Primer on Sustainable Food Systems for Nutrition and Dietetics Professionals

Released January 2021

This resource was developed as part of the Academy of Nutrition and Dietetics Foundation’s Future of Food initiative, which is supported by an educational grant from National Dairy Council.

Acknowledgements

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About the Future of Food Initiative

The Academy of Nutrition and Dietetics Foundation launched the Future of Food initiative in 2012 to position the Academy and its members to address the issues of global food security, hunger, and malnutrition. The initiative was launched with support from National Dairy Council and Feeding America.

Resources produced within the Future of Food initiative include:

Curricula for dietetic interns and students
- Food Insecurity / Food Banking curriculum (released in 2014)
- Sustainable, Resilient, and Healthy Food and Water Systems (SFS) curriculum (released in 2018)

Publications
- Cultivating Sustainable, Resilient, and Healthy Food and Water Systems: A Nutrition-Focused Framework for Action (Spiker et al., 2020)

Webinars, toolkits, infographics, and other resources

Visit the Foundation’s website for more: https://eatrightfoundation.org/why-it-matters/public-education/future-of-food/

By the end of this primer, you will be able to:

1. Use a conceptual framework of the food system to describe how food systems influence diets, nutrition and health.
2. Discuss sustainability, resilience, and health in food systems through the lens of environmental, economic, and social factors.
3. Use tools from systems thinking to describe complexities, co-benefits, and trade-offs within food systems.
4. Identify five entry points through which nutrition and dietetics professionals can leverage their unique skills to cultivate sustainable food systems.
5. Locate reliable resources related to sustainable food systems for nutrition and dietetics professionals.
Primer on Sustainable Food Systems for RDNs and NDTRs

Module 1: Why care about sustainable food systems?

Module 2: A food systems tour (20 min.)

Module 3: A conceptual framework (10 min.)

Module 4: Sustainable, resilient, and healthy food and water systems (20 min.)

Module 5: Exploring the multiple domains of sustainable food systems (20 min.)

Module 6: Understanding complexity in food systems (20 min.)

Module 7: Strategies for nutrition professionals to create food systems change (20 min.)
By the end of this module, you will be able to:

1. Describe the **growing interest** in sustainable food systems from individuals, institutions, and policymakers.

2. Identify **core skills** of the nutrition and dietetics profession that are especially helpful in navigating issues in the food system.

3. Identify ways that familiarity with sustainable food systems can help **RDNs and NDTRs meet their goals** in a variety of practice settings.

**Nutrition and food are inseparable from sustainability**

*We recommend varied, balanced diets.* But, people can’t follow our recommendations if nutritious foods are not:

- **Accessible** (e.g., is this food available at places I can regularly visit?)
- **Affordable** (e.g., is this food available at prices I can regularly afford?)
- **Available** in the food supply (e.g., is enough produced or imported?)

For example:

- **In the United States:**
  - As of 2010, our food supply had a Healthy Eating Index score of 55 out of 100, indicating that the food supply did not align with the 2010 Dietary Guidelines for Americans (1)
  - Per capita **vegetable** availability (1.64 cups/day) falls short of recommended 2.5 cups/d (2)
  - Per capita **fruit** availability (0.87 cups/day) falls short of recommended 2 cups/d (2)
  - Per capita **fish** availability (4.4 oz/week) falls short of recommended 8 oz/week (3)

- **Globally:** 45% of the world lives in countries that do not produce or import the World Health Organization (WHO) target of 400 g fruits and vegetables per capita per day (4)

Nutrition and food are inseparable from sustainability – continued

Feeding people always involves an ecological footprint.

Agricultural practices account for:
- 34% of global land use (1)
- 70% of water withdrawn for human purposes (2)
- 11% of global greenhouse gas emissions (3)

Globally, 1/3 of all food produced is ultimately lost or wasted (4)

So the question is:
How can we ensure the long-term viability of the natural, economic, and social resources needed to produce a nutritious food supply?

Sources: (1) Ramankutty et al., 2008 (2) Molden et al., 2007 (3) Center for Climate and Energy Solutions, 2020 (4) World Resources Institute, 2013. See handout for full references.

Patients and clients have questions about sustainability

Do we produce enough to feed the world? Will there be enough food for our children and grandchildren?

How can I eat sustainably on a budget?

How can I waste less food?

Are the labels meaningful – cage free, pasture raised, fair trade, certified humane, marine stewardship council?

Do my individual actions matter? Should I “vote with my fork”? How can my purchases support community economies?

Should I buy organic or conventional?

How do genetically modified foods affect nutritional value, human health, biodiversity, global food security?

How do different fishing practices affect nutritional value, fish stocks, marine environments?

Should I buy local food?

What type of fish should I buy?

What about seasonal food?

Where can I find reliable, unbiased information?

Should I be worried about pesticide residues?

Plant-based and animal source foods – how do they affect human health, climate change, water use, animal welfare, antibiotic resistance, farm labor?

Should I avoid plastic packaging?

How can we reduce packaging in general?
Institutions have questions about sustainability

How can our food procurement, menu planning, and other operational decisions help us provide meals that are nutritious, environmentally friendly, culturally acceptable, affordable, and support community economies?

How do we ensure that the easy choice within workplaces and cafeterias is also the healthy and sustainable choice?

How can we use organizational policies, technologies, and behavior change strategies to reduce waste of food, water, and other resources—within commercial kitchens? within school cafeterias? within supermarkets?

How can we engage and train frontline workers to sustain waste reduction interventions over the long term?

Policymakers have questions about sustainability

To what extent should population-level dietary guidance take into consideration the long-term sustainability of the food supply, and the impact of human diets on natural resources?

Are healthy diets also sustainable diets? Where are there co-benefits or tradeoffs?

And, what is the strength of the evidence to support these relationships?
Are we prepared to respond to these questions, as individual practitioners and as a profession?

The core skills of the nutrition and dietetics profession help us to navigate these challenges. We are skilled at:

- Helping people navigate dietary choices amidst complexity and uncertainty
- Fulfilling multiple goals through food: not just nutritious, but also safe, delicious, affordable
- Critically evaluating and translating research from a variety of scientific disciplines
- Collaborating as part of interprofessional teams and engaging with other sectors
When RDNs and NDTRs are familiar with food systems and sustainability, we are better equipped to:

- Engage the public’s growing interest in food, food systems, and sustainability as an opportunity to guide individuals towards nutritious choices
- Amplify the effectiveness of individual-level interventions (e.g., education and behavior change) with actions at the policy, systems, and environmental levels
- Identify actions that generate positive changes in the food system (e.g., improving equitable access to culturally appropriate foods, strengthening local economies)

### Primer on Sustainable Food Systems for RDNs and NDTRs

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Primer on Sustainable Food Systems for Nutrition and Dietetics Professionals: Module 2

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Module 2

A food systems tour

Learning Outcomes

By the end of this module, you will be able to:

1. Define the concept of *food systems*.

2. Provide examples of how food supply chains, food environments, and consumer behavior can *vary in different geographic settings*.
What is the food system?

Neff and Lawrence define the food system as:

“A system encompassing all the activities and resources that go into producing, distributing, and consuming food; the drivers and outcomes of those processes; and, the extensive and complex relationships between system participants and components.”

Source: Neff and Lawrence, 2014. See handout for full reference.

Preview of the food systems conceptual framework

Underlying drivers

Food supply chains

Food environments

Consumer behavior

Diets

Impacts on nutrition and health

Impacts on environmental, economic, and social factors

“a system encompassing all the activities and resources that go into producing, distributing, and consuming food; the drivers and outcomes of those processes; and, the extensive and complex relationships between system participants and components”

Sources: Definition from Neff and Lawrence, 2014. Framework adapted from HLPE, 2017. See handout for full references.
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Sources: Definition from Neff and Lawrence, 2014. Framework adapted from HLPE, 2017. See handout for full references.

We produce many kinds of food – crops, livestock, marine plants & animals

We produce food for many purposes – subsistence, income, community


We produce food at many different scales

We produce food using different ways of providing & recycling nutrients


We produce food using water from different sources – irrigated, rainfed

We have different methods of on-farm storage...

... and many ways of transporting food...
... and distributing large quantities of food

We sort and process food, ranging from minimally- to ultra-processed
We **package** food for **food safety, preservation, quality, and convenience**

The supply chains that bring food to us depend on many **workers**
Our **food environments** have many characteristics

![Images of markets and food items]

- Is food available?
- Is it affordable?
- Is it safe?
- What advertising surrounds us?
- What info do we have access to?

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<thead>
<tr>
<th>Calories</th>
<th>Per serving</th>
<th>Per container</th>
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<tr>
<td></td>
<td>245</td>
<td>490</td>
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<tr>
<td>% DV*</td>
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</tr>
<tr>
<td>Total Fat</td>
<td>12g 14%</td>
<td>24g 29%</td>
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<tr>
<td>Saturated Fat</td>
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<td>Trans Fat</td>
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<tr>
<td>Cholesterol</td>
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... and we **sell foods** prepared away from home

As consumers, our food-related **behaviors** are complex
We don’t just eat food, we also waste it

We know that dietary intake affects human nutrition and health
Dietary intake also has **environmental, economic, and societal impacts**

**Additionally, there are underlying drivers influencing the system (pt. 1)**
Sustainable Food Systems Primer for RDNs and NDTRs

Additionally, there are underlying drivers influencing the system (pt. 2)


Primer on Sustainable Food Systems for RDNs and NDTRs

Building a Food Systems Foundation (40 minutes)

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Unpacking Sustainability (40 minutes)

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Adding Tools To the Toolkit (40 minutes)

Module 6: Understanding complexity in food systems (20 min.)

Module 7: Strategies for nutrition professionals to create food systems change (20 min.)
Primer on Sustainable Food Systems for Nutrition and Dietetics Professionals:
Module 3

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Module 3 Learning Outcomes

A food systems conceptual framework

By the end of this module, you will be able to:

1. Identify the three **major components of food systems**
2. Identify at least three **underlying drivers** that influence food systems
3. Describe at least three ways nutrition is important for achieving the **Sustainable Development Goals**
A food systems conceptual framework

Breaking down the conceptual framework

Underlying drivers

Food supply chains → Food environments → Consumer behavior → Diets → Impacts on nutrition and health

Impacts on environmental, economic, and social factors

Breaking down the conceptual framework: Three major components

Underlying drivers

Food supply chains → Food environments → Consumer behavior → Diets → Impacts on nutrition and health

Impacts on environmental, economic, and social factors

The HLPE report describes three major components of the food system: food supply chains, food environments, and consumer behavior. Each component has multiple “entry and exit points for nutrition.”

Source: Adapted from HLPE, 2017. See handout for full reference.
Breaking down the conceptual framework: Underlying drivers

The three components of the food system shape what humans eat, which in turn affects human health and environmental, economic, and social factors. These things also influence underlying drivers of the food system.
The Sustainable Development Goals (SDGs)

1. No Poverty
2. Zero Hunger
3. Good Health and Well-Being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation, and Infrastructure
10. Reduced Inequalities
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life Below Water
15. Life on Land
16. Peace and Justice
17. Partnerships for the Goals

Source: SDG Communications toolkit. See handout for full reference.

NUTRITION IS ESSENTIAL FOR THE SUCCESS OF ALL THE SDGS

Optimal nutrition is essential for achieving several of the Sustainable Development Goals, and many SDGs impact nutrition security. Nutrition is hence linked to goals and indicators beyond Goal 2 which addresses hunger. A multisectoral nutrition security approach is necessary for success.

Source: SUN Civil Society Network SDG Toolkit. See handout for full reference.
Take a moment to pause and reflect before starting the next section (modules 4-5)

Thought Starter for Modules 1 – 3

Think about a food or beverage you’ve consumed in the past 24 hours:

- Were you able to choose the food you consumed? If so, what were your primary reasons for choosing this food?
- How did you acquire it? Did you travel somewhere, or was it delivered to you?
- What costs were associated with acquiring the item, preparing it, transportation, etc?
- Where did the food originate, and how did the food get to where you acquired it?
- What workers were involved throughout food system to make this food available to you?
- What alternative product might you have chosen?

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Primer on Sustainable Food Systems for Nutrition and Dietetics Professionals: Module 4

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Module 4

Sustainable, resilient, and healthy food and water systems

By the end of this module, you will be able to:

1. Define the concepts of sustainability, resilience, and health on their own and within the context of food systems.

2. Define the concept of equity and discuss how equity is related to sustainability, resilience, and health in the food system.

3. Describe the importance of water for food systems and human health.
What exactly do we mean by sustainable, resilient, and healthy food and water systems?


Key definition: Equity

What is equity?
The World Health Organization defines equity as “the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically.” (1)

How is equity different from equality?
“The route to achieving equity will not be accomplished through treating everyone equally. It will be achieved by treating everyone justly according to their circumstances.” – Paula Dressel, Race Matters Institute (2)

Example of equality: All public schools in a community have computer labs with the same number of computers and hours of operation during school hours.

Example of equity: Computer labs in lower income neighborhoods have more computers and printers, as well as longer hours of operation, because some students don’t have access to computers or the internet at home.

Key definition: Equity

Inequality: Unequal access to opportunities
Equality: Equally distributed tools and assistance
Equity: Custom tools that identify and address inequality
Justice: Using the system to offer equal access to both tools and opportunities

Image source: Images by @lunchbreath, based on Shel Silverstein’s Giving Tree, for John Maeda’s 2019 Design in Tech Report

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Key definition: Sustainability

Isolating the concept of sustainability:
Can a system be maintained over the long term?

Thinking about what sustainability means in the food system:
A sustainable food system meets the needs of individuals and communities in the present moment, but also:
- Adjusts over time to accommodate future generations
- Does not jeopardize the ability of future generations to meet their needs

How does the concept of equity apply to sustainability?
Some people are less likely to have their needs met, both now and in the future:
- Examples: Women; Black and indigenous people, and people of color; individuals living in low socioeconomic households; communities exposed to environmental contaminants; people displaced by climate change


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**Sustainability example: Importance of soil health**


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**Key definition: Resilience**

Isolating the concept of resilience:
Can a system withstand or adapt to disturbances over time?

Thinking about what resilience means in the food system:
A resilient food system can withstand or rebound more quickly to shocks such as climate change, natural disasters, disease epidemics, political or economic crises, or rapid urbanization.

How does the concept of equity apply to resilience?
Individuals and communities differ in their ability to withstand and recover from disruptive events. Individuals and communities that were more vulnerable before a disruptive event may take longer to recover.

Resilience example: COVID-19 and food supply chains

Key definition: Healthy

Isolating the concept of healthy:
Do people have the opportunity to attain their full health potential?

Thinking about what healthy means in the food system:
A healthy food system facilitates well-being and disease prevention for all individuals. For example, a healthy food system:
- Makes nutrient-rich foods accessible and affordable for all individuals
- Minimizes contamination of resources such as air and water
- Ensures that people have access to resources needed for food storage, preparation, and feeding and caregiving practices that support child and family health

How does the concept of equity apply to health?
Achieving health equity requires addressing historical and contemporary structural inequities, including:
- Poverty, systemic racism, gender disparities in decision-making, and geographic disparities in access to health services and healthy environments
**Healthy example: Promoting nutrition and health**

Nutrition is affected by many sectors including agriculture, food retail, and rural development. RDNs and NDTRs can help to maximize the impact of activities in these other sectors on human nutrition and health.

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**Common threads between these concepts**

**Thinking about the concepts of sustainability, resilience, and health:**

- Relevant to all areas of nutrition and dietetics practice
- Broader than any one practice setting or individual intervention
- Interconnected, and grounded in the importance of equity
- Require action at multiple levels – individual, policy, systems, environments
- Can be carried out at multiple scales

**For example:**

- We can build resilience within an individual patient or client, but we can also build resilience with an organization, community, farm, or food supply chain
- We can promote health within individuals, but we can also develop environments, organizations, and policies that facilitate health
Let’s talk about the **water** part of sustainable, resilient, and healthy food and water systems

Key concepts in **water systems**

**Concepts related to water:**

- **What is the source of water?**
  - **Green water:** Water from precipitation; it is stored in soil and available for plants to uptake
  - **Blue water:** Water from surface or groundwater sources (e.g., lakes, glaciers, aquifers)

- **What are the main challenges related to water?**
  - **Water use:** Do we have enough fresh water? How is water use allocated for agriculture and other purposes? How can water be used more efficiently?
  - **Water quality:** Is water safe enough for drinking, swimming, fishing, agricultural uses, and to support marine ecosystems? How are water sources affected by pollution and contaminants?
Key definitions: Putting it all together

“A sustainable, resilient, and healthy food and water system is one in which all individuals have equitable access to a safe, adequate, and secure supply of food and water that supports optimal health, both now and in the future.”

Sustainable food systems are at the intersection of four domains:
- Nutrition and health
- Economic vitality
- Social, cultural, and ethical capital
- Environmental stewardship

The next module discusses these domains in detail.


A few notes about sustainability in the context of food systems

- **Sustainability is:**
  - Comprised of multiple domains
  - About now and the future
  - About equity: all people, all places
  - Related to structural inequities
  - Fundamental to the profession

- **Sustainability is not:**
  - Exclusively about the environment
  - Only about the future
  - Only for those with financial means
  - Isolated from structural inequities
  - Only relevant to specialized practitioners

- Fred Kirschenmann: “sustainability is a process, not a prescription... it is a journey we embark upon together, not a formula upon which we agree.”

Source: Kirschenmann FL, 2008; see handout for full reference.
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Module 5

Exploring the multiple domains of sustainable food systems

By the end of this module, you will be able to:

1. Identify the **four domains** of sustainable, resilient, and healthy food and water systems

2. Describe **principles** within each domain

3. Discuss how human diets **affect and are affected by** environmental, economic, and social factors
Sustainable Food Systems Primer for RDNs and NDTRs

Sustainability is multi-dimensional

Sustainable, resilient, and healthy food and water systems are at the intersection of four domains:

- Nutrition and health
- Economic vitality
- Social, cultural, and ethical capital
- Environmental stewardship


Nutrition and health

How are nutrition and health interdependent with the other domains of sustainable food systems?

Nutrition and health advance the other domains.
Well nourished, healthy people can promote environmental stewardship; economic vitality; and social, cultural, and ethical capital.

Nutrition and health are not possible without the other domains.
Promoting healthy dietary patterns requires that nutritious foods be available, accessible, and affordable – factors with environmental, economic, and social components.

Economic vitality

Economic factors affect human diets:
- People are more likely to consume nutritious foods if they are affordable.
- Farmers and businesses are more likely to produce, process, distribute, and market nutritious foods if it is economically viable to do so.

Human diets affect economic outcomes:
- Consumer choices drive the demand for agricultural and food systems livelihoods.
- Malnutrition can lead to economic losses for households and nations:
  - Direct losses in productivity
  - Indirect losses in productivity from schooling deficits
  - Increased healthcare costs

Social, cultural, and ethical capital

Social factors affect human diets:
- Nutritious foods are more likely to be consumed if they are culturally appropriate.
- Workers’ rights, safety, and fair working conditions facilitate jobs – from agricultural labor to restaurant foodservice – that support the availability of nutritious foods.
- Equitable access to nutritious foods, health services, healthy environments, fair wages, and other factors supports human health.

Human diets affect social outcomes:
- Consumers can influence the demand for policies, regulations, and voluntary industry standards that support fair working conditions and animal welfare
Environmental stewardship: Introducing key terms

Concepts related to **climate change:**

**What are greenhouse gases? (GHGs)**
Gases that trap heat and make the planet warmer, including carbon dioxide (CO$_2$), methane, nitrous oxide, and fluorinated gases. Greenhouse gases can be emitted (e.g., by cars or fertilizer application) or sequestered (e.g., in soil, trees, and other biomass).

**What is climate change?**
Increased levels of greenhouse gases contribute to atmospheric warming, which affects ocean temperatures, sea level, precipitation patterns, and extreme weather events.

**How can climate change affect human nutrition and health?**
- Sea level rise may cause soil erosion or salinization, or aquifer contamination.
- Scarce land and water resources may cause conflict, or changes in food availability or price.
- Migration due to sea level rise and other extreme weather events may cause urbanization, crowding, and heightened susceptibility to infectious disease and undernutrition.

Environmental stewardship: Introducing key terms

Concepts related to **biodiversity:**

**What is biodiversity?**
Biological diversity of genes, species, and ecosystems.

- Example of ecosystems diversity: A variety of different pasture habitats on the earth
- Example of species diversity: A variety of different species of seaweed within a marine ecosystem
- Example of genetic diversity: A variety of different cultivars within a species such as wheat or rice

Each ecosystem, species, or cultivar has its own ability to adapt to environmental changes.

**Why is biodiversity important for agriculture, nutrition, and human health?**
- Ensures that soils are productive (e.g., soil organisms are essential for cycling nutrients)
- Promotes resilience of food producers to climate change (e.g., one cultivar may be less susceptible to flood, drought, or heat than another)
- Allows for a diversity in nutrient composition (e.g., sweet potato cultivars can differ in carotenoid content by a factor of 200)
Environmental stewardship: Introducing key terms

Can we use land to grow food?
- **Arable land**: Land that is capable of being used to grow crops
- **Marginal land**: Land that is of little agricultural value due to challenging terrain (e.g., excessive slope), poor soil quality, low rainfall and lack of access to irrigation, or pollution from industrial activities

How much land should we use to grow food?
- **Land sharing**: An approach where agricultural yields are kept low in order to maintain biodiversity within the agricultural landscape
- **Land sparing**: An approach where agricultural yields are maximized in order to leave more natural habitat untouched

What happens when we increase the amount of land used to grow food?
- **Land use conversion**: When uncultivated land (e.g., forests) are converted to agricultural land, carbon dioxide is released and the remaining land sequesters less carbon

Environmental stewardship

The environment affects human diets:
- Growing crops, animals, and marine food sources requires specific environmental conditions – e.g., healthy soil, healthy marine ecosystems, biodiversity, adequate rainfall or water for irrigation, land suitable for grazing.
- There is a limit to how much food we can produce using the natural resources we have, and we need to protect that resource base.
- Food production relies on ecological systems. Ecological changes such as climate change may affect agricultural yields, nutritional content of crops, and more.

Human diets affect the environment:
- We need natural resources to produce, distribute, acquire, and prepare foods.
- Different foods and farming and supply chain practices vary in their resource intensity and their effects on the environment.

Environmental stewardship examples: greenhouse gas emissions

 Examples of ways human diets affect the environment

Foods may differ in their greenhouse gas emissions:

- Rice production tends to have higher CO₂ emissions per kg than potatoes, because flooded rice fields release methane. (1)
- Beef production tends to have higher CO₂ emissions per kg than poultry, because a) ruminant livestock release methane and b) more land is required for grazing and growing feed. (1)
- Beef finished on grass tends to have higher CO₂ emissions per kg than beef finished on feedlots, because cows finished on grass take more time to reach market weight. (2)
- Transporting foods by air may emit 50x more carbon dioxide equivalents than transporting foods by boat. (3)

Sources: (1) Clune et al., 2017 (2) Pelletier et al., 2010 (3) Ritchie 2020. See handout for full references. Image source: Astrid860 via Getty Images.

Environmental stewardship examples: water use

 Examples of ways human diets affect the environment

Foods may differ in their water use:

- Producing rice requires more water than producing potatoes, because rice cannot grow unless paddy fields are flooded. (1)
- Producing meat requires more water than producing vegetables, due to the water required to grow animal feed (whether that water is from irrigation or rainfall). (2)
- Compared to beef finished on feedlots, beef finished on grass requires less blue water (water from irrigation) but more green water (water from rainfall). (3)

Environmental stewardship examples: water quality

Examples of ways human diets affect the environment

Foods may differ in their effect on water quality:

- Excessive application of fertilizer on crops can cause nutrients (e.g., nitrogen, phosphorous) to run into freshwater and marine waterways. (1)
- Excessive nutrients can lead to algae blooms and anoxic dead zones in the water. (1)
- Bivalves (e.g., oysters, clams, mussels, scallops) are filter feeders: they remove excess nitrogen from the water. (2,3)


How should we use this information?

When we conceptualize sustainability as including multiple domains, we can:

- See that achieving optimal nutrition and health are dependent on other factors
- Ensure that interventions to promote sustainability consider multiple factors
- Help colleagues in other sectors, fields, and professions see the value of nutrition
- Identify potential collaborators
- Consider potential co-benefits and trade-offs of nutrition interventions

Thought Starter for Modules 4 – 5

Take a moment to pause and reflect before starting the next section (modules 6-7)

Think about a food or beverage you’ve consumed in the past 24 hours:

- How might this food have affected:
  - Your nutrition and health
  - Environmental stewardship
  - Economic vitality
  - Social, cultural, and ethical capital

In thinking about this, consider how the food was produced, processed, distributed, prepared, consumed, and possibly wasted.
Primer on Sustainable Food Systems for Nutrition and Dietetics Professionals: Module 6

Released January 2021

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Module 6

Understanding complexity in the food system

Learning Outcomes

By the end of this module, you will be able to:

1. Define a complex system.

2. Describe at least three characteristics of complex systems.

3. Discuss how systems thinking can be used to approach issues in nutrition.

4. Provide at least one example of a co-benefit and one example of a tradeoff within the food system.
What is the systems part of food systems?

What is a system? Interconnected parts that operate towards a purpose

What are different types of systems?

Simple systems: A well-defined relationship between an event and its outcome.
Example: The way a valve lets air into an engine.

Complicated systems: The co-existence of several well-defined relationships between events and outcomes.
Example: The many mechanical actions and chemical reactions that occur when a vehicle operates.

Complex systems: The co-existence of several relationships that are not well defined, and that may change over time.
Example: The effect of widespread vehicle use on human physical activity and health.

Sources: Definition of system from Peters 2014; examples of system types drawn from Spiker et al 2020; see handout for full reference.

Characteristics of complex systems: Bidirectional feedback

Bidirectional feedback: Two components may affect one another

Example 1: Undernutrition makes children more susceptible to infectious disease, and infectious disease makes children more susceptible to undernutrition.

Example 2: The food supply (what's available) affects demand (what people want), and demand (what people want) also affects the food supply (what is grown, processed, and marketed).

Image sources: Left: Loop by Hare Krishna from the Noun Project. Middle: Michael Blann via Getty Images. Right: Estiviml via Getty Images. See handout for additional resources on these examples.
Some feedback loops are **balancing loops**: Two relationships bring the system back to a state of equilibrium

Some feedback loops are **reinforcing loops**: Two relationships amplify each other’s effects

**Example of a balancing loop:**

- Level of blood glucose + Release of insulin from beta cells
- Nutritional status - Resilience to infectious disease
- Ripening of fruit + Release of ethylene gas

**Bidirectional feedback, continued: feedback loops**

**Characteristics of complex systems: Time-delayed responses**

**Time-delayed responses:** Some impacts may not be felt immediately

**Example 1:** Exposure to undernutrition during gestation or early life can increase the likelihood of obesity or chronic disease in later life.

**Example 2:** When carbon dioxide is emitted into the atmosphere, the full effect of those emissions on global warming may take several decades to emerge.
Characteristics of complex systems: Nonlinear relationships

Nonlinear relationships:
A change in one part of the system may not correspond with a constant change in another part of the system.

Example 1: Combining micronutrient supplementation with psychosocial stimulation may have synergistic effects on children’s cognitive development (an example of synergy).

Example 2: Overfishing can lead to the collapse of wild fish stocks, even after what appears to be years of relative stability (an example of a tipping point).

Characteristics of complex systems: Convergence

Convergence:
Many routes may lead to the same outcome.

Example 1: Individual weight gain or loss can result from a multitude of factors, such as changes in dietary intake, changes in physical activity, and changes in health status.

Example 2: Changes in population-level diet quality can result from a multitude of factors, such as economic development, modernization of food retailers, and global supply chains.
Divergence: One route may produce many outcomes

Example 1: Removing sugar sweetened beverages (SSBs) from school vending machines can have both positive and negative impacts (e.g., decreased SSB intake at schools, increased SSB intake away from school).

Example 2: Keeping domestic food animals can have both positive and negative impacts (e.g., improved dietary diversity, increased risk of environmental enteric dysfunction).

Why learn about complex systems?

Having the language of complex systems helps us to see that:

- Improving the nutritional status of individuals and communities may not be as straightforward as we imagined.
  - Time delays and nonlinear relationships make it challenging to identify causal relationships.
  - Convergence and divergence make it challenging to isolate causal factors or guarantee that an intervention will produce uniform results without unintended consequences.

- The strategies we use as nutrition and dietetics professionals need to complement the strategies of other sectors and professions.
  - The root causes of nutrition issues are multi-faceted, not based solely on biology or behavior.
  - Few nutrition issues can be improved with a single strategy.
How can we help address complex systems issues?

Not every person can (or should) do everything! But, seeing the big picture helps us to:

- Form **collaborative relationships** with other professionals whose expertise complements our own

- Identify the most effective ways to **leverage our unique skillset**

- Establish **role clarity** between different sectors, disciplines, and professions

Systems thinking

**What is systems thinking?**

- A perspective of seeing and understanding a system as a whole, rather than as a collection of unrelated components

**How can I practice systems thinking in my day-to-day work?**

- Think about root causes of the problems you see in your patient population

- Think about downstream effects of your interventions, both intended and unintended

- Collaborate with people who work in other parts of the system:
  - Learn each other’s professional languages – you may be using different terminology to describe the same phenomenon
  - Take the time to listen and understand the priorities of other stakeholders
  - Share your expertise with professionals in other fields
More systems thinking tools: co-benefits and trade-offs

Co-benefits: Benefits or synergies that occur alongside each other

- Example: A co-benefit of walking or bicycling to work for cardiovascular health is that transitioning away from fossil-fuel intensive commutes can also contribute to climate change mitigation.

Trade-offs: Achieving one goal makes it difficult to achieve another

- Example: In low- and middle-income country settings, building new roads in rural areas may drive economic development for farmers who now have more access to markets, but it also may involve environmental trade-offs (such as previously forested land being used for roads).

Examples: Exploring nuances of food waste reduction

Examples of co-benefits

A co-benefit between waste reduction and nutrition: Smaller portion sizes for packaged foods can reduce waste from uneaten food, and smaller portion sizes may also assist with patient’s goals for weight management.

A co-benefit between waste reduction, food safety, and economics: When consumers have more knowledge about food safety, they may be less likely to unnecessarily discard foods that are still safe to consume. Fewer unnecessary discards can help to save money, and food safety knowledge can reduce risk of foodborne illness.

Examples of trade-offs

A trade-off between waste reduction and the environment: Refrigerating and freezing perishable foods reduces spoilage, but it also requires energy. In some settings, older refrigeration systems may leak refrigerants that are greenhouse gases (such as hydrofluorocarbons, HFCs).

A trade-off between waste reduction social and cultural considerations: Food donations can reduce waste, but an inability for food banks and pantries to control the nature of food donations may mean that recipients may receive food in undesired amounts or types, or at undesired times.
Why think about co-benefits and trade-offs?

- The food system is full of co-benefits and trade-offs!
- We should be prepared for the reality that promoting human nutrition and health may not always be a win-win with other outcomes, and it may not align with the priorities of other stakeholders. But, there may be co-benefits we have not explored.
- A systems approach can help RDNs and NDTRs to navigate the complexity of the food system.

Primer on Sustainable Food Systems for RDNs and NDTRs

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<th>Module 2: A food systems tour (20 min.)</th>
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Primer on Sustainable Food Systems for Nutrition and Dietetics Professionals:
Module 7

Released January 2021

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Module 7

Strategies for RDNs and NDTRs to create food systems change

By the end of this module, you will be able to:

1. Identify five entry points through which RDNs and NDTRs can leverage their knowledge and skills to cultivate sustainable food systems.

2. Identify cross-cutting skills that are common to nutrition and dietetics practice that can help RDNs and NDTRs to promote sustainable food systems.

3. Locate reliable resources related to sustainable food and water systems for RDNs and NDTRs.
How can RDNs and NDTRs leverage their skills in nutrition and dietetics to cultivate sustainable, resilient, and healthy food and water systems?

Cultivating Sustainable Food and Water Systems: A Nutrition-Focused Framework for Action

**Education & Training**
- By developing knowledge and skills in sustainable food and water systems, RDNs and NDTRs can:
  - Bring food systems knowledge to the many sites where they practice
  - Critically interpret and translate findings from research on the multiple dimensions of sustainability
  - Strengthen food systems policy initiatives from other sectors by identifying linkages to human nutrition and health

**Research**
- As part of multi-sectoral research teams, RDNs and NDTRs can:
  - Ensure the content of food systems education and training is current with an evolving evidence base
  - Translate research into clear messaging for practitioners to share
  - Lead and contribute to rigorous, transparent, and multi-sectoral research to inform evidence-based policy

**ENTRY POINTS**
- that leverage the strengths of registered dietitian nutritionists (RDNs) and nutrition dietetics technicians, registered (NDTRs) to cultivate sustainable food and water systems:
  1. Shape and deliver dietary guidance
  2. Improve food and nutrition security and water security
  3. Align food production and nutrition
  4. Optimize supply chains and food environments
  5. Reduce waste

**Practice**
- RDNs and NDTRs work in diverse settings throughout the food system, which enables them to:
  - Inform and strengthen the content of food systems education and training
  - Bring experience and collaborative partners to the research process
  - Lead and advocate for changes in organizational and public policy

**Policy**
- RDNs and NDTRs can advocate for and evaluate organizational and public policies, including:
  - Curriculum and credentialing decisions related to sustainable food and water systems education and training
  - Research priorities and budgets within organizational plans or legislative appropriations
  - Decisions that affect the daily activities of practitioners in all settings, including funding of programs

Shape and deliver dietary guidance

Why is this important?

The food system shapes human diets, and human diets influence the sustainability of the food system.

Nutrition education, menu planning, food procurement decisions, and policy-based dietary guidelines are all opportunities to support both nutrition and sustainability.

RDNs and NDTRs bring a valuable perspective to this work.

What could this entry point look like? A few examples:

- Learning to critically interpret research related to sustainable diets, which may use methods that are less common in nutrition
- Making evidence-based menu planning or food procurement decisions that support an institution’s goals for both nutrition and sustainability
- Bringing nutrition expertise to multi-disciplinary research efforts assessing ways to maximize nutrition and health while minimizing environmental impact
- Submitting public comments that inform the development of national food-based dietary guidelines

Improve food and nutrition security, water security

Why is this important?

Malnutrition is critically linked with hunger and food insecurity.

These issues are also connected to water security. We need clean, safe water for drinking, sanitation, and agriculture.

Sustainability underpins many concerns related to the availability, access, utilization, and stability of food and water supplies.

What could this entry point look like? A few examples:

- Developing familiarity with existing programs that provide benefits and services to under-resourced individuals (including federal, state, and municipal programs)
- Leading, supporting, and advocating for new services to meet the needs of under-resourced individuals (e.g., food pharmacies, mobile markets)
- Using food security screening tools and other instruments to assess the extent of food and nutrition insecurity among specific populations
- Bringing nutrition expertise to food policy councils and other coalitions that can advocate for policy changes that affect structural factors such as poverty and built environments

Align food production and nutrition

Why is this important?
Crop, livestock, and marine food production practices determine the quantity, quality, diversity, and safety of foods available for human consumption.

We want to make sure that food production practices support a nutritious food supply and promote human health while also protecting and renewing environmental, economic, and societal resources.

What could this entry point look like? A few examples:
- Learning about ways that human, animal, soil, water, and plant systems are connected by the flow of nutrients through food systems
- Contributing to multi-disciplinary research on how climate change affects the nutritional status of crops and people
- Enhancing knowledge of food production among professionals and the public through hospital gardens or teaching gardens
- Participating in advocacy efforts to ensure that legislation such as the Farm Bill supports nutrition, both directly and indirectly

Optimize supply chains and food environments

Why is this important?
RDNs and NDTRs work in many settings where food is processed, packaged, distributed, and made available to individuals.

These settings are all points of intervention for promoting nutrition while investing in capacity for sustainable food production and supply chain practices.

What could this entry point look like? A few examples:
- Learning about the logistical and business considerations of food supply chains and food environments, in order to ensure that recommendations are economically viable
- Assessing the effectiveness of different kinds of environmental cues (e.g., product placement or signage) to facilitate healthy, sustainable choices
- Overseeing sustainability initiatives in a hospital foodservice setting, and leveraging the power of procurement to strengthen local economies and food supply chains
- Helping businesses understand and implement product labels that facilitate healthy and sustainable choices

Reduce waste (of food, water, and other resources)

Why is this important?
Approximately 1/3 of all food goes to waste. RDNs and NDTRs are well positioned to reduce waste of food, water, and other resources throughout the food system.

Food waste is at the intersection of food safety, dietary intake, and individual and organizational behavior. RDNs and NDTRs are uniquely positioned to champion this critical issue.

What could this entry point look like? A few examples:
- Learning how the waste management hierarchy (reduce, reuse, recycle) can be applied to food waste reduction efforts in a variety of settings.
- Incorporating food safety and waste reduction messaging into nutrition education, in order to help reduce consumer-level waste.
- Assessing the relative effectiveness of different strategies and technologies to reduce waste in foodservice settings.
- Creating organizational policies that reduce waste within the workplace, such as ensuring the availability of recycling and compost, or incentivizing green meetings.

How can just one person create systems change?

education
Making a personal commitment to lifelong learning, and helping to shape the future of dietetics education.

practice
Generating demand for sustainable food systems practices from individuals and institutions.

research
Contributing to our collective knowledge base through research, and ensuring that nutrition and dietetics is represented in multi-disciplinary research efforts.

policy
Advocating for changes in organizational or public policies that support both nutrition and sustainability.

Individual plus Policy, Systems, and Environment (I+PSE) Conceptual Framework for Action
Creating Systems Change that Support Sustainable Food Systems

Cross-cutting skills that support sustainable food systems

Skills related to evidence-based practice:

• Staying current with an evolving evidence base and upholding standards of evidence-based practice
  o Note that in the context of sustainable food systems, the evidence may come from a variety of scientific disciplines.

• Translating population-level guidance into recommendations that are appropriate for subpopulations and individuals
  o What is the unique set of goals, context, and resources?

• Communicating clear, evidence-based messaging with the public on topics that involve complexity, uncertainty, and emotion
Cross-cutting skills that support sustainable food systems

Skills related to interprofessional collaboration:

- **Collaborating as part of an interprofessional team**
  - Note that our network of collaborators may include not just other healthcare providers, but also professionals such as food producers, climate scientists, and policymakers.
  - Important to make sure that all members of the team are present – which voices are missing?

- **Getting nutrition on the agenda:** ensuring that collaborative efforts from other sectors also prioritize nutrition and health
  - Example: if a program promotes climate-resilient agriculture, does it also consider nutritional quality of crops, cultural appropriateness of foods and preparation methods, and food safety issues?

- **Being a champion** of critical issues: leading, training, and collaborating with others who have complementary skills

Cross-cutting skills that support sustainable food systems

Skills related to systems thinking:

- **Thinking about both immediate and underlying causes** of nutritional issues

- **Elevating the needs of vulnerable populations**

- **Initiating collaborative efforts** with other sectors, professions, and scientific disciplines to address underlying causes
  - Example: Advocating for neighborhood walkability, safe communities, and equitable access to reliable public transportation in order to support food security
  - Example: Lending expertise to collaborative efforts to reduce energy poverty

- **Learning from people with different perspectives** – whether those are your collaborators or populations you serve
  - Learn their priorities, challenges, and language
Building sustainable food systems requires collaboration

I’m excited about food systems! Where do I begin?

Academy resources: publications and curricula

**Standards of Professional Performance (SOPP):** A framework for professional skill development in sustainable food systems. Includes resources, role examples, a glossary, and a framework for skill development.

**Cultivating Sustainable Food Systems: a Nutrition-Focused Framework for Action:** Describes how RDNs and NDTRs can promote sustainable food systems through 5 entry points. Includes examples to inspire further action.

**Sustainable, Resilient, and Healthy Food and Water Systems Curriculum:** 12 activities that encompass 7 sectors of the food system, to provide dietetic interns and students with foundational knowledge in sustainable food systems.

**Food Insecurity / Food Banking Curriculum:** 12 activities to help dietetic interns and students develop knowledge and skills necessary for an entry level position in a food bank, including experiences in nutrition education, food bank management, and food systems.

Academy resources: websites and communities

- The Academy’s Food Security and Sustainability page
- The Academy Foundation’s Future of Food page

→ See annotated bibliography for web URLs

Dietetics Practice Groups (DPGs) and Member Interest Groups (MIGs):

Sustainable food systems is an area with implications for all DPGs and MIGs. A few groups have been particularly active in this area:

- Hunger and Environmental Nutrition (HEN)
- Food and Culinary Professionals (FCP): Agriculture Subgroup
Thought Starter for Modules 6 & 7

Take a moment to pause and reflect before finishing

Based on what you’ve learned in this primer:

- What is one thing you learned that surprised you?
- What is one thing you want to know more about?
- What is one thing you can do in your work to support sustainable, resilient, and healthy food and water systems?

Thank you!

For questions related to continuing and professional education for this primer, please contact foundation@eatright.org

For questions related to the content of this primer, please contact mspiker@uw.edu