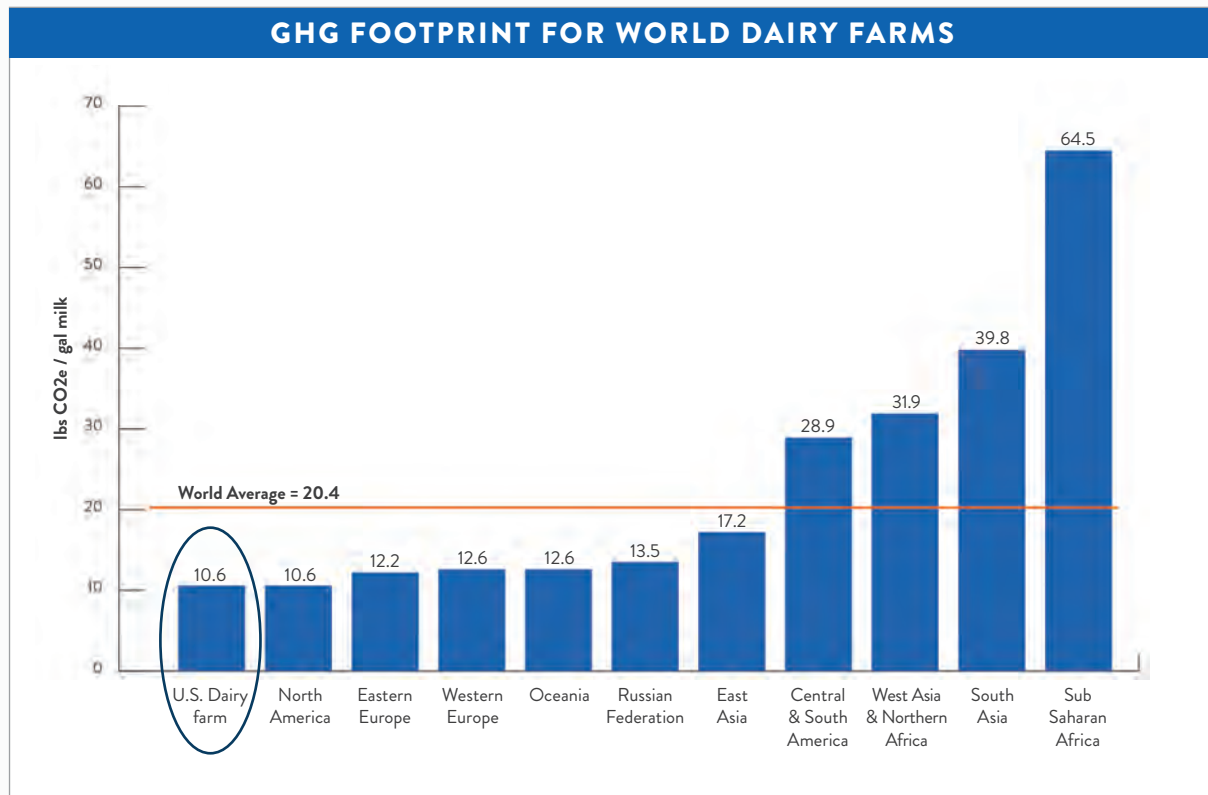
What is a Life Cycle Assessment?⁶⁷

- A LCA studies the environmental impact throughout a product's life cycle, from farm to table.
- A LCA is a science-based and quantifiable approach that provides a clearer picture of the impact of industries and products.
- A LCA identifies and helps prioritize both risks and opportunities that individual farms or businesses can use to set goals, identify improvements and track progress.

The assessments showed that production of all dairy products in the U.S. accounts for approximately two percent of the nation's total GHG emissions (2010).⁸³ Globally, milk production, processing and transportation contribute 2.7 percent of total GHGs (2010).⁸⁴

Dairy cows' GHG emissions come from enteric fermentation, part of their digestive process, as well as manure storage and management.⁸⁴ Methane, the GHG that contributes the most to the global warming impact of milk production,⁸⁴ has a global warming potential over a 100-year period about 28 times higher than that of carbon dioxide.⁸⁵

The dairy community is taking active measures to reduce methane emissions. Research efforts are directed at dairy feed composition, delivery, processing and supplementation, as well as plant breeding and dairy cow health and breeding. The dairy community is also evaluating a wide variety of technologies to collect, handle, process and store dairy manure.⁸⁶



Milk in North America is produced with fewer carbon emissions per gallon than anywhere else in the world, making the U.S. a global leader in efficient dairy production.^{84, 87}

In addition, the dairy community’s improved breeding practices, advanced management practices and innovative technology have helped mitigate its environmental impact. Today, North American and European dairy cows are remarkably efficient, producing four times more milk than the world’s average cow – while generating the lowest GHG emissions per gallon.⁸⁴

From 1944 to 2007, the U.S. dairy community reduced its carbon footprint by nearly 65 percent,⁸⁸ and much of that progress happened before the dairy community began carbon accounting. At the time, many of these carbon reduction measures were considered good farming business decisions and production improvements.

The U.S. dairy community is continuing to make strides to reduce its carbon footprint. In 2012, it voluntarily committed to a carbon reduction goal of 25 percent by 2020.

As rising global demand for protein⁵⁸ could lead to increased worldwide dairy consumption, production and development, the global dairy community has an opportunity to reduce its environmental footprint by investing in better management practices and adopting best practices in technology. The global adoption of yield improvements and feed efficiencies, as well as how manure and human food byproducts are used, will also contribute to more resilient food systems. These efficiencies are attainable by dairy as well as other agricultural sectors.



> Land Use

CHALLENGE

Land is one of the most important resources in the food and agriculture sector, yet only about one-third of our total land mass may be suitable for farming.⁸⁹

OPPORTUNITY

Animals can efficiently provide nutrition from lands that cannot sustain crops. Animals eat a variety of crops and coproducts, converting many foods people can't or won't eat into more nutrient-rich foods to help nourish people.^{90, 91}

GLOBAL IMPACTS

Land is one of the most important resources in the food and agriculture sector, yet only about one-third of the world's total land mass may be suitable for farming. Meanwhile, the growing population, increased development and agriculture are all competing for land use. As a result, there are more opportunities to impact the land in unintended ways, especially in the process of land transformation and occupation. In developing countries, deforestation occurs as farmers clear forests to make land available for cultivation.⁹² At the same time, cities are converting valuable farm and ranch land for human occupation.⁹³

As of 2015, 11 percent of the world's total land surface was used in crop production. This is about one-third of the land that potentially could be used for farming. Not all of the remaining land is available for agriculture, as some is already in use, is protected or is not ideal for productive farming.⁸⁹

Raising animals on land that cannot sustain crops is an important part of the food system, since less than half of the Earth's surface area can be used for farming. Many lands are not suitable for crop production due to weather or soil conditions. But these areas may be suitable for grazing animals, extending the productivity of marginal land for food production. This makes it essential to optimize yields on land that is already being farmed.⁸⁹

U.S. IMPACTS

In the U.S., farmlands are essential to our future food security. Just over 40 percent of our available land is under the stewardship of farmers as of 2012,⁹⁴ but we lose 175 acres of farmland every hour to development and urban sprawl.⁹⁵ And in North America, arable land declined by two percent annually from 1961-1963 to 2006-2007.⁹⁶

PROGRESS AND OPPORTUNITIES

Farmers have always worked to improve yields. Today, there is an added impetus to boost nutritional yields more sustainably, from every arable acre. Applying precision agriculture techniques – including precise applications of fertilizer and irrigation – is one way farmers are producing more food efficiently while mitigating environmental impacts.

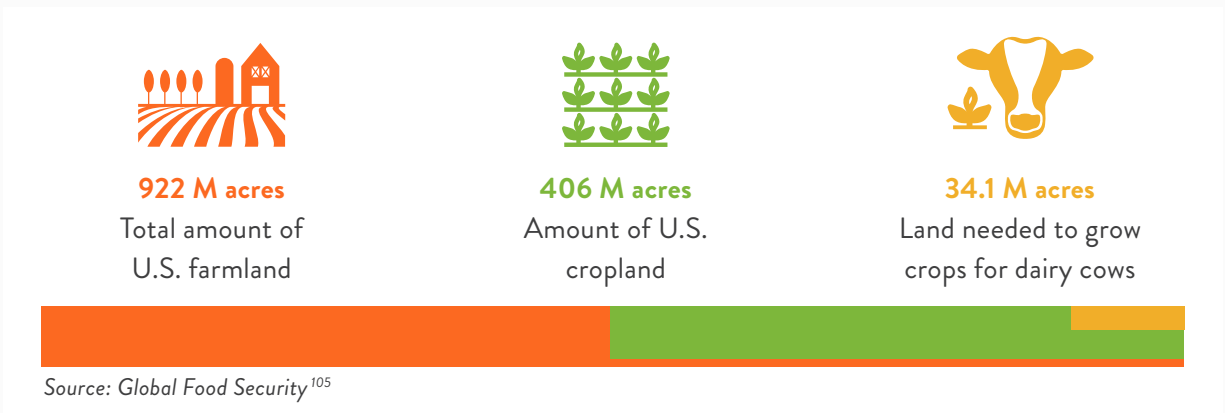
Today's agriculture is also addressing its impact on soil health, the foundation of the food system. Erosion from conventional tillage and cropping practices can deplete soil health and water retention capacity. By reintroducing organic matter, such as manure, into the soil, farmers can improve soil structure, drainage and aeration, increase water and nutrient storage capacity and increase the activity and number of soil microorganisms, which further improves soil structure.^{97, 98, 99, 100, 101, 102}

Farmers are exploring a wide variety of innovative alternative food production methods, such as hydroponics, aquaponics, aeroponic and vertical farming, which are practices that can be applied in urban environments. Algae also shows promise, with potential for multiple uses, including as a human food.¹⁰³

► DAIRY'S ROLE

Much of dairy's effective land use can be credited to the efficiency and stewardship of dairy farmers. The U.S. dairy community has worked to improve the efficient conversion of animal feed, which is digested by the cow's unique four-chambered stomach and turned into nutrient-rich milk. The land area required to produce feed crops for dairy cows is only 3.7 percent of total U.S. farmland and 8.4 percent of U.S. cropland (2008).⁶⁷

On a global scale, the primary milk-producing animals (i.e., dairy cows, sheep, goats and buffaloes) require about one billion hectares of land, equal to seven percent of total land on earth.¹⁰⁴ Most land used for livestock feed production is grassland.¹⁰⁵



Some people believe animal feed production competes with human food production for renewable and nonrenewable resources, including land. Since the most productive and easily arable land is limited, these groups argue that animal agriculture occupies land that could be better used to grow plant-based foods that feed people directly.¹⁰⁵

These arguments fail to consider that farm animals eat a variety of crops and coproducts, converting many foods people can't or won't eat into more nutrient-rich foods to help nourish people. In fact, 80 percent of what cows eat can't be digested by people.⁹⁰

Cows eat coproducts and byproducts from edible human foods such as pulp, peels, pits and seeds from fruits and vegetables, as well as hulls from almonds.⁹⁰ Cows are able to unlock nutrition from plants, which may have little protein of varying quality, and turn it into milk, which contains high-quality protein and eight other essential nutrients to help nourish people. In many ways, dairy cows are nature's recyclers.

Using these coproducts and byproducts in animal feed is an economically and environmentally sustainable way of repurposing them so they don't go to landfills.

The dairy community works to continuously improve efficiency in sustainable farming practices – combined with the dairy cow's inherent nutrient recycling capabilities – to help mitigate the competition between feeding dairy cows and feeding people, one of several overarching environmental concerns.



> Water Use, Quality and Scarcity

CHALLENGE

Every continent is now experiencing the effects of water scarcity.¹⁰⁶

OPPORTUNITY

In times of drought, dairy farmers can switch to less water-intensive feed crops and safely reuse water for various farming needs.

GLOBAL IMPACTS

As global population growth and economic development increases competition for water, access to adequate water is becoming a growing concern for agriculture stakeholders around the world.¹⁰⁷ Climate change is likely to alter both water availability and consumption as warming conditions increase people's and animals' need for water.^{107, 108, 109, 110, 111, 112, 113, 114}

U.S. IMPACTS

Water scarcity is a growing concern in the U.S., where rates of groundwater withdrawal are greater than its natural replenishment in some areas.¹¹⁵ Agriculture accounts for about 80-90 percent of the consumptive water use in the U.S., which means water actually consumed by crop plants.¹¹⁶ Almost all rain and snow that falls in the contiguous United States falls first on private lands, a large portion of which is farmland.¹¹⁷ Well-managed farm and ranch lands filter this water for streams, estuaries and aquifers.

PROGRESS AND OPPORTUNITIES

While there is enough freshwater on the planet for seven billion people, it is distributed unevenly – and too much of it is wasted, polluted or unsustainably managed.¹¹⁸

Because agriculture is dependent on consistent water supplies, farmers can play an important role in water resource management. Approximately 70 percent of all the water used in the world is managed by farmers and ranchers.¹¹⁹ Many resources regarding water management and conservation best practices are available to farmers.¹²⁰

► DAIRY'S ROLE

While dairy production uses a small fraction of total water – just over five percent of total U.S. water withdrawal⁶⁷ – the dairy community is dedicated to responsible water use.

Conservation practices extend to how feed is grown for cows, where most water (i.e., 93.5 percent) is used in dairy farming, and to other necessary on-farm activities that require water (i.e., 3.6 percent).⁶⁷

In times of drought, dairy farmers can switch to less water-intensive feed crops. Many farmers also safely reuse water for various farming needs by using specialized technologies and processes to recycle water.

Dairy farmers can reuse water as many as five or six times. For example, water used to clean milking parlors can be reused to clean production areas and then to irrigate fields. Modern dairy farms also often use heat exchangers, a technology that uses water to aid in more efficient cooling of milk. Then, that water can be used again for other farming needs.

To protect water quality, farmers can use precision farming and climate-smart agriculture techniques that allow them to apply products like fertilizers more selectively and sparingly, reducing crop inputs while minimizing runoff.

Investing in precision agriculture best practices and technologies, high-efficiency irrigation and the development of drought-tolerant varieties of crops are critically important steps to help ensure sustainable food systems.

IV. Agriculture's Role in Economic Development

CHALLENGE

Around the world, the livelihoods of 2.5 billion people in developing nations depend on agriculture.¹²²

OPPORTUNITY

The dairy value chain offers unique economic stability. Dairy farming can produce marketable food 365 days of the year.

When agriculture grows, economies grow.¹²³ Today, with the expected population boom and increase in global trade, the agriculture sector has the opportunity to help transform economies and sustain economic growth.

Agricultural development will need to reflect each nation's food policies, values and modes of farming and production – while also accommodating global food sources and trade, if regional supplies are threatened by natural events or limited natural resources.

Increasingly volatile and extreme weather patterns – and the resulting price fluctuations – will continue to alter the economic landscape of countries, reinforcing the need to invest in agriculture and food resiliency in the coming decades.¹²⁴

GLOBAL IMPACTS

In many developing economies, agriculture, in the form of small farms, is the most effective way for individuals to provide for themselves and their families. Their ability to weather the challenges of climate change will be key to continued economic growth.¹²²

In these regions, livestock are used to pull farm implements, like plows, and as a regular source of food and income for farmers.¹⁰⁴ They are also among the most popular assets for rural women, as livestock is more easily acquired than land and other financial assets, making it important to the empowerment of women in developing countries.^{104, 125}

“... ere long, the most valuable of all arts will be the art of deriving a comfortable subsistence from the smallest area of soil.”

Abraham Lincoln¹²¹

U.S. IMPACTS

America's food and agriculture sectors are the nation's twin engines, propelling the economy and fueling the nation. It all starts with the land.

There are over two million farms and ranches on U.S. soil in 2012, creating livelihoods for generations of families from coast to coast.⁹⁴ Food and beverage companies and retailers complete the value chain to get the food to the public. The dairy value chain provides high-quality nutrition for people to enjoy in their homes as well as in restaurants where more than 14 million Americans work.¹²⁶

Over the years, agriculture has become increasingly efficient, helping keep food costs in the U.S. low. Americans spent an average of 11.4 percent of their disposable household income on food in 2014.¹²⁷

The food and agriculture sectors will continue to play an integral role in economic growth and standard of living.

PROGRESS AND OPPORTUNITIES

The next 40 years will be unprecedented in the history of agriculture. Each growing season, farmers around the world will be called to increase their knowledge and ingenuity to optimize production of nutrient-rich foods.

They will also be challenged by the stark reality of unpredictable climate conditions and volatile global trade, which are factors that affect pricing, and consequently, food access and nutrition security. In recent decades, U.S. agriculture has made tremendous improvements in yields. Now, with an understanding of carbon impacts from farming and introduction of precision agriculture, farmers can consider yields, inputs and soil in the context of the environment. Instead of only focusing on yield, sustainable agriculture is driven by the need to optimize for both yield and environmental impact.

► DAIRY'S ROLE

Dairy generates employment opportunities throughout its value chain. Globally, up to one billion people derive their livelihoods from dairy, including traditionally disadvantaged segments of society, from small landholders to laborers and women.¹⁰⁴ In 2013, approximately 150,418 employees worked on American dairy farms – with an average of 5.1 workers per farm.¹²⁸

The year-round income from dairy farming allows for savings and diversification of crops. The dairy community and the nutrient-rich milk and dairy foods they provide can help nourish the global food economy – now and for generations to come.

V. Dietary Guidance Landscape

CHALLENGE

Food-based dietary guidelines (FBDG) recommend foods that will help meet nutrient needs and promote health. Increasingly, guidelines are being called on to reduce environmental impact and provide sustainable solutions to the triple burden of malnutrition.¹⁵

OPPORTUNITY

Developing healthy eating patterns and sustainable food systems requires holistic solutions that account for environmental, social and economic aspects of sustainability. Dairy foods can be part of healthy and sustainable eating patterns.

Many countries rely on FBDG, such as the Dietary Guidelines for Americans (DGA) in the U.S., to define healthy eating patterns. Ideally, these guidelines use best practices and science to identify eating patterns that meet nutrient and calorie recommendations, support growth and maintenance of health at all life stages and reduce the risk of chronic, non-communicable diseases. Recently, adding sustainability concepts to FBDG has been proposed;¹²⁹ if these proposals are implemented, integration of nutrition and sustainability may require new definitions and approaches.

In 2010, FAO defined the concept of sustainable diets including multiple characteristics of eating patterns that address sustainability priorities. FAO defines sustainable diets as “those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.”¹³⁰ FAO, however, does not define the foods that fit into a “sustainable diet.”

In 2014, the FAO and WHO jointly organized the Second International Conference on Nutrition (ICN2) “to address the multiple challenges of malnutrition in all its forms and identify opportunities for tackling them in the next decades.”¹³¹ The resulting Rome Declaration on Nutrition recognized and described the importance of both healthy diets and sustainable food systems in this context, as follows:

- Nutrition improvement requires healthy, balanced, diversified diets, including traditional diets where appropriate, meeting nutrient requirements of all age groups, and all groups with special nutrition needs, while avoiding the excessive intake of saturated fat, sugars and salt/sodium, and virtually eliminating trans-fat, among others;
- Food systems should provide year-round access to foods that cover people’s nutrient needs and promote healthy dietary practices;
- Food systems, including all components of production, processing and distribution, should be sustainable, resilient and efficient in providing more diverse foods in an equitable manner, with due attention to assessing environmental and health impacts.¹³²

The food and nutrition landscape is changing.

In the current environment, the challenge for dairy will be to continue to demonstrate the value of dairy foods by highlighting the well-established nutrient contributions and health benefits of dairy foods, as well as the full breadth of dairy’s social, economic and environmental contributions to sustainability.

GLOBAL IMPACTS

FBDG provide recommendations about foods to consume to meet nutrient needs and promote health. Dietary guidelines often form the basis of food and nutrition policies, and they can impact the health and wellness marketplace by helping define what constitutes healthy eating.

Extensive evidence supports the role of dairy foods in FBDG, though there is no single diet that is appropriate for everyone. According to the WHO, “The exact make-up of a diversified, balanced and healthy diet will vary depending on individual needs (e.g., age, gender, lifestyle and degree of physical activity), cultural context, locally available foods and dietary customs.”¹³³

In the face of undernutrition, dairy foods provide important nutrients often missing in diets of at-risk populations, including children.¹³⁴ An extensive review of milk and health by the FAO³⁸ found that milk consumption is associated with better linear growth and nutrient status in undernourished or socioeconomically underprivileged children. In undernourished children, milk is likely to supply nutrients that are deficient in the diet and important for growth, and milk can help support growth and development, especially during the first two years of life.

Emerging data show a link between dairy food consumption and reduced risk for non-communicable diseases.⁶¹ Healthy eating patterns like the DASH or Mediterranean diets, which include low-fat or fat-free dairy foods, are associated with reduced risk for key chronic diseases, including cardiovascular disease (CVD) and type 2 diabetes.¹³⁵ Studies published since the 2015-2020 DGA, have found total dairy food consumption is not associated with increased risk for CVD or coronary artery disease (moderate to high quality evidence), and it is associated with reduced risk for stroke (moderate quality evidence).^{61,136,137}

Currently, few FBDG include sustainability criteria, but there is momentum to change that.

The 2016 FAO report, “Plates, Pyramids and Planet,” found that out of the world’s 215 countries, only 83 surveyed had formal FBDG – and only four included sustainability considerations. The report outlines opportunities to change food systems and dietary patterns to be more healthful and respectful of environmental limits. It also highlights FBDG as a policy tool to achieve change.¹³⁸

Given FAO’s support of this perspective, there may be increasing efforts by countries to develop or adopt FBDG that include recommendations that consider sustainability.

When integrating FBDG and sustainability, the role of animal foods has been questioned on the basis of health and environmental impacts.¹²⁹

A definition of sustainable food systems that includes a balance of environmental, social and economic impacts, and a science-based approach to developing FBDG is needed to address health and sustainability. For example, the 2016 Foresight Report²² by the Global Panel on Agriculture and Food Systems for Nutrition stated, “Animal source foods (e.g., dairy, eggs, fish and meat) provide important nutrients. Policy support for these foods should be pragmatically evidence-based rather than driven by ideology.”²²

U.S. IMPACTS

Dairy foods have been part of the Dietary Guidelines for Americans (DGA) since the first one released in 1980 was built on guidance using the basic food groups, including the “milk, cheese, and yogurt” group.¹³⁹ Since 2005, the DGA has recommended three servings of low-fat or fat-free dairy foods for Americans nine years and older as part of a healthy eating pattern to meet nutrient needs. This recommendation continued as a core part of the Healthy U.S.-Style Eating Pattern in the 2015-2020 DGA.⁴³ The DGA notes dairy consumption is linked to improved bone health, especially in children and adolescents, and healthy eating patterns are associated with a lower risk for CVD, based on strong evidence, and lower for T2D, based on moderate evidence.⁴³

The 2015 Dietary Guidelines for Americans Committee (DGAC) Report included a chapter on food sustainability and safety for the first time in its history.¹²⁹ The chapter concluded that “a diet higher in plant-based foods, such as vegetables, fruits, whole grains, legumes, nuts, and seeds, and lower in calories and animal based foods is more health promoting and is associated with less environmental impact than is the current U.S. diet.” Although the environmental recommendations were not included in the final DGA policy document, all of the 2015-2020 DGA dietary patterns contained more plant foods and dairy foods than the amounts Americans currently eat, on average, and included dairy foods in all Healthy Eating Patterns, including the Healthy Vegetarian Eating Pattern.⁴³

Some new research has begun to evaluate aspects of dairy foods on sustainability beyond environmental impact. One study found that nutrient-rich diets tend to have a higher environmental cost and that what is optimal for the planet also may not be healthiest for people. Sustainable diets should be nutrient-rich, affordable, acceptable and sparing of the environment. Dairy foods like milk are “nutrient-rich, affordable, acceptable and appealing,” based on multiple sustainability metrics,¹⁴⁰ and the U.S. Dairy community is committed, industry-wide, to continuously and proactively reducing climate-related impacts.¹⁴¹



PROGRESS AND OPPORTUNITIES

The food and nutrition landscape – including development of dietary guidelines in the U.S. and internationally – is changing. Looking ahead, dietary guidelines may include more guidance about sustainability, but getting there will involve debate on the topic.

Nutrient-rich dairy foods, including milk, cheese and yogurt, are core components of healthy eating patterns around the world.³⁸ Three servings of dairy foods are included in the Healthy U.S.-Style Eating Pattern in the 2015-2020 DGA. More than 100 countries worldwide have FBDG. In the FAO FBDG database, there are 90 individual country pages that are provided in English. Of those, 78 percent contain some recommendations for dairy foods.¹⁴²

Research continues to demonstrate the role of dairy foods in providing essential nutrients and supporting health, and additional research is underway to help define dairy's contributions to environmental, social and economic aspects of sustainability.

The public process to develop the 2020-2025 DGA began in 2018, and international efforts to develop new guidance are also underway. The dairy community has the opportunity to participate in the process, educating experts in nutrition guidance about dairy's unique contributions to healthy eating patterns and sustainable food systems.

► DAIRY'S ROLE

The current conversation provides many opportunities to educate dairy stakeholders and experts about the role of dairy foods in healthy eating patterns and sustainable food systems. Reinforcing the multiple benefits of eating dairy foods – and correcting misconceptions about dairy's health, environmental, social and economic contributions – can generate important dialogue.

A HEALTHY DIET, DEFINED

The 2015-2020 DGA provides guidance on healthy eating patterns, including these key recommendations:⁴³

A healthy eating pattern includes:

- A variety of vegetables from all of the subgroups – dark green, red and orange, legumes (beans and peas), starchy and other
- Fruits, especially whole fruits
- Grains, at least half of which are whole grains
- Fat-free or low-fat dairy, including milk, yogurt, cheese and/or fortified soy beverages
- A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas) and nuts, seeds and soy products
- Oils

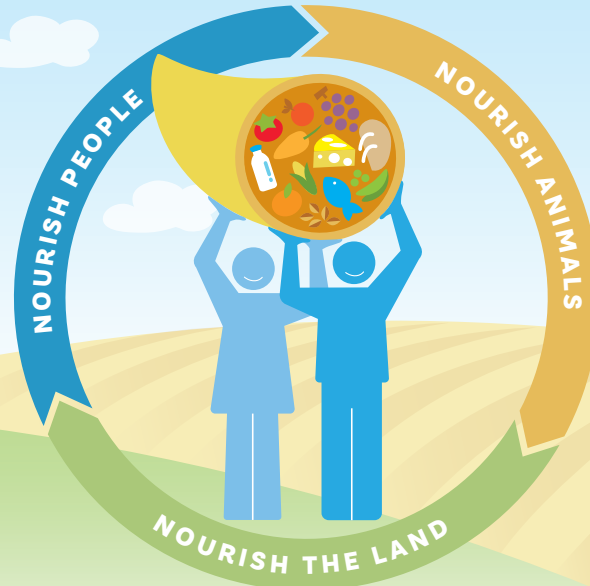
HONOR THE HARVEST

Honoring the Harvest is about how we work together to use food with good purpose, so it's never wasted.

That means ensuring all people have access to nutrient-rich foods and also utilizing parts of food people can't or won't eat by moving nutrients through food systems – from people, to animals and back to the land to grow food more sustainably – rather than going to a landfill. We all have a role to support this cycle and build sustainable food systems that benefit people, communities and the planet.

Learn how the dairy community contributes to a natural nutrient cycle.

WORKING TOGETHER WE CAN
HONOR THE HARVEST
AND LIVE BETTER



INNOVATION CENTER FOR U.S. DAIRY
HEALTHY PEOPLE • HEALTHY PRODUCTS • HEALTHY PLANET

NDC
NATIONAL DAIRY COUNCIL

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Here's how the dairy community contributes to a natural nutrient cycle – and you can help, too.

1 NOURISH PEOPLE

We need to ensure a variety of nutritious foods, including nutrient-rich dairy foods, are available and affordable to help all people thrive.

Enough food is produced globally to nourish 10 billion people. And yet, food insecurity impacts people in every region, including 1 in 8 Americans.¹



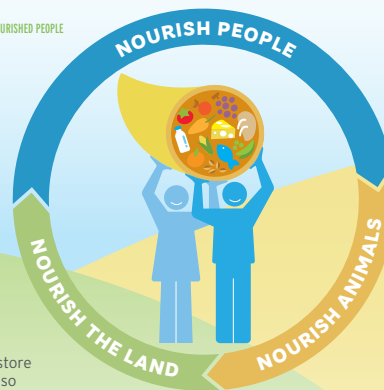
Food waste contributes to this discrepancy.



National and international efforts are underway to close this gap, and you can help by reducing your food waste. Find out more at FurtherWithFood.org.



DAIRY CAN BE PART OF THE SOLUTION TO FOOD AND NUTRITION SECURITY DUE TO ITS NUTRIENT CONTRIBUTIONS. MILK NATURALLY CONTAINS HIGH-QUALITY PROTEIN, CALCIUM, PHOSPHORUS AND B VITAMINS.



3 NOURISH THE LAND

Returning nutrients back to the land to replenish the soil completes the cycle.

Cow manure's unique composition helps restore nutrients in the soil, helping it be healthier, so food can be grown with reduced use of synthetic fertilizer, which is fossil fuel-based.



EACH DAY, 1 COW PRODUCES 17 GALLONS OF MANURE. THAT'S ENOUGH FERTILIZER TO GROW 46 POUNDS OF CORN.²

WORKING TOGETHER WE CAN
HONOR THE HARVEST
AND LIVE BETTER

2 NOURISH ANIMALS

Just like people have specific nutritional needs, so do dairy cows.

Dairy cows have a unique, 4-chambered stomach, so they can unlock nutrition from parts of plants people can't or won't eat. For example, people drink the OJ and cows eat the citrus pulp, and people eat almonds and cows eat the almond hulls.



80% OF WHAT DAIRY COWS EAT CAN'T BE EATEN BY PEOPLE.

©2018 Innovation Center for U.S. Dairy and National Dairy Council. Notes: 1. Food Insecurity at some point in time in 2016; 2. Based on average soil content and lactating dairy cow in IL. Sources: Coleman-Jensen et al. USDA ERS. Economic Research Report No. 237, Sep. 2017. FAO/UN. The State of Food Security and Nutrition in the World 2017. Holt-Gimenez. J Sustain Agr Vol 36, 2012. FAO/UN. SAVE FOOD: Global Initiative on Food Loss and Waste Reduction. Tilman D et al. Nature 418, 671–77. USDA NRCS. Animal Manure Management RCA Issue Brief No. 7. ASAE D384.2, Mar. 2005. Manure Production and Characteristics. Below F. Brandau P. How Much Nitrogen Does Corn Need? Tricarico, J Proc of the Tri-State Dairy Nutrition Conference, Fort Wayne, IN, pgs. 49-57, 2016. eXtension. Liquid Manure Storage Ponds, Pits, and Tanks. Oct. 27, 2015.

THE COST OF FOOD WASTE

Although hunger continues to plague millions, our food supply is increasingly abundant – and so is the amount of food we waste.¹⁴⁴ FAO reports show that roughly one-third of the food produced in the world for human consumption every year is lost or wasted.¹⁴⁵ Reducing food waste is essential to achieving sustainable nutrition.

The value of food lost and wasted each year is stunning, at roughly \$680 billion in industrialized countries and \$310 billion in developing countries.¹⁴⁵

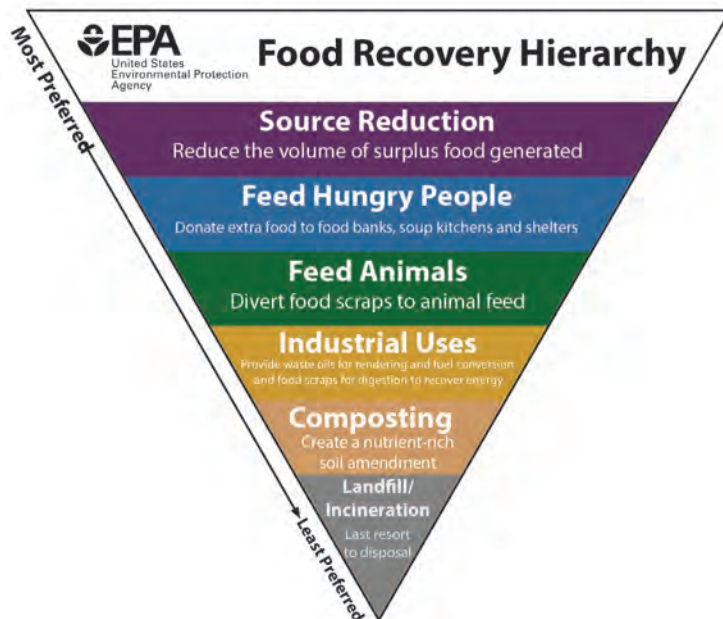
Not only does food waste undermine the economy and food security, but it also squanders the considerable resources used to produce food and bring it to market, including water, land, energy, labor and capital. Compounding the problem, unwanted food left to decompose in landfills also emits methane, contributing to climate change.¹⁴⁶

Because of food waste’s enormous human and environmental costs, the U.N. addressed the problem in SDG 12 with this specific target: “By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.”¹⁴⁷

The U.S. Environmental Protection Agency (EPA) has also produced the Food Recovery Hierarchy, shown here, which provides guidance on what to do with excess or imperfect food. The hierarchy recommends feeding people first, then animals, digesters, composts and landfills.

“Food recovery can increase by 1.8 billion meals annually, nearly doubling the amount of meals rescued today and diverting 1.1 million tons of waste.”

– ReFED¹⁴³



Source: United States Environmental Protection Agency¹⁴⁶

In 2013, the EPA, together with the United States Department of Agriculture (USDA), launched the U.S. Food Waste Challenge.¹⁴⁸ This gave leaders and organizations across the food chain a platform to share best practices on reducing, recovering and recycling food loss and waste.

In 2015, the U.S. announced its first national food waste reduction goal, calling for a 50 percent reduction by 2030.¹⁴⁶ As part of this effort, the federal government established a public/private partnership to reduce food loss and waste in order to improve overall food security and conserve the nation's resources.

Another public/private partnership – Further with Food – is focused on innovative approaches to reduce food loss and waste.¹⁴⁹ This initiative has broad support from many organizations, including the Academy of Nutrition and Dietetics, Feeding America and the Innovation Center for U.S. Dairy®, as well as government agencies and the Rockefeller Foundation.

Addressing food waste is an opportunity to mitigate hunger and reduce the food system's environmental impacts and resource use.¹⁴⁶

Increasingly, people rate sustainability-related attributes as an important consideration with their food and beverage choices.¹⁵⁰ Environmental footprints calculate the total amount of natural resources individuals use to sustain themselves. We can examine food choices in a similar manner, calculating all the natural resources used in an individual's diet or their footprint.⁷⁶

According to calculations from a recent footprint study, in 2010, the average American adult wasted 35 percent of food (by weight) available at the retail and consumer level.⁷⁶

When food is wasted, natural resources used to produce are wasted, too, and we also miss the opportunity to improve eating patterns and food security. Food wasted at the retail and consumer levels of the U.S. food supply in 2012 contained 1,217 kcal, 33 g protein, 5.9 g dietary fiber, 1.7 ug vitamin D, 286 mg calcium and 880 mg potassium per capita per day.¹⁵¹

VI. Dairy's Contributions to Sustainable Nutrition

The need for sustainable nutrition has galvanized the dairy community. Building on the long-standing commitment to providing nutritious, safe and high-quality foods, the dairy community is equally committed to advancing sustainable nutrition and contributing to the achievement of the SDGs.

People in the dairy community are exploring the environmental impacts of dairy production and finding new ways to reduce environmental impact and resource use. Additionally, exploration of opportunities to regenerate the environment is a priority.

Dairy representatives are educating more people about the nutritional and health benefits associated with consumption of dairy foods within healthy dietary patterns, while working to improve access to and affordability of dairy foods. Other dairy professionals are continually driving scientific research and sharing discoveries across the food, nutrition and dietary guidance landscape.

Working together, the dairy community will continue to explore new ways to help nourish a growing population with nutrient-rich dairy foods and ingredients that are affordable and accessible to achieve sustainable nutrition for all – today and for future generations.

As the dairy community works to demonstrate its value to society, it has the opportunity to reflect society's changing values and concerns related to sustainable nutrition.

Its challenge and opportunity will be to keep pace with other major stakeholders who are already addressing food security and sustainable nutrition as strategic imperatives – acknowledging its impacts on human health, global peacekeeping and climate change.

A host of market forces in the food and nutrition space are also realizing that the sustainable nutrition challenge brings substantial new opportunities – estimated at \$2.3 trillion.²

This significant opportunity is attracting many new stakeholders, eager to define what food should mean to healthy eating and sustainable food systems, and to prescribe how food should be grown. The dairy community can offer significant contributions to this important conversation.

While demonstrating leadership through its contributions to sustainable nutrition, the dairy community has an opportunity to reflect stakeholders' related interests and concerns – including lifestyles of health and sustainability, the impact of food production on environmental sustainability and how food systems can help reduce food waste.



> Contributing to Healthy Lifestyles

Dairy foods have historically been included in U.S. recommendations for healthy eating patterns, which have sound foundations in nutrition science.^{43,139} Dietary guidance in the U.S. has consistently communicated dairy's role in a healthy eating pattern and its unique nutrient profile.^{152,153,154,155,156,157,158}

These dairy attributes will likely resonate with consumers as they begin to embrace a broader definition of health – one that encompasses healthy and sustainable lifestyles, including environmental sustainability.¹⁵⁰

The dairy community has gained a deep understanding of its environmental impacts, but it has not effectively portrayed its positive impact and story in these broader terms. Now, the dairy community has a key opportunity to make its story more meaningful and relevant.

Dairy can reflect both the public and the public health community's interest in the broader surroundings of food, nutrition and health – including how the dairy community cares for its animals and uses responsible production best practices to minimize the environmental impact of dairy production, from farm to table.

Conveying dairy's broad benefits within the context of lifestyles of health and sustainability is a matter of some urgency. The scientific community continues to explore the composition and role of specific foods within sustainable diets and food systems. The dairy community is currently engaged in some of these conversations, but there is room for additional collaboration.



Commentaries, even in high-profile media outlets,^{159,160} suggest that animal agriculture is often not well understood or valued. Future DGA or other dietary guidance may address the environmental aspects of eating patterns and specific foods – with the potential for a recommended reduction in dairy servings as an unintended consequence of not considering all dimensions of sustainability.

As a result, the window is closing for the dairy community to have conversations with thought leaders, decision makers and consumers to raise awareness of the growing body of science-based evidence for dairy that will define sustainable diets and food systems.

It is critical for the dairy community to share and highlight its investments in scientific research that support the environmental, nutritional and health benefits of dairy foods and dairy ingredients.

The dairy community has a tremendous opportunity to engage with other stakeholders to share, with a unified voice, the positive social, economic and environmental benefits of dairy cows, dairy farmers and the entire dairy value chain, to demonstrate their valuable contributions to local communities and Americans – and to the world at large.



> Addressing Food Waste and Hunger

Food waste is closely linked to environmentally sustainable food systems.¹⁶¹ Many parties – from government agencies, public and private companies and organizations to industries, thought leaders and the public – have raised awareness of this issue and the potential positive effect of reduced food waste on hunger, food security and planetary health.^{162,163,164,165}

As a result, these audiences are likely to be interested in dairy's progress reports on waste reduction. Updates should frame waste reduction as one part of the dairy community's contribution to sustainable food systems, with high-quality nutrition at the center.

This education and outreach can help bring to life key elements of the DGA, encouraging nutrient-rich foods with better portion control and reduced food waste. The dairy community can also help educate the public on the value of portion control in reducing waste and promoting balanced, healthy eating patterns that support well-being.

The dairy community's timely engagement on the topic of food waste showcases its commitment to responsibly produced, nutrient-rich dairy foods that are fully appreciated for their value in nourishing people. Dairy foods are too good to waste.



> Playing an Active Role in Sustainable Food Systems

The dairy community is well positioned to respond to the growing demand for sustainable nutrition. We can begin by addressing how dairy foods are responsibly made, how dairy cows are treated and how the dairy community is addressing hunger, food security and health.

At the same time, we should also share how the dairy community is continuously working to mitigate the environmental impact of agriculture and dairy production, reducing the dairy value chain's environmental footprint.

The dairy community showcases agriculture's larger potential. Agriculture can help solve the profound challenges of global food security, climate adaptation and resilience and economic security.¹⁶⁶

The dairy community must actively partner with global food systems stakeholders to define food security, establish a framework for environmentally sustainable food systems and create a path forward for worldwide economic prosperity.

The dairy community has the opportunity to engage at the highest level with those who are driving the global conversation and guidance on sustainable nutrition. It can also engage at the local community level, demonstrating its continuous commitment to sustainability, sustainable food systems and public health.

Through a commitment to continuous progress and being engaged in addressing sustainable nutrition, the dairy community can help sustain its integral role in food systems of the future, while helping ensure that other agricultural commodities endure and prosper as well.

VII. Appendix

KEY CONCEPTS

Arable land – Land under temporary agricultural crops (multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years).¹⁶⁷

Blue water footprint, also known as consumptive water use – Water that has been sourced from surface or groundwater resources and is either evaporated, incorporated into a product or taken from one body of water and returned to another. Irrigated agriculture, industry and domestic water use can each have a blue water footprint.¹⁶⁸

Biodiversity – Comprised of the total sum of all plants, animals, fungi and microorganisms in a particular area.⁶⁷

Buffer strip – Also known as conservation buffers, buffer strips are small areas or strips of land in permanent vegetation, designed to intercept pollutants or manage other environmental concerns.¹⁶⁹

Carbon sequestration – Agricultural practices use the process of carbon sequestration to remove carbon dioxide from the atmosphere. Because carbon dioxide is the most important GHG emitted by human activities, sequestration can help prevent climate change by enhancing carbon storage in plant matter and soils.⁶⁷

Consumer behavior – Reflects the choices made by consumers, at household or individual levels, on what food to acquire, store, prepare and eat, and on the allocation of food within the household. Consumer behavior is influenced by personal preferences determined by taste, convenience, culture and other factors.¹⁵

Consumptive water use – See “blue water footprint.”

Conventional agriculture – The prevailing agricultural system, which can vary from region to region, that allows for the use of techniques and practices not part of other systems (such as organic farming), like chemical fertilization and synthetic pesticides, among others.¹⁷⁰

Environmental footprint – The measure of how much land and water is needed to produce a resource and to dispose of the waste that is generated.⁶⁷

Eutrophication – The process by which a body of water becomes enriched by inorganic plant nutrients, especially phosphates and nitrates.⁶⁷

Food environment – Refers to the physical, economic, political and socio-cultural context in which consumers engage with the food system to acquire, prepare and consume food. The key elements of the food environment that influence food choices, food acceptability and diets are: physical and economic access to food; food promotion, advertising and information; and food quality and safety.¹⁵

Food system – A food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socioeconomic and environmental outcomes. Types of food systems include:¹⁵

- o **Traditional** – Rely on minimally processed seasonal foods, collected or produced for self-consumption or sold mainly through informal markets.
- o **Mixed** – In which food producers rely on both formal and informal markets to sell their crops. Highly processed and packaged foods are more accessible, while nutrient-rich foods are more expensive.
- o **Modern** – Characterized by more diverse food options all year long, and by processing and packaging to extend food's shelf life. Food safety is monitored and enforced, and storage and transport infrastructures are generally prevalent and reliable.

Food supply chain – Encompasses all activities that move food from production to consumption, including production, storage, distribution, processing, packaging, retailing and marketing. The decisions made by the many actors at any stage of this chain have implications for other stages.¹⁵

Foodprint – The environmental footprint (analysis of water, energy, land, fertilizer requirements and greenhouse gas emissions) required to sustain a diet, either for an individual or a group.⁷⁶

Greenhouse gas emissions – Some gasses, including carbon dioxide, methane and nitrous oxide, trap heat from sunlight near the earth's surface. These gasses are termed “greenhouse gasses” because they have the same effect in the atmosphere as glass in a greenhouse.⁶⁷ Anthropogenic greenhouse gas emissions are those generated by human activities.

Green water – Water from precipitation that is stored in the root zone of the soil and evaporated or transpired through plants. It is particularly relevant for agricultural, horticultural and forestry products.¹⁷¹

Grey water footprint – The amount of fresh water required to assimilate pollutants to meet specific water quality standards. The grey water footprint considers point-source pollution discharged to a freshwater resource directly through a pipe or indirectly through runoff or leaching from the soil, impervious surfaces, or other diffuse sources.¹⁷¹

Life-cycle assessment – A method regulated by the International Organization for Standardization (ISO) that provides a standard procedure for assessing environmental impacts. It is a compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product or service throughout its life cycle.⁶⁷

Microbial soil inoculation – Agricultural amendments that use beneficial microbes to promote plant health.¹⁷²

Micronutrient deficiencies – Refer to the inadequate intake of vitamins and minerals. Those of greatest public health concerns globally are vitamin A, iron and iodine. Other important deficiencies are vitamin D, B12, folate, calcium and zinc.¹⁵

Nutrition transition – Refers to changes in lifestyle and dietary patterns driven by urbanization, globalization and economic growth, and their resulting impacts on nutrition and health outcomes.¹⁵

Renewable energy – Renewable energy is energy generated from naturally replenished sources. Examples include solar power, wind power, methane digesters and hydroelectricity.⁶⁷

Undernutrition – Being underweight, stunted (low height-for-age) or wasted (low weight-for-age).¹⁵

Water quality – A term used to describe the chemical, physical and biological characteristics of water. It is usually used to determine water's suitability for a particular purpose.⁶⁷

Water withdrawal – Describes the water removed from any water body.⁶⁷

WORKS CITED

1. Clay J. This and No More: Freezing the Footprint of Food. World Wildlife Fund. Available at: <https://www.worldwildlife.org/blogs/on-balance/posts/this-and-no-more-freezing-the-footprint-of-food>. Published November 2014.
2. Business & Sustainable Development Commission. Valuing the SDG Prize in Food and Agriculture. Available at: <http://businesscommission.org/our-work/valuing-the-sdg-prize-in-food-and-agriculture>. Published October 2016.
3. National Dairy Council. Dairy as a Driver of the Sustainable Development Goals. Available at: <https://dairygood.org/content/2018/dairy-as-a-driver-of-the-sustainable-development-goals>. Published April 2018.
4. World Health Organization. United Nations Decade of Action on Nutrition. Available at: <http://www.who.int/nutrition/decade-of-action/en/>. Updated 2018.
5. High Level Expert Forum. Global Agriculture towards 2050. Available at: http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf. Published October 12, 2009.
6. United Nations Development Programme. World leaders adopt Sustainable Development Goals. Available at: <http://www.undp.org/content/undp/en/home/presscenter/pressreleases/2015/09/24/undp-welcomes-adoption-of-sustainable-development-goals-by-world-leaders.html>. Published September 25, 2015.
7. Food and Agriculture Organization of the United Nations. The Dairy Declaration of Rotterdam. Available at: <http://www.dairydeclaration.org/Portals/153/Dairy%20Declaration.pdf?v=1>. Published October 2016.
8. Dairy Sustainability Framework. Dairy Sustainability Framework. Available at: <https://dairysustainabilityframework.org/>.
9. Food and Agriculture Organization of the United Nations. The State of Food Insecurity in the World 2004. Available at: <http://www.fao.org/3/a-y5650e.pdf>. Published 2004.
10. The International Food Policy Research Institute. *Global Nutrition Report 2016: From promise to impact: Ending malnutrition by 2030*. Available at: <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130354>. Published 2016.
11. Food and Agriculture Organization of the United Nations. The State of Food Security and Nutrition in the World. Available at: <http://www.fao.org/3/a-l7695e.pdf>. Published 2017.
12. National Dairy Council. Is yogurt good for you? Dairy Good. Available at: <https://dairygood.org/content/2017/is-yogurt-good-for-you?ref=www.nationaldairycouncil.org>. Published January 2017.
13. National Dairy Council. Is milk good for you? Available at: <https://dairygood.org/content/2017/is-milk-good-for-you?ref=www.nationaldairycouncil.org>. Published January 2017.
14. National Dairy Council. Is cheese good for you? Available at: <https://dairygood.org/content/2017/is-cheese-good-for-you?ref=www.nationaldairycouncil.org>. Published January 2017.
15. Committee on World Food Security. Nutrition and food systems: A report by the High Level Panel of Experts on food security and nutrition (Rep. No. 12). Available at: http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-12_EN.pdf. Published 2017.
16. Blossner M, de Onie M. Malnutrition: Quantifying the health impact at national and local levels. Retrieved from http://www.who.int/quantifying_ehimpacts/publications/eb12/en/. Published 2005.
17. Global Panel on Agriculture and Food Systems for Nutrition. The cost of malnutrition: Why policy action is urgent. Retrieved from <https://www.glopan.org/sites/default/files/pictures/CostOfMalnutrition.pdf>. Published 2016.
18. National Dairy Council. The triple burden of global malnutrition. Available at: <https://dairygood.org/content/2018/the-triple-burden-of-global-malnutrition>. Published April 2018.

19. United Nations. World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100. Available at: <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>. Published 2017.
20. United Nations. World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100 – says UN. Available at: <https://www.un.org/sustainabledevelopment/blog/2017/06/world-population-projected-to-reach-9-8-billion-in-2050-and-11-2-billion-in-2100-says-un/>. Published 2017.
21. World Health Organization. Malnutrition. Available at: <http://www.who.int/mediacentre/factsheets/malnutrition/en/>. Published 2018.
22. Global Panel on Agriculture and Food Systems for Nutrition. Food systems and diets: Facing the challenges of the 21st century. Retrieved from <https://glopan.org/sites/default/files/ForesightReport.pdf>. Published 2016.
23. Food and Agriculture Organization of the United Nations. Food system strategies for preventing micronutrient malnutrition. Available at: http://www.fao.org/fileadmin/templates/esa/Papers_and_documents/WP_13_06_Miller_Welch.pdf. Published 2013.
24. World Health Organization. Micronutrient deficiencies. Available at: <http://www.who.int/nutrition/topics/idd/en/>.
25. Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. Household Food Security in the United States in 2016. United States Department of Agriculture. Available at: <https://www.ers.usda.gov/publications/pub-details/?pubid=84972>. Published September 2017.
26. United States Department of Agriculture. Household Food Security in the United States in 2016. Available at: <https://www.ers.usda.gov/publications/pub-details/?pubid=84972>. Published September 2017.
27. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition. Chapter 2. Available at <https://health.gov/dietaryguidelines/2015/guidelines/chapter-2/current-eating-patterns-in-the-united-states/>. Published December 2015.
28. Bird JK, Murphy RA, Ciappio ED, McBurney MI. Risk of Deficiency in Multiple Concurrent Micronutrients in Children and Adults in the United States. *Nutrients*. 2017;9(7):655. doi:10.3390/nu9070655.
29. Saavedra JM, Deming D, Dattilo A, Reidy K. Lessons from the Feeding Infants and Toddlers Study in North America: What children eat, and implications for obesity prevention. *Ann Nutr Metab*. 2013; 62(3):27-36. doi:10.1159/000351538.
30. Sullivan LM, Brumfield C. The First 1,000 Days: Nourishing America’s Future. Available at: http://fhop.ucsf.edu/sites/fhop.ucsf.edu/files/custom_download/1000Days-NourishingAmericasFuture-Report-FINAL-WEBVERSION-SINGLES_0.pdf. Published 2016.
31. United Nations. The Millennium Development Goals Report 2013. Available at: <http://www.un.org/millenniumgoals/pdf/report-2013/mdg-report-2013-english.pdf>. Published 2013.
32. World Health Organization. Global Nutrition Targets 2025: Policy Brief Series. Available at: http://apps.who.int/iris/bitstream/handle/10665/149018/WHO_NMH_NHD_14.2_eng.pdf;jsessionid=1F29E2507304C2B729A59FAD92433760?sequence=1. Published 2014.
33. World Food Programme. Overview. Available at: <http://www1.wfp.org/overview>.
34. World Health Organization. Global Targets 2025. Available at: <http://www.who.int/nutrition/global-target-2025/en/>.
35. Food and Agriculture Organization of the United Nations. Combating Micronutrient Deficiencies: Food-based Approaches. Available at: <http://www.fao.org/docrep/013/am027e/am027e.pdf>. Published 2011.
36. Hinchliffe E, Adams JL, Shipton CA, et al. Improving the nutritional value of Golden Rice through increased pro-vitamin A content. *Nature Biotechnology*. 2005;23:482-487.

37. Sayre R, Beeching JR, Cahoon EB, et al. The BioCassava plus program: biofortification of cassava for sub-Saharan Africa. *Annual review of plant biology*. 2011;62:251-272.
38. Muehlhoff E, Bennett A, McMahon D. Food and Agricultural Organization. Milk and Dairy Products in Human Nutrition. Available at: <http://www.fao.org/docrep/018/i3396e/i3396e.pdf>. Published 2013.
39. Dror DK, Allen LH. The importance of milk and other animal-source foods for children in low-income countries. *Food and nutrition bulletin*. 2011;32:227-243.
40. Manary M, Callaghan M, Singh L, Briend A. Protein Quality and Growth in Malnourished Children. *Food and nutrition bulletin*. 2016;37 Suppl 1:S29.
41. Weinfield NS, Mills WG, Institute U, et al. Hunger in America 2014 National Report Prepared for Feeding America. Available at: <http://help.feedingamerica.org/HungerInAmerica/hunger-in-america-2014-full-report.pdf>. Published 2014.
42. Zaborsky V. The Great American Milk Drive. Available at: <http://www.feedingamerica.org/hunger-blog/milk-drive-can-help.html>. Published June 2015.
43. U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015 – 2020 Dietary Guidelines for Americans. 8th Edition. Available at: <https://health.gov/dietaryguidelines/2015/guidelines/>. Published December 2015.
44. Milk Life. The Milk Gap. Available at: <https://milklife.com/give>.
45. Keast DR, Fulgoni VL, Nicklas TA, O’Neil CE. Food sources of energy and nutrients among children in the United States: National Health and Nutrition Examination Survey 2003–2006. *Nutrients*. 2013;5:283-301.
46. O’Neil CE, Keast DR, Fulgoni VL, Nicklas TA. Food sources of energy and nutrients among adults in the US: NHANES 2003–2006. *Nutrients*. 2012;4:2097-2120.
47. Fulgoni VL, Keast DR, Auestad N, Quann EE. Nutrients from dairy foods are difficult to replace in diets of Americans: food pattern modeling and an analyses of the National Health and Nutrition Examination Survey 2003-2006. *Nutrition Research*. 2011;31:759-765.
48. National Dairy Council. Three servings of milk delivers a unique nutrient package. Available at: <https://www.nationaldairycouncil.org/content/2015/three-servings-of-milk-delivers-a-unique-nutrient-package>. Published February 2018.
49. National Heart, Lung, and Blood Institute, the National Institute of Diabetes and Digestive and Kidney Diseases. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report. National Institutes of Health. Available at: https://www.nhlbi.nih.gov/files/docs/guidelines/ob_gdlns.pdf. Published September 1998.
50. World Health Organization. Obesity and Overweight. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en>. Published October 2017.
51. Food and Agriculture Organization of the United Nations. The State of Food Insecurity in the World. Available at: <http://www.fao.org/docrep/016/i3027e/i3027e.pdf>. Published 2012.
52. World Health Organization. Global status report on noncommunicable diseases 2010. Available at: http://www.who.int/nmh/publications/ncd_report_full_en.pdf. Published October 2010.
53. Musaiger AO, Hassan AS, Obeid O. The Paradox of Nutrition-Related Diseases in the Arab Countries: The Need for Action. *International Journal of Environmental Research and Public Health*. 2011;8(9):3637-3671. doi:10.3390/ijerph8093637.
54. Centers for Disease Control and Prevention. Chronic Disease Overview. Available at: <https://www.cdc.gov/chronicdisease/overview/index.htm>. Published June 2017. Updated June 2017.

55. American Public Health Association. Public Health and Chronic Disease. Available at: https://www.apha.org/~media/files/pdf/factsheets/chronicdiseasefact_final.ashx.
56. Probst Y. Electronic tools for healthy choices. Available at: <http://fstjournal.org/features/29-4/healthy-choices>. Published January 2015.
57. New Nutrition Business. 10 Key Trends in Food, Nutrition & Health 2018. Available at: <https://www.new-nutrition.com/keytrend?id=55>. Published November 2017.
58. Innova Market Insights. Briefing Series, Special Report - Top 10 Trends 2017. Available at: <http://www.foodingredientsfirst.com/webinars/top-ten-trends-for-2017.html>. Published November 2016.
59. Fischer K. Healthline: The Best Diabetes Apps of 2018. Available at: <https://www.healthline.com/health/diabetes/top-iphone-android-apps>. Published April 2018.
60. National Dairy Council. Science Summary: Dairy & Nutrient Contributions. Available at: <https://www.nationaldairycouncil.org/content/2015/science-summary-dairy-and-nutrient-contributions>. Published February 2016.
61. Drouin-Chartier J, Brassard D, Tessier-Grenier M, et al. Systematic Review of the Association between Dairy Product Consumption and Risk of Cardiovascular-Related Clinical Outcomes. *Advances in Nutrition: An International Review Journal*. 2016;7:1026-1040.
62. Lu L, Xun P, Wan Y, He K, Cai W. Long-term association between dairy consumption and risk of childhood obesity: a systematic review and meta-analysis of prospective cohort studies. *European journal of clinical nutrition*. 2016;70:414-423.
63. National Dairy Council. Dairy: Part of the solution to the triple burden of malnutrition. Available at: <https://dairygood.org/content/2018/dairy-part-of-the-solution-to-the-triple-burden-of-global-malnutrition>. Published April 2018.
64. ReliefWeb. Thought Leaders At Davos Discuss How To Ensure Food Security. Available at: <https://reliefweb.int/report/world/thought-leaders-davos-discuss-how-ensure-food-security>
65. Food and Agriculture Organization of the United Nations. Building a common vision for sustainable food and agriculture. Available at: <http://www.fao.org/3/a-i3940e.pdf>
66. Dairy Sustainability Framework. The Dairy Sustainability Framework. Available at: <https://dairysustainabilityframework.org/the-gdaa/programmes-of-the-gdaa/the-dairy-sustainability-framework/>.
67. Innovation Center for US Dairy. U.S. Dairy's Environmental Footprint: A summary of findings, 2008-2012. Available at: <https://www.usdairy.com/~media/usd/public/dairysenvironmentalfootprintbrochure-july.pdf>.
68. United States Environmental Protection Agency. Global Greenhouse Gas Emissions Data. Available at: <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>. Updated April 2017.
69. NASA. Climate Change: Vital Signs of the Planet: Causes. Available at: <https://climate.nasa.gov/causes/>.
70. Raftery AE, Zimmer A, Frierson DMW, Startz R, Liu P. Less than 2°C warming by 2100 unlikely. *Nat. Clim. Change*. 2017;7:637-641.
71. Food and Agriculture Organization of the United Nations. Key facts and findings. Available at: <http://www.fao.org/news/story/en/item/197623/icode/>.
72. Edenhofer O, Madruga RP, Sokona Y, et al. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. 2014.
73. United States Environmental Protection Agency. Sources of Greenhouse Gas Emissions. Available at: <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>. Updated April 2018.

74. USDA. US Agriculture and Forestry Greenhouse Gas Inventory 1990-2013. Available at: https://www.usda.gov/oce/climate_change/AFGG_Inventory/USDA_GHG_Inventory_1990-2013_9_19_16_reduced.pdf. Published September 2016.
75. Jones C, Kammen D. Quantifying Carbon Footprint Reduction Opportunities for U.S. Households and Communities. *Environmental Science & Technology*. 2011;45(9): 4088-4095. Available at: <https://pubs.acs.org/doi/pdf/10.1021/es102221h>
76. Birney CI, Franklin KF, Davidson FT, Webber ME. An assessment of individual foodprints attributed to diets and food waste in the United States – Supplemental Information. *Environ. Res. Lett.* 2017;12(10).
77. Burney JA, Davis SJ, Lobell DB. Greenhouse gas mitigation by agricultural intensification. *Proc Natl Acad Sci USA*. 2010;107(26). doi: 10.1073/pnas.0914216107.
78. Smith P, Bustamante M, Ahammad H, et al. 2014: Agriculture, Forestry and Other Land Use (AFOLU). In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer O, Pichs-Madruga R, Sokona Y, et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
79. Lal R, Follett RF, Stewart BA, Kimble JM. Soil Carbon Sequestration to Mitigate Climate Change and Advance Food Security. *Soil Science*. 2007;172:943-956.
80. Horowitz J, Gottlieb J, United States. Department of Agriculture. Economic Research Service. The role of agriculture in reducing greenhouse gas emissions. Washington, D.C.: U.S. Dept. of Agriculture, Economic Research Service; 2010;no. 15.
81. 4 Pour 1000. Welcome to the “4 Per 1000” Initiative. Available at: <https://www.4p1000.org/>.
82. Ontl TA, Schulte LA. Soil Carbon Storage. *Nature Education Knowledge*. 2012;3(10):35
83. Thoma, G., et al. Greenhouse Gas Emissions from Production of Fluid Milk in the US. University of Arkansas & Michigan Technological University. 2010. https://data.nal.usda.gov/dataset/data-greenhouse-gas-emissions-milk-production-and-consumption-united-states-cradle-grave-life-cycle-assessment-circa-2008_110
84. Food and Agriculture Organization of the United Nations. Greenhouse Gas Emissions from the Dairy Sector: A Life Cycle Assessment. Available at: <http://www.fao.org/docrep/012/k7930e/k7930e00.pdf>. Published 2010.
85. Greenhouse Gas Protocol. Global Warming Potential Values. Available at: http://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf. Published February 2016.
86. Hristov AN, Ott T, Tricarico J, et al. Special topics—Mitigation of methane and nitrous oxide emissions from animal operations: III. A review of animal management mitigation options. *Journal of animal science*. 2013;91:5095.
87. Thoma G., et al., Greenhouse gas emissions from milk production and consumption in the United States: A cradle-to-grave life cycle assessment circa 2008. *International Dairy Journal*. Available at: <https://www.sciencedirect.com/science/article/pii/S0958694612001975>. Published August 2013.
88. Capper JL, Cady RA, Bauman DE. The environmental impact of dairy production: 1944 compared with 2007. *Journal of animal science*. 2009;87:2160.
89. Food and Agriculture Organization of the United Nations. Crop production and natural resource use. Available at: <http://www.fao.org/docrep/005/y4252e/y4252e06.htm>.
90. Tricarico JM. Role of dairy cattle in converting feed to food. *Proc. of the 2016 Tri-State Dairy Nutrition Conference, Fort Wayne, IN*. 2016(ref 5): 49-57. <https://www.cabdirect.org/cabdirect/abstract/20163250358>

91. Van Soest PJ. *Nutritional Ecology of the Ruminant: Ruminant Metabolism, Nutritional Strategies, the Cellulolytic Fermentation, and the Chemistry of Forages and Plant Fibers*. United States: 1982.
92. Leblois A, Damette O, Wolfersberger J. What has Driven Deforestation in Developing Countries Since the 2000s? Evidence from New Remote-Sensing Data. *World Development*. 2017;92:82-102.
93. American Farmland Trust. Farms Under Threat Keep America Bountiful. Available at: <https://www.farmland.org/initiatives/farms-under-threat>.
94. USDA. Farms and Farmland Numbers, Acreage, Ownership, and Use. Available at: https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Farms_and_Farmland/Highlights_Farms_and_Farmland.pdf. Published September 2014.
95. American Farmland Trust. Farmland. Available at <https://www.farmland.org/our-work/areas-of-focus/farmland>.
96. Food and Agriculture Organization of the United Nations. OECD-FAO Agricultural Outlook 2009-2018. Available at: <http://www.oecd.org/berlin/43042301.pdf>. Published 2009.
97. Watts DB, Torbert HA, Feng Y, Prior SA. Soil Microbial Community Dynamics as Influenced by Composted Dairy Manure, Soil Properties, and Landscape Position. *Soil Science*. 2010;175:474-486.
98. Wortmann CS, Shapiro CA. The effects of manure application on soil aggregation. *Nutrient Cycling in Agroecosystems*. 2008;80:173-180.
99. Wortmann CS, Walters DT. Residual effects of compost and plowing on phosphorus and sediment in runoff. *Journal of environmental quality*. 2007;36:1521-1527.
100. Edmeades DC. The long-term effects of manures and fertilisers on soil productivity and quality: a review. *Nutrient Cycling in Agroecosystems*. 2003;66:165-180.
101. Xia L, Lam SK, Yan X, Chen D. How Does Recycling of Livestock Manure in Agroecosystems Affect Crop Productivity, Reactive Nitrogen Losses, and Soil Carbon Balance? *Environmental Science & Technology*. 2017;51:7450.
102. Soil Health Institute. Manure Land Application and Soil Health Indicators: 2016 Manure and Soil Health Working Group Report. Available at: <https://soilhealthinstitute.org/wp-content/uploads/2018/02/Lim-Report.pdf>. Published September 2017.
103. Wells ML, Potin P, Craigie JS, et al. Algae as nutritional and functional food sources: revisiting our understanding. *Journal of Applied Phycology*. 2016;2017;29:949.
104. Food and Agriculture Organization of the United Nations. The global dairy sector: Facts. Available at: <http://www.fil-idf.org/wp-content/uploads/2016/12/FAO-Global-Facts-1.pdf>. Published 2016.
105. Mottet A, de Haan C, Falcucci A, Tempio G, Opio C, Gerber P. Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. *Global Food Security*. 2017.
106. United Nations. Water Scarcity. Available at: <http://www.unwater.org/water-facts/scarcity/>.
107. Food and Agriculture Organization of the United Nations. Coping with water scarcity: An action framework for agriculture and food security. Available at: <http://www.fao.org/docrep/016/i3015e/i3015e.pdf>. Published 2008.
108. Georgakakos A, Fleming P, Dettinger P, et al. Ch. 3: Water Resources. Climate Change Impacts in the United States: The Third National Climate Assessment. *U.S. Global Change Research Program*. 2014;69-112. doi: 10.7930/J0Z31WJ2.
109. Walsh M, Backlund P, Janetos A, et al. The effects of climate change on agriculture, land resources, water resources, and biodiversity in the United States. Washington, DC: U.S. Climate Change Science Program; 2008;43.

110. Walsh J, Wuebbles D, Hayhoe K, et al. Ch. 2: Our Changing Climate. *Climate Change Impacts in the United States: The Third National Climate Assessment*. 2014;19-67. doi:10.7930/J0KW5CXT.
111. Cisneros BEJ, Oki T, Arnell NW, et al. Freshwater resources. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 2014; pp. 229-269.
112. Titus JG, Anderson KE, United States. National Oceanic and Atmospheric Administration, et al. Coastal sensitivity to sea-level rise: a focus on the mid-Atlantic Region. Washington, D.C: U.S. Climate Change Science Program; 2009;4.1.
113. National Research Council (U.S.). Committee on Ecological impacts of Climate Change. *Ecological Impacts of Climate Change*. National Academies Press, 2008.
114. Julius SH, West JM, Baron J, Climate Change Science Program (U.S.). Preliminary review of adaptation options for climate-sensitive ecosystems and resources: final report. Washington, D.C: U.S. Climate Change Science Program; 2008;44.
115. United States Geological Survey. Groundwater depletion. Available at: <https://water.usgs.gov/edu/gwdepletion.html>. Updated December 2016.
116. USDA Economic Research Service. Irrigation & Water Use. Available at: <https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use>. Updated April 2018.
117. American Farmland Trust. Water. Available at <https://www.farmland.org/our-work/areas-of-focus/water>.
118. United Nations. Water scarcity. Available at: <http://www.un.org/waterforlifedecade/scarcity.shtml>. Updated November 2014.
119. Food and Agriculture Organization of the United Nations. Irrigation Management. Available at: <http://www.fao.org/3/a-i4591e.pdf>.
120. USDA National Agricultural Library. Water Conservation. Available at: <https://www.nal.usda.gov/waic/water-conservation>.
121. United States Department of Agriculture. Lincoln's Milwaukee Speech. Available at: <https://www.nal.usda.gov/lincolns-milwaukee-speech>. Delivered September 1859.
122. Food and Agriculture Organization of the United Nations. People and Demography: Part 1 The setting. Available at: <http://www.fao.org/docrep/015/i2490e/i2490e01a.pdf>.
123. The World Bank. Agriculture and Food. Available at: <http://www.worldbank.org/en/topic/agriculture/overview>. Updated September 2017.
124. Stevanović M, Popp A, Lotze-Campen H, et al. The impact of high-end climate change on agricultural welfare. *Science advances*. 2016;2:e1501452-e1501452.
125. Walingo MK. Role Of Livestock Projects In Empowering Women Smallholder Farmers For Sustainable Food Security In Rural Kenya. *African Journal of Food, Agriculture, Nutrition and Development*. 2010;9.
126. National Restaurant Association. Facts at a Glance. Available at: <http://www.restaurant.org/News-Research/Research/Facts-at-a-Glance>.
127. USDA Economic Research Service. Food Expenditures. Available at: <https://www.ers.usda.gov/data-products/food-expenditures/food-expenditures/#Food%20Expenditures>. Updated April 2018.
128. Adcock F, Anderson D, Rossen P. The Economic Impacts of Immigrant Labor on US Dairy Farms. *Texas A&M AgriLife Research*. 2015.
129. USDA. Scientific Report of the 2015 Dietary Guidelines Advisory Committee. Available at: <https://health.gov/dietaryguidelines/2015-scientific-report/PDFs/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf>. Published February 2015.

130. Food and Agriculture Organization of the United Nations. Food-based dietary guidelines: Dietary guidelines and sustainability. <http://www.fao.org/nutrition/education/food-dietary-guidelines/background/sustainable-dietary-guidelines/en/>.
131. Food and Agriculture Organization of the United Nations, World Health Organization. Second international conference on nutrition: Conference outcome document: Rome declaration on nutrition. Available at: <http://www.fao.org/3/a-m1542e.pdf>. Published November 2014.
132. Food and Agriculture Organization of the United Nations. Second International Conference on Nutrition. Available at: <http://www.fao.org/3/a-m1542e.pdf>. Published November 2014.
133. World Health Organization. Healthy diet. Available at: <http://www.who.int/mediacentre/factsheets/fs394/en>. Published September 2015.
134. Food and Agriculture Organization of the United Nations. Milk and dairy products in human nutrition: Questions and Answers. Available at: http://www.fao.org/fileadmin/user_upload/newsroom/docs/Milk%20and%20Dairy%20Q&A.pdf. Published 2013.
135. Office of Disease Prevention and Health Promotion. Scientific Report of the 2015 Dietary Guidelines Advisory Committee. Available at: <https://health.gov/dietaryguidelines/2015-scientific-report/07-chapter-2>.
136. Chen G, Wang Y, Tong X, et al. Cheese consumption and risk of cardiovascular disease: a meta-analysis of prospective studies. *European Journal of Nutrition*. 2017;2016;56:2565-2575.
137. Goede d, J, Soedamah-Muthu SS, Pan A, Gijsbers L, Geleijnse JM. Dairy consumption and risk of stroke: A systematic review and updated dose-response meta-analysis of prospective cohort studies. *Journal of the American Heart Association*. 2016;5:n/a.
138. Fischer CG, Garnett T. Plates, pyramids, planet. Developments in national healthy and sustainable dietary guidelines: a state of play assessment. Published 2016.
139. US Department of Health & Human Services. History of Dietary Guidelines for Americans. Available at: <https://health.gov/dietaryguidelines/history.htm>.
140. Drewnowski A. Measures and metrics of sustainable diets with a focus on milk, yogurt, and dairy products. *Nutrition Reviews*. 2018;76(1):21-28. <https://doi.org/10.1093/nutrit/nux063>
141. Innovation Center for U.S. Dairy. Stewardship and sustainability framework for U.S. dairy. Available at: <https://www.usdairy.com/sustainability/commitment/stewardship-and-sustainability-framework-for-us-dairy>. Published June 2017.
142. Food and Agriculture Organization of the United Nations. Food-based dietary guidelines. Available at: <http://www.fao.org/nutrition/nutrition-education/food-dietary-guidelines/en/>.
143. Rethink Food Waste. A Roadmap to Reduce US Food Waste by 20 Percent. Available at: https://www.refed.com/downloads/ReFED_Report_2016.pdf. Published 2016.
144. Hall KD, Guo J, Dore M, Chow CC. The Progressive Increase of Food Waste in America and Its Environmental Impact. Sorensen TIA, ed. *PLoS ONE*. 2009;4(11):e7940. doi:10.1371/journal.pone.0007940.
145. Food and Agriculture Organization of the United Nations. Key facts on food loss and waste you should know!. Available at: <http://www.fao.org/save-food/resources/keyfindings/en/>.
146. US Environmental Protection Agency. United States 2030 Food Loss and Waste Reduction Goal. <https://www.epa.gov/sustainable-management-food/united-states-2030-food-loss-and-waste-reduction-goal>. Updated December 2017.

147. United Nations. Sustainable Development Goal 12. Available at: <https://sustainabledevelopment.un.org/sdg12>. Published 2017.
148. USDA. USDA and EPA Launch US Food Waste Challenge. Available at: <https://www.usda.gov/media/press-releases/2013/06/04/usda-and-epa-launch-us-food-waste-challenge>. Published June 2013.
149. Further with Food. Center for Food Loss and Waste Solutions. Available at: <https://furtherwithfood.org/>.
150. Hartman Group. Connecting Benefits with Values through Personal Consumption: Sustainability 2017 Report Overview. Available at: <http://store.hartman-group.com/content/Sustainability-2017-Overview.pdf>. Published 2017.
151. Spiker ML, et al. Wasted Food, Wasted Nutrients: Nutrient Loss from Wasted Food in the United States and Comparison to Gaps in Dietary Intake. *J. Acad. Nutr. Diet.* 2017;117(7):1031-1040.
152. United States. Dept. of Agriculture, United States. Dept. of Health, Education, and Welfare. *Nutrition and Your Health : Dietary Guidelines for Americans*. 1980.
153. United States. Dept. of Agriculture, United States. Dept. of Health, Education, and Welfare. *Nutrition and Your Health : Dietary Guidelines for Americans*. 1985.
154. United States. Dept. of Agriculture, United States. Dept. of Health, Education, and Welfare. *Nutrition and Your Health : Dietary Guidelines for Americans*. 1990.
155. United States. Dept. of Agriculture, United States. Dept. of Health, Education, and Welfare. *Nutrition and Your Health : Dietary Guidelines for Americans*. 1995.
156. United States. Dept. of Agriculture, United States. Dept. of Health, Education, and Welfare. *Nutrition and Your Health : Dietary Guidelines for Americans*. 2000.
157. United States. Department of Agriculture, United States. Dietary Guidelines Advisory Committee, United States. Department of Health and Human Services. *Dietary guidelines for Americans, 2005*. Washington, D.C.: U.S. Dept. of Health and Human Services, U.S. Dept. of Agriculture; 2005;HHS-ODPHP-2005-01-DGA-A.;no. 232.
158. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2010*. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010.
159. McWilliams J. The Myth of Sustainable Meat. *New York Times*. April 12, 2012. <https://www.nytimes.com/2012/04/13/opinion/the-myth-of-sustainable-meat.html>.
160. Cameron J, Cameron SA. Animal agriculture is choking the Earth and making us sick. We must act now. *The Guardian*. December 4, 2017. <https://www.theguardian.com/commentisfree/2017/dec/04/animal-agriculture-choking-earth-making-sick-climate-food-environmental-impact-james-cameron-suzy-amis-cameron>.
161. Food Wastage Footprint. Impacts on Natural Resources. Available at: <http://www.fao.org/docrep/018/i3347e/i3347e.pdf>. Published 2013.
162. World Food Program USA. 8 Facts to Know About Food Waste and Hunger. Available at: <https://wfpusa.org/articles/8-facts-to-know-about-food-waste-and-hunger/>. Published November 2017.
163. Feeding America. Fighting Food Waste with Food Rescue. Available at: <http://www.feedingamerica.org/our-work/our-approach/reduce-food-waste.html>.
164. US Environmental Protection Agency. Reduce Wasted Food By Feeding Hungry People. Available at: <https://www.epa.gov/sustainable-management-food/reduce-wasted-food-feeding-hungry-people>.
165. Food and Agriculture Organization of the United Nations. Food Loss and Food Waste. Available at: <http://www.fao.org/food-loss-and-food-waste/en/>.
166. Food and Agriculture Organization of the United Nations. The future of food and agriculture: Trends and challenges. Available at: <http://www.fao.org/3/a-i6583e.pdf>. Published 2017.

167. Food and Agriculture Organization of the United Nations. Agriculture. Available at: <http://www.fao.org/ag/agn/nutrition/Indicatorsfiles/Agriculture.pdf>.
168. Hoekstra AY, Chapagain A, Martinez-Aldaya M, Mekonnen M. *The Water Footprint Assessment Manual; Setting the Global Standard*. Earthscan; 2011.
169. USDA Natural Resources Conservative Service. Buffer Strips: Common Sense Conservation. Available: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=nrcs143_023568.
170. USDA. USDA Coexistence Fact Sheets Conventional Farming. Available at: <https://www.usda.gov/sites/default/files/documents/coexistence-conventional-farming-factsheet.pdf>. Published February 2015.
171. Water Footprint Network. What is a water footprint? Available at: <http://waterfootprint.org/en/water-footprint/what-is-water-footprint/>.
172. Brown PE, Soil Inoculation. *Circular (Iowa State College. Agricultural Experiment Station)*. 1918;Paper 43.



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