Introduction to the Food System

Lesson#4.1

Lesson Description:

Although we participate in the food system each day by eating, most of us do not often think about how food gets from field to table. If we ask ourselves where a food might come from, we will often respond, 'the grocery store'. However, most of us do understand that apples grow on trees somewhere and that farms grow most of our food. It may take time and discussion to define many of the steps in the food system that we are less familiar with or have not experienced. The primary goals of the lesson are to identify the major steps of the food system.

What is A System?

A **system** is a group of interacting, interrelated, and oftentimes interdependent elements that function together as a complex, unified whole.

One core concept of a system is that a change in one element of a system has an impact, either directly or indirectly, on one or more additional elements in that system.

Another core concept is that systems generally require inputs to function and produce outputs that need to be dealt with one way or another. Inputs and outputs in the food system are too numerous to list here, but every component of the food system uses inputs and results in outputs. For example, the "Growing" segment of the food system requires seeds, soil, water, sunshine, fertilizer/compost, human work, machinery and energy to run the machinery as inputs. "Growing" generates crops that serve as food for humans, and waste that may be incorporated back into the soil or disposed of in another way. Inputs and outputs vary a great deal depending on the type of food system being considered.

What is A System?

In a true system, the components of that system are treated or considered as a whole and cannot be considered in isolation from other related components or elements of the system.

Everything in the system is interdependent.

Systems vary in the degree to which they are "open" or "closed" -- that is, the degree to which system components interact with, or are (insulated) from, the larger external environment.

Given the nature of food systems, which have biological, physical, and socio-economic aspects, there is a high degree of interchange both among the subsystems and with the larger environment.

The food system is a complex network that is deeply connected to health, society, and the environment.

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Why Study the Food System?

Food and the Environment

Consider this quote for a moment:
*"**How we eat determines**, to a considerable extent, **how the world is used**."* (By Wendell Berry)

Now, follow James on his journey to do better for himself and the world:

James is concerned about the environment, and believes human activity is responsible for the current period of rapid climate change. James' view on climate change is consistent with the overwhelming body of scientific evidence. He follows a whole-food, plant-based diet for most days of the week, and frequently shops at a farmers' market so he can support farmers who follow sustainable agricultural practices.

Why Study the Food System?

He values supporting his local economy, but also recognizes that what he eats, and how it is produced, is more important for the environment than how far his food travels. He is careful not to purchase more than he can eat, and when food waste is unavoidable, he composts it rather than letting it go to a landfill.

James is fictional, but following his example could produce real benefits. Our food choices (along with policy, technology, culture, and other influences) drive agricultural practices that affect air, water, soil, biodiversity, and other threatened natural resources. More than just environmental concerns, these are concerns for public health, not least because human civilizations and the long-term viability of our food supply depend on natural capital and a stable climate.

Food and Health

Consider this quote:
"People are fed by the food industry, which pays no attention to health, and are healed by the health industry, which pays no attention to food" (By Wendell Berry)

Now, let's look at the following scenarios:

Brian lives in Southwest Alberta. He earns a little over minimum wage working as a custodian. He has nerve damage in his foot, a complication of type 2 diabetes, making walking difficult. Like many residents in his neighborhood, he doesn't own a vehicle, and the nearest supermarket is over 2 kilometers away. Public transit is unreliable, so he usually shops for food at the closest corner store, which doesn't carry any fresh produce or whole wheat bread. When he is able to carpool to the supermarket, Brian uses his monthly food stamps benefits to stock up on canned goods, soda, and other non-perishable, low-cost items.

Food and Health

Brian's cousin, D'Anne, lives with her family in Saskatchewan and faces a different kind of struggle. Four years ago, a 14,000-head swine operation — typical in size for large hog farms — was built within a kilometer of their home. The odors from the operation are so strong that she has to keep the windows closed.

Sharon, a fifth-generation hog farmer, runs the operation near D'Anne's home. Sharon is regularly exposed to hydrogen sulfide, animal dander, and other airborne contaminants. She often experiences wheezing and chest tightness. In her occupation, one in four workers have some form of respiratory illness. Several years ago, Sharon suffered a cut on her leg that became infected with an antibiotic-resistant strain of streptococcus bacteria. The infection was nearly fatal, requiring multiple doses of different drugs to treat.

Brian, D'Anne, and Sharon are fictional, but their experiences are based on actual events and evidence. These scenarios illustrate problems of food insecurity, the impact of industrial livestock operations on communities, and occupational hazards—a few of the many public health challenges in the food system.

Food and Health

So, why should you study the food system?

Learning about the food system often begins with personal interests, such as 1) wanting to know where our food comes from, 2) whether what we are eating is safe or healthy, or 3) how to preserve a batch of tomatoes. But the food system also has ties to widespread global challenges, such as 1) climate change, 2) chronic illness, 3) infectious disease, 4) social inequality, 5) animal welfare harms, 6) environmental degradation, and 7) the concentration of economic power.

Addressing these challenges requires system thinking – recognizing, for example, **how changing one part of the system affects the others**. The heavy use of certain pesticides was born of a desire to control pests, but has led to problems of pesticide-resistance and harmful effects on humans and wildlife.

Understanding the complex, dynamic relationships among food, health, society, and ecosystems is critical to avoiding these kinds of problems.

Food and Health

Learning about these connections can **empower people to become "food citizens" who make informed food choices** ("voting with their forks"), advocate for policy, and even grow and process some of their own food. Some may additionally pursue careers in agriculture, nutrition, public health, ecology, public policy, education, and other fields that offer powerful opportunities for food system change. Fostering a healthy, just, and sustainable food system requires people with expertise across many disciplines.

History of Agriculture

Agriculture has dramatically transformed over the last century. Agriculture, the **cultivation of food and goods through farming**, produces the vast majority of the world's food supply. During its brief history, agriculture has radically transformed human societies and fueled a global population that has grown from 4 million to 7 billion since 10,000 BCE, and is still growing.

Dawn of Agriculture

For the vast majority of the time since our species' arrival on the evolutionary scene, we acquired food by gathering it from the wild. Wild plant-based foods and fungi were important staples in the **paleolithic** diet, including the wild ancestors of some species that are widely cultivated today. While the ancestral hunt for wild animals is often depicted as an epic conflict against woolly mammoths and giant elk, early humans foraged for insects and scavenged for the remains of dead animals.

History of Agriculture

From as early as 11,000 BCE, people began a **gradual transition away from a hunter-gatherer lifestyle toward cultivating crops and raising animals for food**.

Why did people give up hunting and gathering for farming? There are many possible reasons, all of which likely played some role at different times and across different parts of the world:

- ❑ Changes in climate may have made it too cold or too dry to rely on wild food sources
- ❑ Greater population density may have demanded more food than could be harvested from the wild, and farming provided more food per acre, even if it did require more time and energy
- ❑ Overhunting may have helped push woolly mammoths and other animals and plants to extinction
- ❑ Changing technology, such as domesticated seeds, would have made agriculture a more viable lifestyle

Dawn of Civilization

Agriculture was a driving force behind the growth of civilizations.

Farming probably involved more work than hunting and gathering, but it is thought to have provided 10 to 100 times more calories per acre. More abundant food supplies could support denser populations, and farming tied people to their land. Small settlements grew into towns, and towns grew into cities.

Agriculture produced enough food that people became free to pursue interests other than worrying about what they were going to eat that day. Those who didn't need to be farmers took on roles as soldiers, priests, administrators, artists, and scholars. Whereas hunter-gatherer societies generally viewed resources as belonging to everyone, agriculture led to a system of ownership over land, food, and currency that was not (and is still not) equitably distributed among the people.

Agricultural Timeline

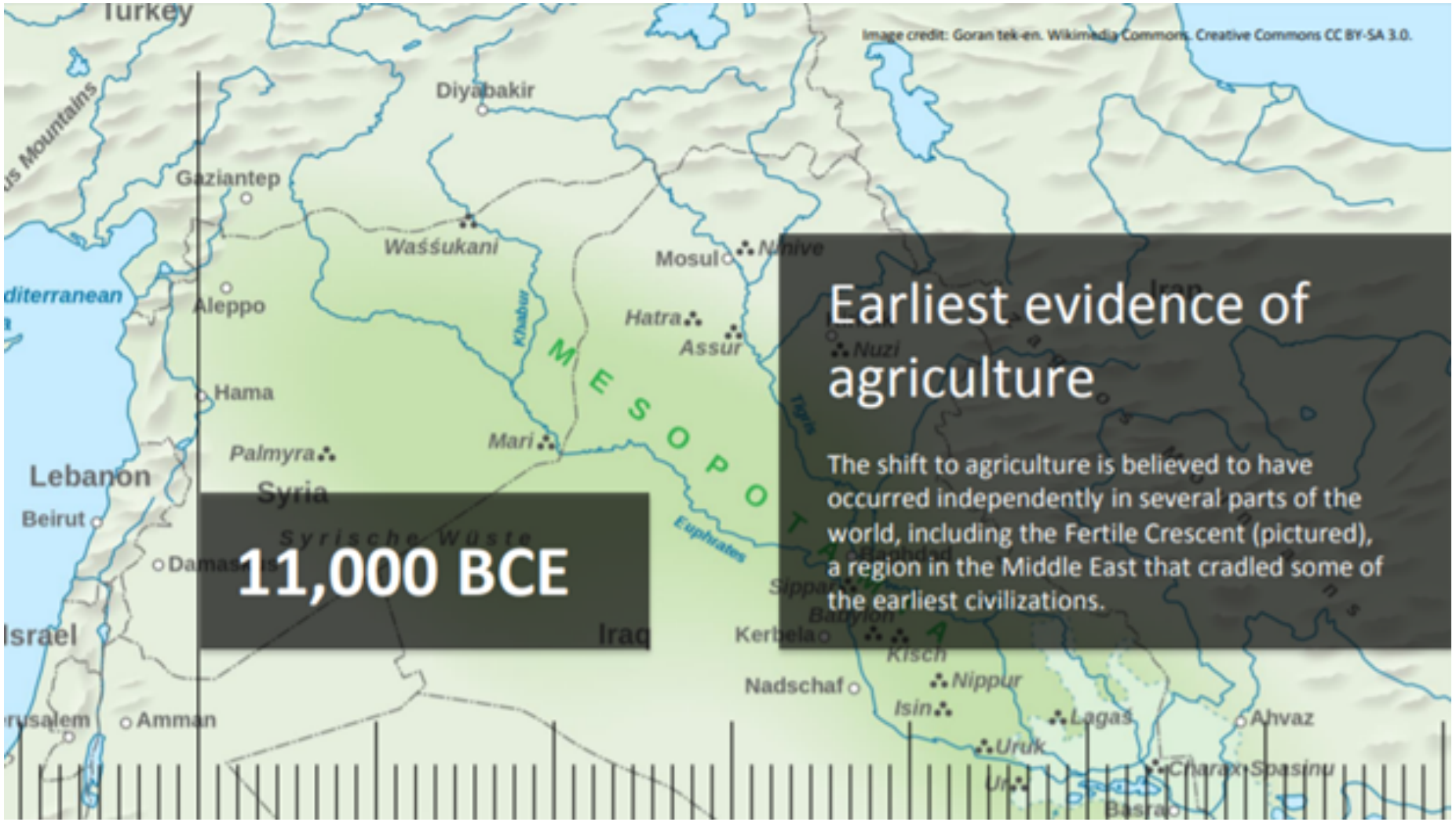
Image credit: Goran tek-en. Wikimedia Commons. Creative Commons CC BY-SA 3.0.
Earliest evidence of agriculture
The shift to agriculture is believed to have occurred independently in several parts of the world, including the Fertile Crescent (pictured), a region in the Middle East that cradled some of the earliest civilizations.
11,000 BCE
Turkey
Diyarbakir
Gaziantep
Waššukani
Mosul
Nineve
Aleppo
Khabur
Hatra
Assur
Nuzi
Hama
Mari
Palmyra
Lebanon
Syria
Beirut
Damascus
Syrische Wüste
MESOPOTAMIA
Euphrates
Tigris
Iraq
Israel
Kerbela
Nadschaf
Babylon
Kisch
Nippur
Isin
Lagaš
Uruk
Ahvaz
Amman
Basra


Photo credit: Maler der Grabkammer des Menna. Wikimedia Commons. Public domain.
6,000 BCE
Most species of farm animals domesticated

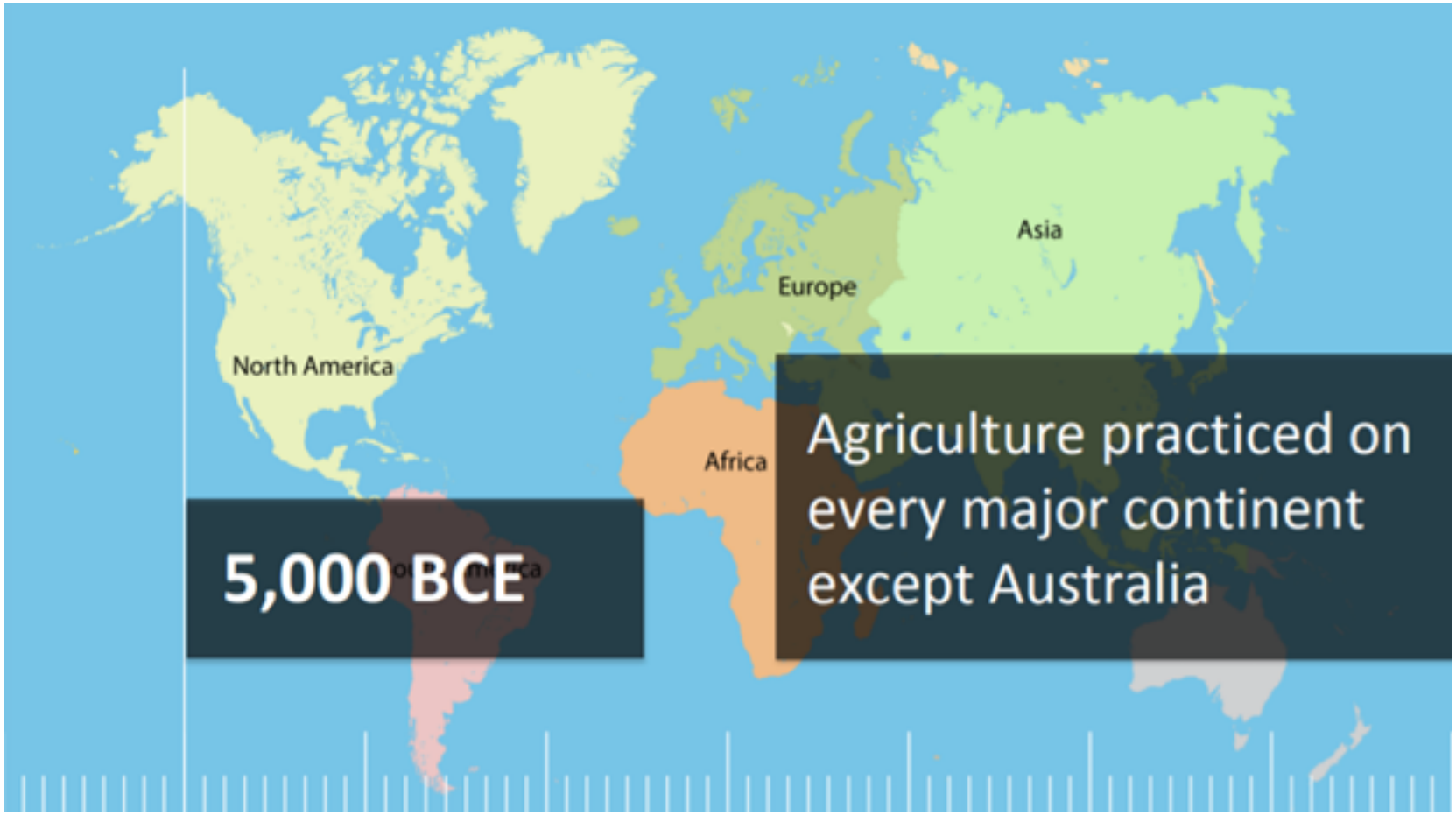
North America
Europe
Asia
Africa
5,000 BCE
Agriculture practiced on every major continent except Australia


Photo credit: Lynn Betts, USDA Natural Resource Conservation Service.
1900s
Widespread adoption of industrial agriculture
Synthetic nitrogen fertilizers (pictured), introduced in the 1900s, have been credited with providing the lion's share of the world's food over the 20th century. Pesticides and monocultures are also hallmarks of industrial agriculture.

Farms, Then and Now

Farms, Then and Now

In the **early 1900s**, more than half of Americans were either farmers or lived in rural communities. **Most farms were diversified**, meaning they produced a variety of crops and animal species together on the same farm, in complementary ways.

Farmers were skilled in a wide range of trades and had autonomy over how to manage their crops and animals. Animals were typically raised with access to the outdoors. Most of the work on the farm was done by human or animal labor.

Although conditions like these still exist, the **industrialization of agriculture** radically transformed how the vast majority of food is produced in America and many other parts of the world. Over the brief span of the 20th century, agriculture underwent greater change than it had since it was first adopted some 13,000 years ago. Modern American agriculture has been described as “the most efficient in the world, at least in terms of the dollar and cent costs of production.” The public health and ecological costs of industrialization, however, are not reflected in the prices of food.

Food's Journey

FoodSpan Infographic

1. Crop production
2. Food animal production
3. Seafood production
4. Food chain workers
5. Climate change
6. Agroecology
7. Food distribution
8. Food safety
9. Food processing
10. Food labeling
11. Food marketing
12. Food environments
13. Food waste
14. Hunger and food insecurity
15. Food policy

Food's Journey

- Food takes a complex journey from farms, ranches, rivers, and oceans, to our plates.
- The journey begins with natural capital, such as soil, freshwater, and the countless organisms that contribute to our food supply.
- Along the way, it may pass through the hands of food safety inspectors, warehouse managers, grocery store owners, and many others involved in food supply chains.
- The route to our plates is further influenced by the decisions of businesses, scientists, policymakers, and consumers.

Steps in the Food Sytem

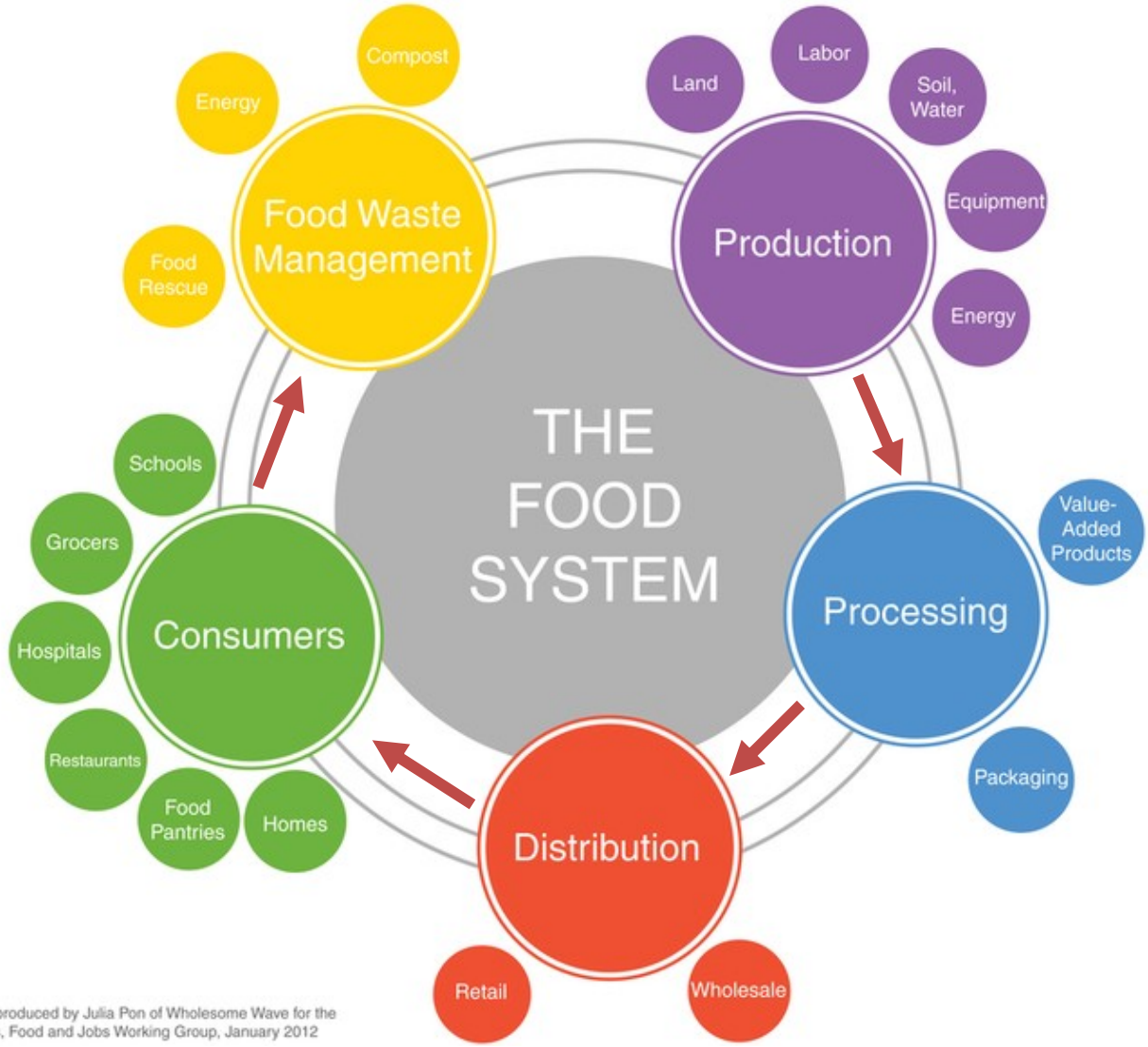

Diagram produced by Julia Pon of Wholesome Wave for the CT Farms, Food and Jobs Working Group, January 2012

Steps in the Food Sytem

Farmers use seeds, water, sunlight, natural and chemical fertilizers and pesticides, and labor to produce plant and animal products. Those products are sold to wholesalers or retailers (or in rarer cases, directly to consumers) who use them to make food for humans or animals, fuel, or fiber. That food, fuel and fiber is sold to the end user, and waste products, generally, end up a landfill.

Food Production

- Involves many of the activities that take place on a farm, at an orchard, in bodies of water, or in greenhouses and fish-farm tanks to produce our food
- Food production depends on the “input” of several resources, both natural (soil, water, climate, seeds, and human labor) and human-made (machinery, fuel, fertilizers, pesticides
- A farmer owns or rents lands to plant crops, or tend animal
- The inputs required vary depending on what is being grown or raised and the type of agriculture system that is in place. For example: many of the pesticides and fertilizers common in most of our agriculture are not allowed in organic agriculture

Climate Change and Agriculture

Climate change is among the greatest threats of our generation—and of generations to come—to public health, ecosystems, and the economy. The projected impacts of climate change, many of which are already occurring, include:

- More frequent and intense hurricanes, floods, heat waves, and other extreme weather events
- Increased heat-related deaths
- Food and water shortages
- Forced migration from rising sea levels and natural disasters
- Increased damages from flooding and wildfires
- Spreading insect-borne and water-borne diseases

Climate Change and Agriculture

Agriculture has always been at the mercy of unpredictable weather, but a rapidly changing climate is making agriculture an even more vulnerable enterprise. In some regions, warmer temperatures may increase crop yields. The overall impact of climate change on agriculture, however, is expected to be negative—**reducing food supplies and raising food prices**.

Many regions already suffering from high rates of hunger and food insecurity, including parts of sub-Saharan Africa and South Asia, are predicted to experience the greatest declines in food production.

Food system activities, including producing food, transporting it, and storing wasted food in landfills, produce greenhouse gas (GHG) emissions that contribute to climate change. Of these sources, livestock production is the largest, accounting **for an estimated 14.5 percent of global GHG emissions from human activities.**

Climate Change and Agriculture

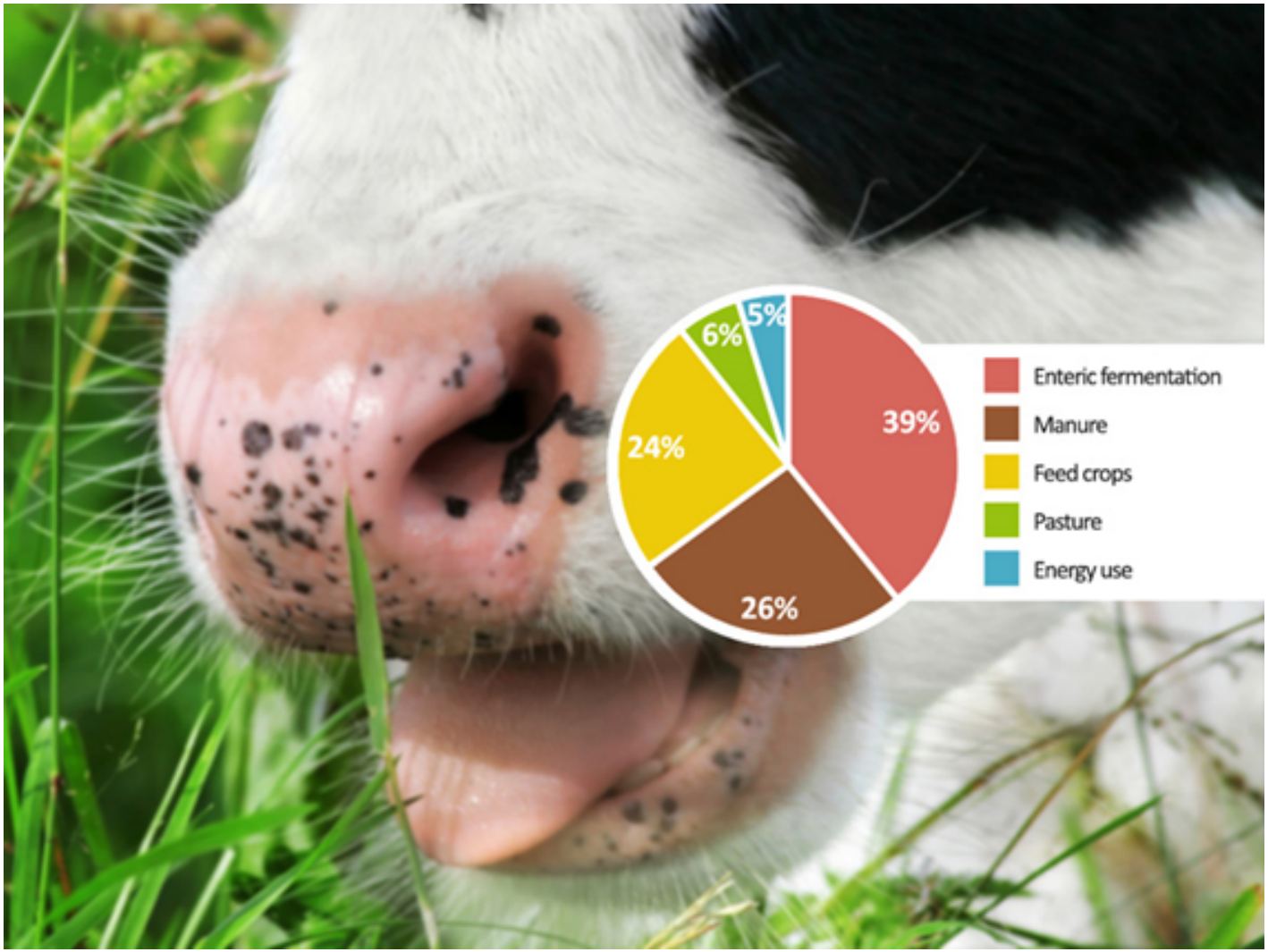

Fig. sources of greenhouse has (GHG) emissions from livestock production

Agroecology

What can farmers learn from nature? **Agroecology** (agriculture + ecology) means building the qualities of natural ecosystems into farm ecosystems, in ways that produce more food, sustainably. These are some examples of such qualities, and how they can be applied to agriculture:

- **Efficiency**: The concept of "waste" does not apply in nature; rainfall and organic matter are continually recycled by natural systems. One way farmers can reduce waste and use resources more efficiently is by composting manure, crop residues, and food waste and returning it to the land, improving soil health and increasing productivity.

- **Self-sufficiency**: While terrestrial (land-based) ecosystems require only sunlight and rainfall, farms often involve hard work and many different resources. Farming can be made less demanding, however, by letting nature do some of the work. Cultivating healthy soil, for example, can lessen or do away with the need for irrigation, pesticides, and synthetic fertilizers.

Agroecology

- **Diversity**: Farmers who cultivate a diversity of plant and animal species together can benefit from the relationships between them. Chickens, for example, that are let loose on unplanted crop fields will eat weed seeds, cattle fertilize pasture with their manure as they graze, pigs can till soil with their powerful nose discs, and certain plants can provide animals with food or shelter.

- **Resilience**: Resilience is the ability of an ecosystem to withstand or recover from floods, hurricanes, droughts, and other shocks. Farmland can be made more resilient against soil erosion (e.g., during heavy storms), for example, by planting trees and using other barriers to block heavy winds, and by plowing and planting crops perpendicular to sloping land (contour farming) to slow rainwater runoff.

Food Distribution

- Is the process of dividing up, spreading out, and delivering food to various places
- Farm products can be taken from their original sources and delivered to supermarkets, other food stores, or farmers' markets for sale as a whole fresh product
- Farm products can also be transported to a site where they will be transformed in some way, combined with other ingredients, made into food products, packaged and then distributed through a number of marketing channels
- Most of what we find in grocery stores today has been transported great distances and has undergone some degree of processing
- We currently transport food by truck, train, boat, and place
- A few foods (tomatoes and bananas primarily) that will be transported a significant distance are usually harvested before full ripeness so that they will withstand the bumps along the way

Food Distribution

Why is Food Transported Long Distances?

There are some valid reasons to transport food long distances, including:

- **Feeding densely populated areas** where there are a lot of people in once place, there may not be enough local farmland to support them all
- **Out-of-season** variety provides people with year-round variety and nutritional diversity over the winter months
- **Allowing regions to focus on their strengths** since some regions are better at producing certain foods than others

Food Processing

- Changes made to a food's structure, composition, character, or condition, is another way to make food available at times or places that it might otherwise not be
- Much of the food we eat on a regular basis is transformed in some way before we eat it. For example: think of the bread on a sandwich, the tomato sauce and the pasta it covers, or the cheese on a cracker
- During processing, food is changed in some way to enhance flavor, make it last longer than the processed raw foods it came from, or create new products altogether
- There are many different ways to process a food. For example: turning fresh strawberries into jam, making juice from fresh apples, pre-cutting and cooking potatoes for frozen French fries are all ways to process food
- Processing may include drying, cooking, freezing and canning, or adding preservatives to lengthen shelf life
- Processing may enhance the nutritional content of a food, and in many cases, may decrease nutritional content
- Depending on the type of food and processing technique, a variety of inputs are necessary for this step. Some include labor, machinery, water, fuel for cooking and freezing, sugar, and preservatives

In Summary

- ✓ Systems- thinking is useful for understanding the larger context of a problem, or a proposed solution
- ✓ The range of food system issues having significant economic, environmental and social consequences for society are many, with both positive and negative outcomes
- ✓ How we produce and consume food has a bigger impact on the world's well-being than any other human activity
- ✓ From the earliest developments of agriculture, a major goal has been to attain sufficient foods that provide the energy and the nutrients needed for a healthy, active life
- ✓ Over time, food production, processing, marketing and consumption have evolved and become highly complex