

Agriculture and Society

SAE for **ALL** Profile

Learning about Agriculture through an SAE

Meet Brylee Ferre from Spanish Fork, Utah. Brylee did not grow up knowing much about agriculture. One of her first experiences was when she participated in pig wrestling with a youth group at the county fair. The activity sparked her interest in agriculture and she enrolled in agriculture classes at her high school. The following year, animal rights activists pressured the county and held demonstrations against pig wrestling. The county decided not to proceed with pig wrestling in the future. In response, Brylee created a Research SAE on pig wrestling and other types of agricultural entertainment and the community's view on these activities.

Brylee became more involved in FFA and decided to expand her animal lab knowledge by raising a pig in the school animal lab. She enjoyed this work and created another Research SAE when she learned the animal lab might be closed. This one involved researching the impact that animal labs have on students and local livestock shows. Brylee was able to use her Research SAEs as projects for the National FFA Agriscience Fair.

Brylee's investigations related to how people in her community connected to agriculture, and allowed her to examine other agriculture perspectives while growing her agricultural knowledge. Through her Research SAEs, Brylee feels like she learned a lot about the many aspects of agriculture. She also learned more about communication skills and problem-solving skills.

Communication Skills. Brylee said, "I have always had a fear of presenting things in front of people. I needed a script to be able to say what I thought needed to be said. [These projects] really taught me how to better communicate in presentations, interviews, and just life in general." Brylee uses these skills in her current job working as an executive assistant in the insurance industry. Brylee attributes many of her workplace skills to what she learned while in FFA and during these projects.

Problem-Solving Skills. Completing the Research SAEs taught Brylee how to find solutions to problems. Brylee's projects involved researching the ways people in her community connected to agriculture. She wanted to find out if these people felt the same way she did about agriculture and determine what effects these outlooks had on the community. She learned how to create surveys and interpret the information compiled from the surveys.

- What questions do you have about how agriculture connects to society?
- How can you create a research project that examines agriculture's effects on everyday life in your community?
- What skills do you think Brylee gained through completing a Research SAE?
- How do you think Brylee could have shared her findings with the public?
- What are the questions you have about agriculture? Spend some time thinking through how you could turn your questions into a research project that you can use for a Research SAE.



Brylee Ferre



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Lesson 1.1

Lesson 1.2

Lesson 1.3

Agriculture's Impact on Society
History of Agriculture, Food Systems,
and Natural Resources
Future of Agriculture, Food Systems,
and Natural Resources Management

LESSON 1.1

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Agriculture's Impact on Society

Essential Question

How does agriculture affect people around the world?

Lesson Objectives

After studying this lesson, you should be able to:

- Define agriculture and the components of the agricultural industry.
- Explain the scope of agriculture as it relates to land use, economic impact, and employment.
- Give the characteristics of the three main areas of agricultural commodities.
- Analyze the importance of the human-agriculture connection.

Words to Know

agriculture
arable land
commodity
consumer

fiber
food
gross domestic
product (GDP)

natural resource
natural resources
management
producer

Before You Read

Find a partner and read the lesson title together. Tell your partner what you have experienced or already know about this topic. Based on your prior knowledge, write a paragraph describing what additional information you would like to learn about the topic. After reading the lesson, share two things you have learned with your classmate.



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Figure 1-1. When people think about agriculture, they picture a single farmer working with many different commodities. *Does your view of agriculture look like this traditional farm?*

What comes to your mind when you hear the word *agriculture*? Most Americans think of something similar to Old MacDonald's farm, such as the image in **Figure 1-1**. You may be surprised to know that modern agriculture looks more like the images in **Figure 1-2**. Agriculture is a modern industry, complete with integrated business models, cutting-edge technology, and billions of dollars in revenue each year. Over the course of this text, we will examine principles of agriculture as they relate to your life, the lives of those around you, and the lives of those around the world.

What Is Agriculture?

In its most basic definition, **agriculture** is the art and science of cultivating plants, animals, and other life forms for use by humans to sustain life. If a human is controlling the patterns of another life form for human benefit, it is agriculture.

Sectors of Agriculture

Because agriculture is such a broad industry, it can be divided into subcategories, or sectors. These sectors are classified by the



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Figure 1-2. Modern agriculture is different from the traditional image that many think of when they hear the word agriculture. Today's agriculture includes highly technical and specialized operations. *Is this what your idea of agriculture looks like?*

type of work they include, **Figure 1-3.** Have you ever wondered how food from around the world makes its way to your grocery store year-round? The relationships between these specialized sectors allow the agricultural industry to continually produce and distribute goods on a global scale. By specializing, each sector performs tasks with maximum efficiency, getting products to consumers on a predicted schedule.

Scope of Agriculture

Before we can fully understand how the principles of agriculture, food, and natural resources influence our lives, we need to examine the broad scope of agriculture. In addition to cultivating other life forms, agriculture includes the industries that process, market, and distribute everything from raw products to processed agricultural goods.

The scope of agriculture is based on three broad categories:

- The amount of land agriculture uses
- The economic impact of agricultural industries
- The number of people employed in agriculture worldwide

Agricultural Land Use

More than three-quarters of Earth's surface is covered by water. It is estimated that half of the remaining quarter is used for some type of agriculture. Agricultural land use includes the land used for crops, forests, rangeland, pastures, national parks, and agricultural businesses. **Arable land** is the term used to describe land that is suitable

Did You Know?

According to the US Department of Agriculture (USDA), when all women involved with farming are added up, they are nearly one million strong and account for 30% of US farmers.

Sectors of Agriculture

Sector	Description	Employment Opportunities
Agribusiness	Managing the profitability of agricultural goods	Commodity trader, farm and/or ranch manager, agricultural loan officer
Agricultural Communications	Informing those in the agricultural industry as well as consumers regarding topics concerning agricultural products	Journalist, public relations manager, sales representative
Agricultural Processing	Transforming raw agricultural goods into modified products for consumers	Grain mill operator, food technician, quality control manager
Agricultural Support Services	Industries and careers that provide support for the equipment and technology associated with agricultural production	Veterinarian, distribution coordinator, mechanic
Agricultural Systems	Design and build agricultural equipment and machinery	Agricultural engineer, irrigation systems specialist
Agriscience	Research and development of emerging agricultural technologies	Geneticist, biotechnology engineer, biologist, food chemist
Natural Resources Management	Focus on the ecology and conservation of cultivated and uncultivated lands	Range manager, fish hatchery technician, wildlife biologist
Production Agriculture	Production of raw animal and plant goods for human use	Cattle rancher, grain producer, catfish farm owner, cotton grower

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Figure 1-3. The agricultural industry is separated into many sectors based on the type of work conducted. *Which sector do you think is most fitting for your personality?*

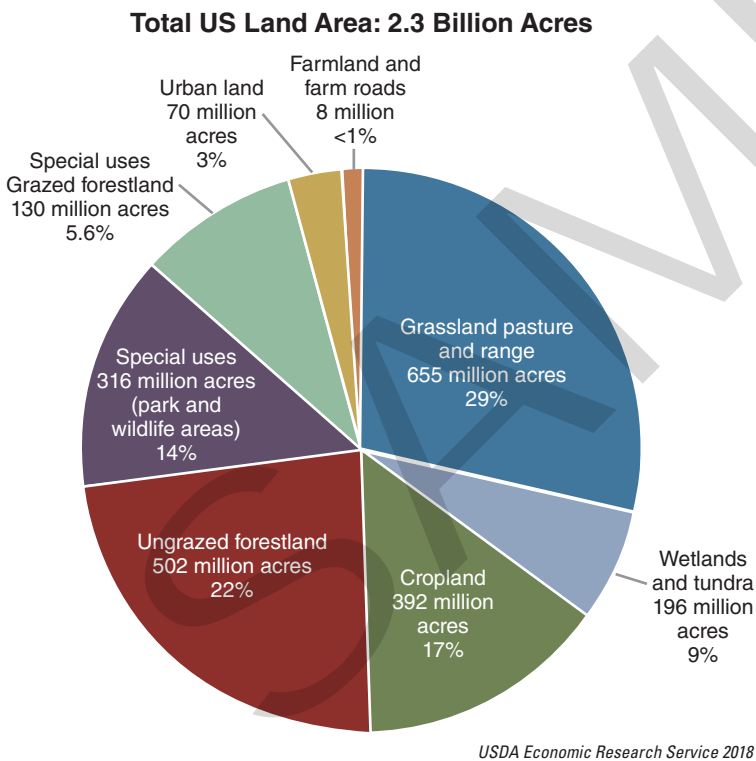


Figure 1-4. Land use in the United States. (Percentages are expressed in rounded numbers.)

for growing crops. It is estimated that only one thirty-second (1/32) of Earth's surface is arable land.

The United States covers nearly 2.3 billion acres. According to the US Census Bureau, land use is broken down as shown in **Figure 1-4**. Agricultural land is in danger. Some reports state that up to three acres of productive farmland are lost per minute (175 acres per hour) to development. More than two-thirds of the economic income from agriculture is generated from land adjacent to urban areas, the type of agricultural land most threatened by urban growth.

Proper management of agricultural land is critical to the success of the agricultural industry. Learning skills that enable agriculturalists to increase production capabilities while maintaining the sustainability of agricultural land will be a large part of agriculture as we move into the future.

Economic Impact of Agriculture

Agriculture as an industry is estimated to account for approximately 10% of all the money spent on trade worldwide. That amounts to more than \$7.2 trillion in agricultural goods sold each year. The influence of agriculture varies by country. In some countries, agriculture accounts for more than half of all product sales. As a country's level of industry increases, the influence of agricultural products on overall sales diminishes.

US Agricultural Trade 2000–2018

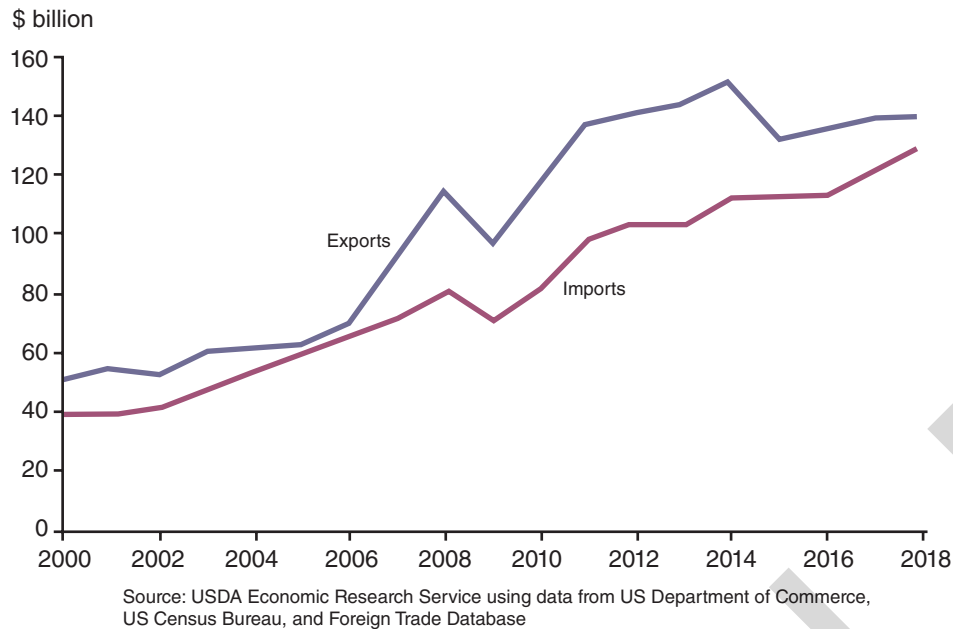


Figure 1-5. US agricultural imports and exports have been on a steady incline for years.

According to the USDA, American agriculture, food, and related industries contribute \$1.05 trillion to the gross domestic product annually, **Figure 1-5**. (The **gross domestic product (GDP)** is the total value of goods produced and services provided by a country during one year.) Most of what is produced through agriculture in the United States is used by American consumers, amounting to about \$635 billion in goods each year. About 20% of American agricultural production is exported to other countries, at a value of around \$140 billion of products each year. The United States imports agricultural products, as well. The United States imports nearly \$129 billion in agricultural goods annually.



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Figure 1-6. In developing countries, more than half of the workforce may be employed by agriculture. *Why do you think so many people are employed by agriculture in these countries?*

Employment in Agriculture

Understanding the scope of agriculture from a land use and financial standpoint is important, but how does that relate to people? When we examine the scope of agriculture as it relates to human interaction, we should consider the number of people the industry employs.

On a global level, agriculture is the world's largest supplier of jobs, with some experts placing the global agricultural workforce at well over a billion people. In around 50 countries, more than half of the population is employed in agriculture, and in many countries, that number exceeds more than three-quarters of the workforce. The percentage of agricultural workers in a country is largely driven by the level of development in the country, **Figure 1-6**. The more industrialized a country is, the more likely a smaller segment of the population is working in agriculture. While there are still large numbers of people employed in agriculture worldwide, the number of farmers has been in a steady global decline since the 1950s.

In the United States, nearly one out of six workers is employed directly or indirectly in the agricultural industry, and nearly 22 million full- or part-time jobs can be

Did You Know?

On a global scale, US farmers provide more than 30% of the world's corn, nearly 29% of the world's soybeans, and nearly 20% of the world's beef.



In 1960, one production agriculturalist in the United States fed 26 people



In 2000, one production agriculturalist in the United States fed 129 people



In 2020, one production agriculturalist in the United States fed 166 people

Source: American Farm Bureau Federation 2020

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Figure 1-7. There is a lot of pressure on individual production agriculturalists as they each become responsible for feeding more and more people. *Is your family in production agriculture? Can you calculate how much food your farm produces and how many people it would feed?*

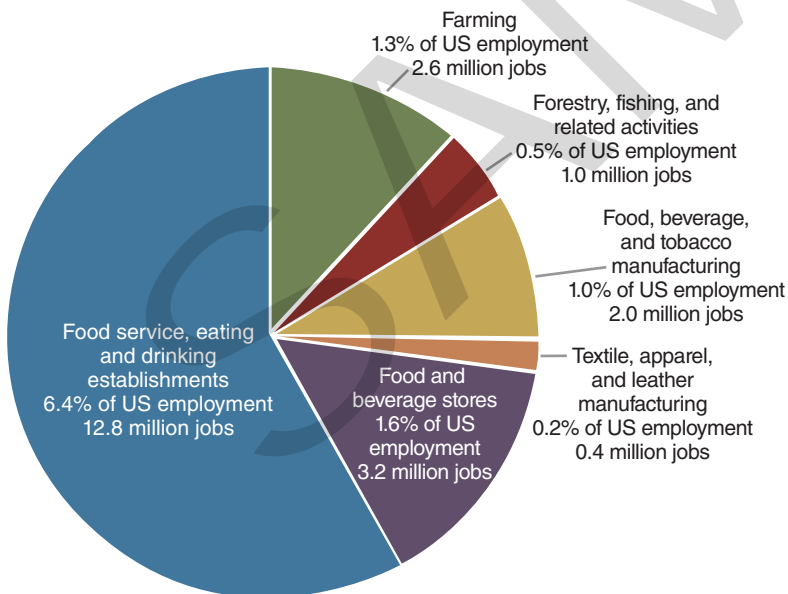
attributed to agriculture and food sectors. Most of these jobs are related to processing, marketing, and distributing agricultural products. The number of Americans involved in production agriculture has been decreasing since the early 1900s. Less than 2% of US workers are currently classified as farmers or ranchers. This small portion of the population is still responsible for producing the food and fiber that sustains life for the rest of the nation and for export around the world. This means that fewer production agriculturalists are now responsible for feeding more of the world than ever before, **Figure 1-7**.

The agricultural industry offers many career opportunities, many of which will be examined in Lesson 3.2. A broad overview of the percentage of people employed in each type of agricultural career is shown in **Figure 1-8**.

Did You Know?

More than 97% of the farms in the United States are family-owned and operated.

Employment* in Agriculture, Food, and Related Industries



*Full- and part-time jobs. Numbers were rounded and may not sum to total.

Source: USDA Economic Research Service using data from US Department of Commerce, Bureau of Economic Analysis (9/24/2019)

USDA, US Department of Commerce, and Bureau of Economic Analysis

Figure 1-8. The breakdown of employment in agriculture in the United States.

Areas of Agriculture

Agriculture is driven by three main commodity areas: food, fiber, and natural resources. A **commodity** is a raw material that can be bought and sold. Corn, market hogs, oranges, and cotton are all examples of agricultural commodities. Understanding these commodity areas will give you more insight into how humans interact with agriculture.

Food

Food includes all materials and substances used for human consumption. Food production includes the growing, harvesting, processing, distributing, marketing, and sale of all products used for human consumption. It also includes the industries related to producing food for humans, including the production of feed for animals that will enter the food chain and the scientific support for raising improved crops and animals for consumption.

Food production is the broadest area of agriculture. In developing countries, consumers typically spend more of their income acquiring food than in developed countries. They are also more likely to be directly involved in the production of their food. How much of your household income goes to purchase food? Where does the money go after you purchase your food? See Figure 1-9.

Fiber

In addition to producing food for worldwide distribution, agriculture also provides basic materials, such as fiber, necessary to produce clothing. A **fiber** is a product with long, thin components, often used to create woven or composite materials. Agricultural fibers are natural fibers, meaning they are the long filaments that occur naturally in plants and animals. The agricultural fiber industry includes the production, processing, and manufacturing of products from fibers, along with the marketing, distribution, and sales of fiber products. Agricultural fibers include cotton, wool, and pulpwood.

Natural Resources

Natural resources are materials and substances that occur in nature, such as minerals, wood, water, and wildlife. Some natural resources are essential for our survival, while others are used to satisfy human needs and wants. Most natural resources are sold for economic gain. This area of agriculture includes natural resources management, and the processing, marketing, and distribution of natural resources to consumers.

2018 Food Dollar Spending



*Note: "Other" includes two industry groups: Agribusiness plus Legal and Accounting. Source: USDA Economic Research Service, Food Dollar Series (2018)

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Figure 1-9. Do you know where the money you spend on food goes? Would you be surprised to learn that on average, the farmers and ranchers who produce your food get eight cents of each dollar you spend on food products?

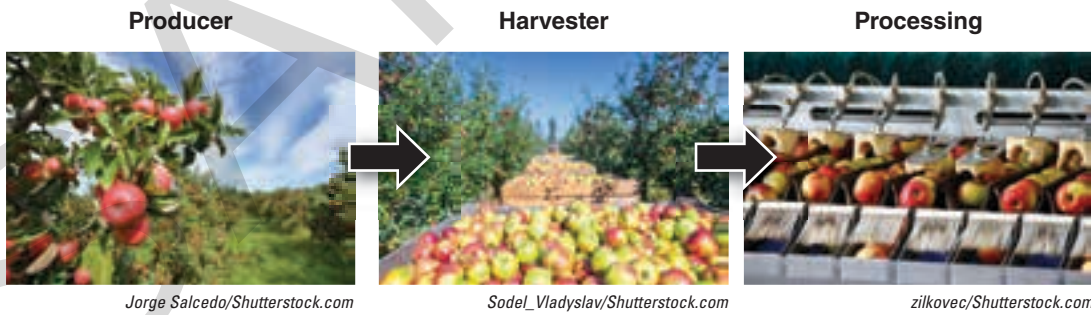


Figure 1-10. Think about what you had for breakfast or lunch today. How many steps did your food go through before it reached your table?

Did You Know?

STEM is the acronym for Science, Technology, Engineering, and Mathematics. Throughout this book, you will find features designed to share STEM principles that are being shown in the text.

STEM Connection

Measurement Conversion

How many is a trillion? It is estimated that the United States produces more than \$1.05 trillion in agricultural products annually. What does a trillion represent? Have you ever seen a trillion of anything? Let us use our math skills to figure out how many granules of sugar it would take to equal the number of dollars for annual US agricultural production.



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If each granule of sugar were \$1, it would take approximately \$23,625 to fill a teaspoon.

1. Fact: Each granule of sugar weighs about 0.2 milligrams.

Calculation: Find out how many granules of sugar per milligram:

$$\underline{\quad} \div \underline{\quad} = \underline{\quad}$$

(number of milligrams \div weight per granule of sugar)

2. Fact: There are 28,350 milligrams in an ounce.

Calculation: Find out how many granules of sugar in an ounce:

$$\underline{\quad} \times \underline{\quad} = \underline{\quad}$$

(number of granules in a milligram \times number of milligrams in an ounce)

3. Fact: There are 16 ounces in a pound.

Calculation: Find out how many granules of sugar are in a pound:

$$\underline{\quad} \times \underline{\quad} = \underline{\quad}$$

(number of granules of sugar in an ounce \times number of ounces in a pound)

4. Fact: There are 1,000,000 million in a trillion.

Calculation: How many pounds of sugar would it take to make a trillion granules?

$$1,000,000,000,000 \div \underline{\quad} = \underline{\quad}$$

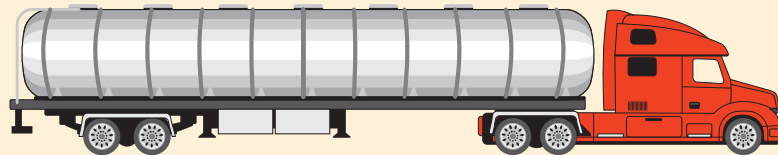
(one trillion \div number of sugar granules in a pound)

5. Fact: The United States produces more than \$1.05 trillion in agricultural goods each year.

Calculation: How many pounds of sugar would it take to make the number of sugar granules equal the annual value of US agricultural products?

$$\underline{\quad} \times \underline{\quad} = \underline{\quad}$$

(number of pounds of sugar to make a trillion granules \times number of trillion of dollars)



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How many trailers like this full of sugar do you think it would take to equal 1.05 trillion granules?

Answers: 1. $1 \div 0.2 = 5$ 2. $28,350 \times 5 = 141,750$ 3. $16 \times 141,750 = 2,268,000$ 4. $1,000,000,000,000 \div 2,268,000 = 440,921.5$ 5. $440.92 \times 1.05 = 463$ lb

Natural resources management includes individual resource management and managing the ecosystems in which the natural resources are found. In recent years, there has been a renewed commitment to responsible natural resources management in the United States. This commitment has developed as consumers have shown an increased interest in environmental preservation.

Did You Know?

Rayon is not a synthetic fiber. It is a manufactured fiber (ca. 1905) made mainly from wood pulp.

The Human-Agriculture Connection

Every human needs agriculture to survive. How we interact with agriculture can be categorized in one of two roles: producer or consumer. **Producers** are those actively involved in raising raw agricultural products. In the United States, very little of the population falls in this category. **Consumers** are those who purchase and use agricultural products. You act in the role of a consumer every time you check out at the grocery store.

Producers

Producers are responsible for making management decisions related to which crops are planted, which animals are crossed for breeding purposes, and timing for both crop and livestock production. In addition, producers in most circumstances shoulder the financial risks associated with producing crops and are reliant on consumers to drive sales of their products. The costs associated with producing crops and livestock are volatile and are controlled by many factors including weather, consumer demands, marketing strategies, and in some cases, even legislative regulation. To meet consumer needs and still be able to be economically viable, most producers specialize in a single type of crop or animal. By specializing, producers can increase the overall scale of their production, which ensures they produce the quantity of food and fiber desired by consumers.

Consumers

Consumers can drive agricultural markets with their purchasing decisions. When agricultural products are in large demand, producers will make management decisions to increase production of those products. Because of the time required between the decision to produce an agricultural product and the time it is ready for the consumer market, these management decisions are critical in the agricultural production chain.

Processing and Cost Differences

The production of some products involves more people than others before they reach the consumer. Consider a fresh apple and a frozen apple pie. Which item receives more processing before reaching the consumer? Those items that require less processing typically reach the consumer more quickly, transfer a greater share of the profit to the producer, and have a less complicated journey prior to reaching the consumer, **Figure 1-11**.

A World without Agriculture?

Think about what a world would be like without agriculture. Do you imagine a world like that of prehistoric cave dwellers? Many people think that without cultivated crops and domesticated animals, humans would simply return to functioning as hunters and gatherers. Are they correct? Not quite. You see, even in the earliest record of humanity, humans had already begun hunting specific types of animals and using wild plants for specific purposes. Therefore, using items from the natural environment for our benefit is standard. It is the concept that has allowed humans to grow and evolve. Neither agriculture nor human beings would exist without the other.

Now that you know more about the agricultural industry, imagine a world without agriculture. Take away all the domesticated crops and animals, all the renewable sources of energy that come from natural resources, and all the by-products that come from processing agricultural products. It sounds like a bleak existence. Do you have a different view of what that world would be like without agriculture after learning what agriculture is and how broad of a scope it has?

Career Connection

Production Agriculturalist

Production agriculturalist is the term used to describe the profession of farming and/or ranching. While most people call this career “farmer” or “rancher,” the correct term is production agriculturalist, as these people produce products that come from cultivating plants and/or animals. Production agriculturalists grow and raise raw agricultural commodities, such as plants or animals, for food and fiber. Being a production agriculturalist requires a wide variety of skills, as this career often encompasses many other careers in the agricultural industry.

Education—Varies. Many production agriculturalists have two- or four-year degrees related to agricultural business management or specific to the commodity they produce.

Salary—The salary for a production agriculturalist varies widely based on the crop they produce and the scale of their production. Many producers have full-time careers in addition to farming and/or ranching. Refer to the USDA ERS online section on Farm Business Income and the Bureau of Labor Statistics for salary ranges of different production careers.

Job fit—This job may be a fit for you if you enjoy working for yourself, you have a strong connection to a specific type of agricultural commodity, or you like to work outdoors.



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Lesson 1.1 Review and Assessment

Lesson Summary

- Agriculture is essential to human survival on Earth.
- Understanding how humans interact with agriculture and how it influences the world is essential to managing our food, fiber, and natural resources.
- By examining the main sectors and the scope of agriculture, we can see how each person fits into the human-agriculture connection.
- Much of available land on Earth is used for agriculture, although that amount is diminishing daily.
- Agriculture is a vital part of the economy in all cultures and generates approximately 10% of the revenue from sales of all goods worldwide.
- Less than 2% of the US population are considered production agriculturists.
- Agriculture has three broad areas: food, fiber, and natural resources.
- Human interaction with agriculture occurs when a person grows or cultivates a raw agricultural product or when a consumer purchases a product.
- We interact with agriculture every day as we eat, dress, and use products made through agriculture or from natural resources.

Vocabulary Review

Match the vocabulary terms listed in the *Words to Know* to the correct definition.

- | | |
|--|---------------------------------|
| 1. Those who purchase and use agricultural products. | A. agriculture |
| 2. Those actively involved in raising raw agricultural products. | B. arable land |
| 3. A product with long, thin components, often used to create woven or composite materials. | C. commodity |
| 4. All materials and substances used for human consumption. | D. consumers |
| 5. Land that is suitable for growing crops. | E. fiber |
| 6. Material or substance that occurs in nature, such as minerals, wood, water, and wildlife. | F. food |
| 7. A raw material that can be bought and sold. | G. gross domestic product (GDP) |
| 8. The processing, marketing, and distribution of natural resources to consumers. | H. natural resource |
| 9. The art and science of cultivating plants, animals, and other life forms for use by humans to sustain life. | I. natural resources management |
| 10. The total value of goods produced and services provided by a country during one year. | J. producers |

Know and Understand

Answer the following questions using the information provided in this lesson.

1. What is agriculture?
 - A. The customs associated with the lives of farmers and ranchers
 - B. Any business that profits from selling food
 - C. The art and science of cultivating plants, animals, and other life forms for use by humans to sustain life
 - D. The plans to reduce carbon emissions in the natural world
2. Which of the following is *not* one of the three broad categories that make up the scope of agriculture?
 - A. The amount of land used
 - B. The number of crops grown by one farmer
 - C. The economic impact of agricultural industries
 - D. The number of people employed in agriculture worldwide

3. Which is a benefit to the specialization in the sectors of agriculture?
 - A. Variation in the quality of products
 - B. Reduction in the availability of agricultural goods
 - C. Products getting to consumers on a predicted schedule
 - D. Decreased efficiency in overall production
4. Land that is suitable for growing crops is referred to as ____ land.
 - A. arable
 - B. barren
 - C. communicable
 - D. derived
5. Which of the following is an agricultural use of land?
 - A. Paving roads
 - B. Building a hospital
 - C. Growing a crop
 - D. Holding a music festival
6. Agriculture as an industry is estimated to account for approximately ____ of all the money spent on trade worldwide.
 - A. 5%
 - B. 10%
 - C. 23%
 - D. 48%
7. American agriculture accounts for more than ____ dollars in sales annually.
 - A. 98.5 million
 - B. 1.05 trillion
 - C. 7.2 trillion
 - D. 20 trillion
8. American agriculture also exports more than ____ dollars of products each year.
 - A. 10.5 billion
 - B. 80 billion
 - C. 140 billion
 - D. 15 trillion
9. *True or False?* On a global level, agriculture is the world's largest supplier of jobs.
10. *True or False?* The number of Americans involved in production agriculture has been on a steady incline since the early 1900s.
11. Which of the following are the three main commodity areas that drive agriculture?
 - A. Food, fiber, and natural resources
 - B. Crops, animals, and labor
 - C. Fruits, vegetables, and grains
 - D. Farmers, ranchers, and scientists
12. Which component of food production includes sending food to the places where it will be consumed?
 - A. Harvesting
 - B. Processing
 - C. Distributing
 - D. Sales
13. What are natural resources?
 - A. Materials and substances that occur in nature
 - B. Metals and plastics used in water management
 - C. Animals cared for under human care
 - D. Crops grown in sustainable methods

14. What is the term for those actively involved in raising raw agricultural products?
- Consumers
 - Processers
 - Producers
 - Distributors

Analyze and Apply

- Think about the scope of agriculture that was discussed in this lesson. List ten things that you have used in the last 24 hours that are tied to agriculture. Then identify which of the sectors of agriculture these items came from.
- Which sector of agriculture do you think is essential to human survival? Please explain your answer with at least three reasons you think this is the most important sector.

Thinking Critically

- Agricultural land is decreasing every day. With a partner, come up with a systematic plan that you feel should be implemented to stop the loss of agricultural land to development. Make sure you include to whom you will address your plan and at least three specific things you feel should be done to prevent land loss.
- Research the top imports and exports of agricultural goods in the United States. Carefully examine the top imports and think of specific products that would fall in each category. Develop your ideas of why the United States imports these types of products.
- Research and explain the difference between gross domestic product (GDP), gross national product (GNP), and gross national income (GNI).

SAE for **ALL** Opportunities

- Foundational: Career Exploration**—Research the number of producers in the United States for different agricultural crops and then determine the average size of their operations. Compile a report to share with others.
- Immersion: Placement/Internship SAE**—Search for opportunities in your community to work for a production agriculturalist. Work in a commodity that you find interesting and try to gain knowledge of what it takes to produce that commodity.
- Immersion: Research SAE**—Using social science procedure, select a population and construct a survey instrument to gather public perception about agriculture in your area.

SAE for **ALL** Check-In

- How much time have you spent on your SAE this week?
- Have you logged your SAE hours?
- What challenges are you having with your SAE?
- How can your instructor help you?
- Do you have the equipment you need?

LESSON 1.2

History of Agriculture, Food Systems, and Natural Resources

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Essential Question

How has the interaction between agriculture and humans changed throughout history?

Lesson Objectives

After studying this lesson, you should be able to:

- Describe advancements made in agricultural production systems since 10,000 BCE.
- Understand the role of increasing global population on the agricultural industry.
- Analyze the impact of inventions and new technology on agriculture throughout history.
- Compare and contrast agriculture systems of the past to those of the present.
- Speculate on new advances that will be needed by agriculture to meet global demands.

Words to Know

agrarian civilization
artificial selection
biotechnology
domestication
Dust Bowl

Fertile Crescent
feudal system
Green Revolution
indentured servitude
land-grant institution

nomadic tribe
Norman Borlaug
precision agriculture
sharecropping

Before You Read

Review the chapter headings and use them to create an outline for taking notes during reading and class discussion. List the main headings and subheadings for each section. After looking over the outline, write two questions that you expect the chapter to answer.



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Figure 1-11. Agriculture has changed drastically since the time draft animals were used for labor. *Why do you think this method is still used in developing countries?*

Have you ever heard the saying, “The only constant is change”? This saying certainly applies to the nature of human society. Think about things like cars, television, telephones, and music media. Are these things the same as they were a few years ago when you were in fifth or sixth grade? How have they changed in the past two or three years? How different are they from the way they were when you were born? How have changes in these technologies affected society since you were born or were in grade school? Now, think about how different these things were for your parents and grandparents when they were in high school.

Just as society changes and adapts to new ideas and technologies, the agricultural field has changed and adapted through the course of history. Advancements in agricultural management, production systems, and equipment make today’s agriculture drastically different from agriculture 1000, 100, 50, or even 20 years ago, **Figure 1-11**. This lesson will examine the evolution of agriculture and allow us to gain a small glimpse into how agriculture has adapted to meet society’s needs.

The Birthplace of Agriculture

Most anthropologists believe an area called the Fertile Crescent, shown in **Figure 1-12**, to be the place where agriculture began. The **Fertile Crescent** is often called the “Cradle of Civilization.” It extends from the eastern part of the Mediterranean to the lower Zagros Mountains in Iraq and Iran. As the climate changed around 10,000 BCE, the land in this area became more suitable for growing crops. **Nomadic tribes** (groups who traveled from place to place hunting available food sources) began settling in this region, causing the shift to an agrarian civilization. **Agrarian civilizations** are those based in agricultural production. Because cultivating crops and raising animals requires people to stay in the same place and set up long-term housing, many anthropologists believe the movement of these tribes from a nomadic to agrarian society was the largest single factor in developing the modern world.



Robert Simmon/NASA

Figure 1-12. The Fertile Crescent has been termed the “birthplace of agriculture.”

The Shift to an Agrarian Society

While there is much debate on the reasons nomadic tribes decided to settle and begin cultivating crops and animals, **Figure 1-13**, the shift to an agrarian society had a definitive impact on human civilization. The shift to an agrarian lifestyle transformed life for early societies. The development of agrarian societies allowed people to:

- Develop complex social organizations
- Formulate methods for governing people and resources
- Develop concepts of property ownership
- Build permanent villages and cities
- Build larger communities through an increase in population supported by an agrarian lifestyle
- Establish business concepts through bartering, markets, and commodity exchange
- Develop methods of controlling water flow through irrigation
- Develop metalworking technologies

Did You Know?

The Egyptians grew their crops along the banks of the Nile River in the rich black soil that was left behind after the yearly floods.

Plant and Animal Domestication

A large part of the shift to an agrarian society is the concept of domestication. **Domestication** is a process in which an animal has been modified by humans behaviorally and structurally from the wild counterpart and is kept under human control for a clear purpose, **Figure 1-14**. The earliest domestication of plants and animals from the wild are believed to have occurred in the Fertile Crescent during the shift to an agrarian society. To be considered domesticated, a plant or animal species must differ from its wild variety in five ways:

- First, the organism must have a structural difference.
- Second, the organism must behave differently. Plants have a new growth pattern or a structure change and animal fear and aggression is diminished or eliminated.
- Third, the organism must rely on humans for sustenance.
- Fourth, the organism’s reproduction must be subject to human control.
- Finally, there must be a clear purpose for humans to use and cultivate the organism.



Bzzuspajk/Shutterstock.com

Figure 1-13. A move to an agrarian society led to the development of permanent villages and cities. Ruins of these early settlements can still be seen in Egypt.



lunamarina/Shutterstock.com; cdrin/Shutterstock.com

Figure 1-14. Trees have been cultivated by man for hundreds of years. Fig trees are one of the earliest plants domesticated by humans. *Have you ever eaten fresh figs?*

The process of domesticating plants and animals is rooted in the scientific principle of artificial selection. **Artificial selection** is the process of selecting organisms to breed to create offspring with more desirable characteristics.

Most experts believe that fig trees, wheat, and millet were the first domesticated crops. Domestication of animals occurred at roughly the same time as the earliest crop domestication, with one exception: the dog. Most anthropologists agree that the dog was domesticated as early as 30,000 BCE. Evidence suggests nomadic tribes kept dogs with them for protection, hunting, and companionship. Livestock animals were domesticated as humans moved into a more civilized agrarian society. Timetables of plant and animal domestication are shown in **Figure 1-15**.

Did You Know?

The undomesticated ancestor of the potato was poisonous to humans. Ancient people in Peru would eat them with a mud made from clay and water to prevent the potatoes from killing them.

Early Plant Domestication

Plant	Region	Date
Fig trees	Fertile Crescent	000 BCE
Wheat	Fertile Crescent	9000 BCE
Foxtail millet	East Asia	9000 BCE
Chickpeas	Turkey	8500 BCE
Gourds	Central America	8000 BCE
Rice	Asia	8000 BCE
Potatoes	Andes Mountains	8000 BCE
Beans	South America	8000 BCE
Squash	Central America	7500 BCE
Maize	Central America	7000 BCE

Early Animal Domestication

Animal	Region	Date
Dogs	Unknown	14,000 – 30,000 BCE
Sheep	Fertile Crescent	8500 BCE
Cats	Fertile Crescent	8500 BCE
Goats	Fertile Crescent	8000 BCE
Pigs	Fertile Crescent	7000 BCE
Cattle	Eastern Sahara	7000 BCE
Chickens	Asia	6000 BCE
Llamas	Andes Mountains	4500 BCE
Alpacas	Andes Mountains	500 BCE
Donkeys	Africa	4000 BCE

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Figure 1-15. Through research and excavation, archeologists have determined the periods in which many plants and animals became domesticated. Use the information above to create a timeline and to determine periods of overlap.

Domesticating the Silver Fox

Did you know there are currently domestication projects underway? Researchers in Russia have been working for more than 50 years to create a domesticated version of the fox. Led by researcher Dmitri Belyaev, a team set out to determine what changes would occur structurally in foxes if they were artificially selected for their ability to interact socially with humans, something the team called “prosocial behavior.”

Belyaev and his team tested hundreds of foxes each generation, and the top 10% of the tamest were selected as the parents for the next generation. They developed a scale for scoring tameness; how a fox scored on this scale was the only criteria for selecting new parents.

After six generations, the majority of foxes born at the facilities interacted comfortably with humans. They enjoyed being petted and held by humans and would even wag their tails when humans approached. The foxes also showed changes structurally. Although tameness was the only factor selected for breeding, the foxes showed an increase in droopy ears, shorter muzzles, curly tails, and more mottled fur patterns. In fact, the foxes started to resemble domesticated dogs rather than their wild counterparts. This led scientists to conclude that there are physical traits connected genetically to the process of domestication.

Researchers today are building on the work of the domestic fox project. New efforts are in place to determine if the genetic markers associated with structural changes in domestication could be influenced by increased production of hormones while sex cells are being developed. There is certainly more work to be done to determine how domestication works from a scientific standpoint.



Ondrej_Prostick/Shutterstock.com

Consider This

1. How has the experiment changed since its inception?
2. Select a domesticated animal and create an illustrated timeline of its evolution.

Early Agriculture on a Global Scale

Since its beginning in the Fertile Crescent, agriculture has been a driving factor in the evolution of civilization. Major agricultural developments have spurred changes in society, and developments in society have provided the stimulus for advancements in agriculture. While the impact of adaptation and developments may be limited to local areas, it often has, or has had, a ripple effect that travels on a global scale.

Fertile Crescent

Agriculture in the Fertile Crescent was largely managed by individual farmers. Each farmer owned the land he farmed and managed the sale of his commodities. Successful farming in the Fertile Crescent gave rise to some of the largest civilizations recorded in ancient history, including that of the ancient Egyptians.

Did You Know?

Silk is considered an animal fiber because it has a protein structure. When unwound, a single filament can be as long as 1600 yards!

East Asia

Agriculture was driven largely by desire for products produced in Asia by countries in the Middle East and Europe. Much of the early agriculture in East Asia was influenced by political and social factors. As new crops were domesticated in this region, they became highly desirable across the world. The government often employed large numbers of people to work in rice fields or collect and produce products from silkworms, **Figure 1-16**. Silk quickly became one of the most highly sought fibers from around 100 BCE through 1500 CE. The demand for silk was a main force behind connecting trade routes between East and Southeast Asia with Persia, East Africa, and Southern Europe. In fact, the east-west trade route was called the “Silk Road.” Even today, a large number of people in Asia are employed in the production of agricultural goods for export to western markets.

Europe

As society developed between 800 BCE and 1400 CE, many European nations managed agriculture with a feudal system. In the **feudal system** of agricultural management, land was granted to those who completed military service, received favor from the upper class, or were the descendants of landowners. These landowners would lease the land, along with supplies, to a farmer in exchange for the payment of taxes and goods as rent. This system placed much of the requirements for labor on the poorest in a region, while most of the profits of agricultural production were yielded to the upper classes. While the feudal system worked well in some cases, many historians cite abuse of the system by the landowners as a key factor leading to its end.

Central and South America

In Central America, advances in agriculture were the driving forces behind the success of ancient civilizations, such as the Mayans, Aztecs, and Incas. Well-developed agricultural systems allowed these groups to produce enough food and fiber to support



A

TOM...foto/Shutterstock.com



B

Santiparp_Wattanapon/Shutterstock.com

Figure 1-16. Rice production was a force that led to the expansion of early agriculture in Asia. A—This farmer is carrying young rice plants that will be planted by hand. B—With an annual value of \$315 million, raw silk is a major export for China. Some people continue to use traditional methods for spinning silk from the silkworm cocoons. *How does the industrial production of silk vary from the method illustrated?*

large populations. The success of much of the agricultural land was related to the development of complex irrigation systems, which allowed previously arid land to be used for crops. In South America, specialized production of crops, such as sugar cane and coffee, grew in value when European settlers first visited these regions. These commodities continue as a way to increase economic viability through exporting tropical goods and crops that grow best in South American climates.

Agriculture in North America

Although new technologies have brought into question exactly which groups of Native Americans first cultivated crops in North America, it has long been accepted that agriculture systems in the United States were well established prior to the influence of European culture.

Many Native American tribes were hunters and gatherers who relied on the abundance of wild plants and animals for their diet, and traveled to ensure they would always have access to the resources they needed. Other tribes were agrarian, using vast tracts of fertile land to cultivate crops like maize, beans, sweet potatoes, peanuts, and tomatoes. Unlike early agriculturalists in other parts of the world, Native Americans did not raise many domesticated animals. An ample supply of fish and wild game provided sufficient protein to their diets.

European Influence on North America

Many of the earliest European settlers coming to North America had little or no agricultural experience. Many of the settlers came to the area they called the New World with hopes of finding natural resources they could sell on the European market. These early settlers were ill-prepared to obtain their own food, and without assistance and instruction from Native Americans, many would have likely perished due to starvation.

As time passed, additional settlers moved to North America and brought agricultural skills and commodities to the colonies. These settlers introduced crops such as rice, wheat, barley, and oats to the colonies and brought livestock such as cattle, sheep, and pigs. As the settlers became more adept at farming in their new location, they began exporting crops such as corn, chocolate, cotton, and tobacco to Europe. The growing European desire for agricultural products that were grown in the colonies was a large driving factor for the settlement of North America.

The American Revolution

Following the American Revolution, the newly formed United States was even more reliant on agricultural export to European markets than the colonies had been. No longer supported by Great Britain, the American citizens needed to create more income to support the burgeoning nation. The strong European demand for crops, such as tobacco, cotton, and rice, led to the widespread use of slavery on large row crop farms called plantations. The reliance on income from agricultural crops necessitated the increase of farm laborers, hence the importation of more slaves and the beginning of a dark period in American agricultural and societal history.

Post-Civil War

After the Civil War and the abolishment of slavery, the agricultural industry needed to reestablish a labor force to remain profitable. This increase in labor force was accomplished through two types of agricultural labor systems: sharecropping and indentured servitude.

Did You Know?

The Incan farmers did not have beasts of burden or iron tools but were still able to grow crops in all sorts of terrain from the deserts to the high mountains.

Did You Know?

George Washington first suggested that Congress form an agriculture department in 1799. The US Department of Agriculture was not officially created until 1862, when Abraham Lincoln authorized the formation of the “people’s department.”

Did You Know?

The dust storms during the Dust Bowl could generate enough static electricity to knock people to the ground if they tried to shake hands during a storm.

Sharecropping

Sharecropping was a method of agricultural labor in which the landowner provided the use of arable land to a farmer in exchange for a share of the crop produced. Sharecropping agreements differed across the country but usually favored the landowner. At the end of a season, workers were often paid with only a third of the crop produced and, in many cases, were indebted to the landowner or other supplier for necessities (seed, fertilizer, clothing, shoes, etc.) purchased on credit from the “plantation store.”

Sharecropping ended as people moved to cities and new technologies, such as tractors and cotton pickers, allowed landowners to work their land with less labor and more efficiency.

Indentured Servitude

Indentured servitude is a system of agricultural labor in which a person is indebted to someone and required to work for that person until their debt is paid. After the Civil War, indentured servants were generally European immigrants who came to America on tickets purchased by a landowner with the agreement that they would work for the landowner until their debt, and often a large amount of interest on the debt, was paid off. As with sharecropping, indentured servitude agreements usually favored the landowner.

The Dust Bowl

American agriculture was extremely prosperous in the early 1900s. This prosperity led farmers to plow hundreds of thousands of acres of range and pasture to produce wheat from 1925 to 1930. This poor management of agricultural land, combined with years of drought, led to the most devastating human-created ecological disaster in American history: the Dust Bowl.

The **Dust Bowl** (1930–1936) is the period in which the mismanagement of American cropland led, in part, to massive dust storms spreading throughout the Midwest region of the United States, **Figure 1-17**. The Dust Bowl had devastating effects on the land, its farmers, and society as a whole:

- Resulted in the loss of topsoil from almost one million acres of farmland
- Was a contributing factor to the Great Depression
 - Forced thousands of Americans to leave their homes in search of more inhabitable areas
 - Changed the social climate of the country by breeding animosity and resentment amongst and toward fellow Americans searching for homes and employment
 - Drastically changed the methods of farming and regulations for soil conservation in the United States



Arthur Rothstein, Library of Congress

Figure 1-17. Poor practices led to the Dust Bowl of the 1930s. Much of the fertile Midwest soil appeared as barren desert. *Could there be another Dust Bowl in the United States? What could cause such a disaster in the United States or in another country?*

Green Revolution

Between 1940 and the late 1960s, there was an astonishing period of growth in agriculture as many scientists focused on developing new technology that would increase agricultural production on a worldwide scale. Driven by a desire to increase food security across the globe, their goals included the following:

- The development of higher-yield crops
- The development and implementation of irrigation systems
- Improved pest and disease control
- The development of synthetic fertilizers

The scientists’ work during this time led to great technological advances in agricultural production and increased agricultural production worldwide. The period became known as the

The Life of a Sharecropper

There are many opportunities to examine sharecropping in the time after the Civil War. Consider the following facts about sharecropping:

- At the end of the Civil War, there were many more African Americans with agricultural skills in the South than white Americans with agricultural skills.
- Many freed African Americans returned to the plantations where they had been slaves to work as sharecroppers.
- Both white and African Americans worked as sharecroppers for wealthy landowners.
- Often, sharecropping contracts were written in ways that left little chance for the sharecropper to make a profit.

Consider This

1. With a group of 2–3 students, use these facts to answer the question: “Was sharecropping an appropriate option for raising crops in the late 1800s?”
2. If you are interested in knowing more about the life of a sharecropper, books you may want to read include *Tobacco Road* by Erskine Caldwell, and *A Childhood: The Biography of a Place* by Harry Crews.



Library of Congress Archives

Green Revolution, Figure 1-18. **Norman Borlaug** (1914–2009) is credited as being the father of the Green Revolution. His scientific exploration of the genetics and production of wheat is credited with saving more than a billion people from starvation and earned him a Nobel Peace Prize. Lessons learned from the Green Revolution are used today as scientists continue to use new technology to help secure a more stable world food supply.

Legislation That Influenced Modern Agricultural Education

Many pieces of governmental regulation shaped agriculture and agricultural education in the United States. Some of the most influential legislation includes the following:

- **Morrill Act (1862)**—This act set aside land in every state for college-level education in agriculture. These colleges were called **land-grant institutions**.
- **Homestead Act (1862)**—This legislation allowed settlers to claim 160 acres of land in a designated area and earn ownership rights by fencing it, digging a well, plowing ten acres for agricultural production, building a house, and living there. This act had a large impact on western expansion in the United States.
- **Hatch Act (1887)**—This act designed the setup of agricultural experiment stations. These stations were developed for regional research in agricultural commodities.



luchschen/Shutterstock.com

Figure 1-18. Widespread scientific research in the mid-twentieth century led to great advances in agriculture called the Green Revolution.

Did You Know?

The first high school to offer agricultural education courses under the Smith-Hughes Act legislation was Woodlawn High School in Woodlawn, Virginia.

- **Smith-Lever Act (1914)**—This act provided federal funding for outreach education for land-grant institutions. These outreach programs are still in place today in the form of cooperative extension programs.
- **Smith-Hughes Act (1917)**—This legislation set up federal funding for agricultural education for students prior to graduation from high school. This act essentially started high school agricultural education.

Inventions That Changed Agriculture

The agricultural industry relies heavily on machinery and equipment, and many of the biggest changes in agriculture have come about because of mechanical inventions that changed the way crops were produced, harvested, and processed. Each invention or new technology affects every aspect of agricultural production—from the seeds planted to the amount of labor required to harvest and process commodities. For example, the time required to produce 100 bushels of wheat or corn has decreased significantly since 1830, **Figure 1-19**. This drastic reduction is directly attributed to mechanical inventions that have made harvesting these crops much less labor-intensive.

Although it is not possible to list all the inventions that have contributed to advances in the agricultural industry, we can review a few key inventions that revolutionized American agriculture.

Cotton Gin

One of the most significant advances in increasing yield for American agriculture was Eli Whitney's 1793 invention of the cotton gin. The cotton gin replaced hand labor with a machine that could effectively remove seeds from the cotton fibers. Using Whitney's revolutionary cotton gin, one worker could clean 50 pounds of cotton in one day! This was 50 times more cotton (per day) that a worker could clean than when removing seeds by hand, **Figure 1-20**.

Mechanical Reaper

In the earliest parts of the nineteenth century, most grains were reaped, or cut down, by hand using blades on long handles called *sickles*. In 1837, Cyrus McCormick developed the first horse-drawn reaper that could be used to reap grains mechanically. This machine used simple mechanisms to move blades back and forth to cut the grain stalks as horses walked through the field, **Figure 1-21**. The process dramatically reduced the amount of time required to harvest cereal grains. The time saved with

Hours of Labor to Produce Crops			
Year	100 Bushels of Wheat	100 Bushels of Corn	Methods
1830	250–300	75–90	Walking plow, harrow, hand planting
1890	40–50	35–40	Gang plow, seeder, thresher, wagons, horses
1930	15–20	15–20	2-bottom gang plow, disk, cultivators, pickers, tractor, combine
1945	10–12	10–14	Tractor, 3-bottom plow, tandem disk, 4-section harrow, 4-row planters and cultivators, and 2-row picker
1975	3.75	3	Tractor, 30-foot sweep disk, 27-foot drill, 22-foot self-propelled combine, 5-bottom plow, 20-foot tandem disk, planter, 20-foot herbicide applicator, 12-foot self-propelled combine, and trucks
Today	Less than 3 hours	Less than 2.75 hours	Machinery, GPS-enhanced equipment using precision pesticide and herbicide applications

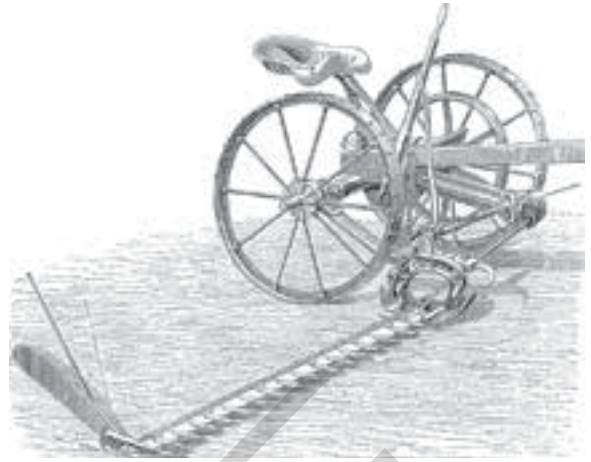
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Figure 1-19. The use of agricultural machines has greatly reduced the number of hours needed to produce crops.



Steven Wynn/iStock/Thinkstock

Figure 1-20. Before Eli Whitney's cotton gin revolutionized cotton processing in the United States, plantation workers would spend hours removing the small cottonseeds from the cotton fiber by hand. *How did the cotton gin remove the seeds?*



Hein Nouwens/Shutterstock.com

Figure 1-21. Imagine the difference in harvest time that farmers experienced when moving from hand reaping to the use of the McCormick horse-drawn reaper.

the mechanical reaper led to a massive increase in the grains planted each year in the United States. Today, cereal grains are planted more than any other type of crop.

Steel Plow

A broken sawmill blade inspired a blacksmith to create one of the most important agricultural inventions in history. In 1837, John Deere, a blacksmith from Illinois, saw the steel saw blade as a possible solution to tilling the sticky clay soil of the Midwest. Prior to the steel plow, farmers would have to stop and clean the dense soil off their cast iron plows with a wooden paddle as they moved through the field. The smooth surface of the steel allowed the sticky soils to slide off as the plow was pulled through the field. Using a steel plow helped decrease downtime and increase the speed with which the tough Midwestern soil could be turned.

Did You Know?
The plow has been cited as one of the most important inventions in the advancement of society.

Steam Tractor

The booming railroad industry helped lead to the invention of the first steam-powered tractor in 1868. Although these machines were very heavy and not well suited to farm work, their invention was the first engine driven labor source in agriculture and led to the decreased use of draft animals for agricultural power. A steam tractor could often accomplish the work of as many as 10 teams of horses in a single day. See **Figure 1-22**.



pwrnc/Shutterstock.com

Figure 1-22. While not perfect by any means, the first steam tractors symbolized the advancement of agricultural machinery in the twentieth century. *What types of problems were there with steam-powered tractors?*

Barbed Wire

The patent for what is considered the first barbed wire was awarded to Joseph Glidden in 1874. Barbed wire became an important tool in managing the large tracts of land where cattle were being housed in the Great Plains region. In contrast to open range and long cattle drives moving animals between grazing lands and market, barbed wire allowed cattle ranchers to keep their animals in managed pastures. Having more

Did You Know?

The only way to get the first tractors delivered from the rail station to the fields was to pull them with draft animals.

Did You Know?

The three main groups of satellites are fixed satellites that handle voice, data, and video; mobile satellites that are used for navigation; and scientific satellites that handle meteorological data, land survey images, and other scientific research functions.

control over the area where cattle could roam led to an increase in selective breeding and improvements in cattle genetics.

General Purpose Tractor

Although tractors had been used since the 1860s, a widely available general-purpose tractor was not available until the mid-1920s. In order for the tractor to be considered general purpose, it needed to be cost-effective for the average farmer and replace the majority of dependence on draft animals for farm labor. While some debate exists, it is widely accepted that the Farmall tractor, produced by the International Harvester company in 1924, was the first general purpose tractor. The widespread use of tractors made a huge impact on modern agriculture.

Satellite Technology

In 1994, the first global positioning systems (GPS) for agriculturalists were used. GPS technology allows farmers to use precision agriculture techniques. **Precision agriculture** is the method of managing agricultural land with the assistance of computer or satellite information, **Figure 1-23**.

Agriculturalists can use GPS technology to control fertilizer and pesticide application, monitor erosion, collect information related to yields in specific areas within larger fields, monitor pest infestation, monitor crops for disease, and evaluate irrigation issues. GPS technology may also be used to monitor and maintain machinery as well as monitor the location of employees working alone in distant areas.



Denton Rumsey/Shutterstock.com

Figure 1-23. It is amazing to see just how far agriculture has progressed in recent years. These potatoes are being planted in Idaho with a GPS-guided tractor. *In what other ways are farmers using modern technology to produce higher yields?*

Biotechnology

Biotechnology is the use of scientific modification to the genetic material of living cells to produce new substances or functions. Biotechnology also includes the process of genetic engineering, where a gene from one living organism is inserted into the genetic makeup of another organism. The first biotechnology crop approved for human consumption was the Flavrsavr™ tomato, which was first available to consumers in 1994. In 1997, the first crops with genetically engineered pest resistance and the first crops with herbicide resistance became commercially available. Since that time, biotechnology has become a valuable tool for agricultural production. Biotechnology in agriculture is explored more in Lesson 5.3.

Career Connection

Geneticist

A geneticist is a scientist who studies how genes are inherited, mutated, activated, and inactivated. Most geneticists specialize in either animal or plant genetics. While many geneticists work with newly developed species, others work to map the genomes of ancient plants or animals.

Education—Most geneticists have a minimum of a bachelor's degree in genetics, biology, or chemistry. To hold a management position, you need a master's degree and a professorship requires a doctorate degree. A solid math background is essential.

Salary—The average annual salary for a geneticist is around \$79,000. Salaries on the high end are around \$153,000 and the entry-level salary is around \$50,000. Salaries vary by geographical location, education, experience, and whether you are employed in the private or public sector. (US Bureau of Labor Statistics)

Job fit—This job may be for you if you are interested in mapping genomes and you enjoy science.



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Lesson 1.2 Review and Assessment

Lesson Summary

- The changes in agriculture from ancient times to modern day are staggering.
- Studying the origins of agriculture allows us to see the impact agriculture has had on the building and development of society.
- Examining the process of domestication illustrates the changes that have been made to wild plants and animals to suit human needs.
- History shows that agriculture plays a large role in the ways that society functions.
- Studying change in global agriculture production provides insight into useful methods for agricultural management.
- Understanding the history of agriculture in the United States allows us to see how agriculture has shaped our nation.
- Knowing the history of agriculture shows the progress we have made, along with the dangers of mismanagement.
- Examining major agricultural inventions shows us how important it is to continue improving agricultural practices and equipment.
- Biotechnology has an important role in making agriculture more effective.

Vocabulary Review

Match the vocabulary terms listed in the *Words to Know* to the correct definition.

- A. agrarian civilization
- B. artificial selection
- C. biotechnology
- D. domestication
- E. Dust Bowl
- F. Fertile Crescent
- G. feudal system
- H. Green Revolution
- I. indentured servitude
- J. nomadic tribe
- K. Norman Borlaug
- L. precision agriculture
- M. sharecropping

1. The period between 1940 and the late 1960s in which scientists focused on developing new technology that would increase agricultural production on a worldwide scale.
2. The use of scientific modification to the genetic material of living cells to produce new substances or functions.
3. Groups of people who traveled from place to place hunting available food sources.
4. The process of humans changing a plant or animal from its wild form to a domesticated form for the benefit of humans.
5. A system of agricultural labor in which a person is indebted to someone and required to work for that person until his or her debt is paid.
6. The process of selecting which organisms to breed to create offspring with more desirable characteristics.
7. The period from 1930–1936 when the mismanagement of American cropland and climate changes led to the loss of topsoil throughout the Midwest.
8. Scientist whose exploration of the genetics and production of wheat is credited with saving more than a billion people from starvation.
9. The area referred to as the birthplace of agriculture.
10. Organized groups whose society is based in agricultural production.
11. An agricultural management system in which the land was owned by those who completed military service.
12. A method of agricultural labor in which the landowner provided the use of arable land to a farmer in exchange for a share of the crop produced.
13. The method of managing agricultural land with the assistance of computer or satellite information.

Know and Understand

Answer the following questions using the information provided in this lesson.

1. What is the name given to the “birthplace of agriculture,” an area that extends from the eastern part of the Mediterranean to the lower Zagros Mountains in Iraq and Iran?
 - A. Egyptian Crescent
 - B. Fertile Crescent
 - C. Zagros Crescent
 - D. Iranian Crescent
2. What are the main differences between a nomadic tribe and an agrarian civilization?
 - A. Nomadic tribes raise animals; agrarian civilizations raise crops
 - B. Nomadic tribes stay in one location; agrarian civilizations move from place to place
 - C. Nomadic tribes do not consume animal products; agrarian civilizations do not eat plants
 - D. Nomadic tribes travel to hunt available food; agrarian civilizations cultivate their own crops and animals
3. *True or False?* Many anthropologists believe the movement from wandering tribes to agrarian society was the largest single factor in developing the modern world.
4. What was the largest influence on the development of modern civilization?
 - A. A shift to an agrarian society
 - B. Increased amounts of foraging foods
 - C. Domestication of animals
 - D. Installation of irrigation systems
5. What is the term for an animal that has been modified by humans behaviorally and structurally from the wild counterpart and is kept under human control for a clear purpose?
 - A. Domesticated animal
 - B. Feral animal
 - C. Tame wild animal
 - D. Wild animal
6. *True or False?* Agriculture in the Fertile Crescent was largely maintained by sharecroppers.
7. *True or False?* Agriculture was driven largely by the desire for products produced in Asia by countries in the Middle East and Europe.
8. In feudal systems of agricultural management, land ownership was _____.
 - A. restricted to those who belonged to royal families
 - B. exchanged for harvested crops
 - C. granted to those who completed military service
 - D. None of the above.
9. *True or False?* Well-developed agricultural systems allowed ancient civilizations such as the Aztecs to produce enough food and fiber to support large populations.
10. Which of the following crops were cultivated by early Native Americans?
 - A. Cotton
 - B. Tobacco
 - C. Maize
 - D. Soybeans

11. What was a large driving factor for producing agricultural products in the early settlement days of North America?
 - A. The need to fund the American Revolution
 - B. Payments required to Native Americans for the purchase of land
 - C. The growing European desire for New World agricultural products
 - D. The need for silk in East Asia
12. Which agricultural labor practice included trading years of service in exchange for passage to North America?
 - A. Irish labor trades
 - B. Indentured servitude
 - C. Plantation stores
 - D. Sharecropping
13. Which ecological disaster occurred because of the mismanagement of agricultural land in the 1930s?
 - A. Eruption of Mount Everest
 - B. Widespread hurricanes on the Atlantic Coast
 - C. The Dust Bowl
 - D. The Green Revolution
14. Who is considered the father of the Green Revolution?
 - A. Cyrus McCormick
 - B. Eli Whitney
 - C. John Deere
 - D. Norman Borlaug
15. Who invented the mechanical reaper?
 - A. Cyrus McCormick
 - B. Eli Whitney
 - C. John Deere
 - D. Norman Borlaug

Analyze and Apply

1. Search online and in your local library for period articles on land conservation. Focus on a particular conservationist and the area(s) with which they were involved. Find a historic illustration or famous painting of the same area. Find current images and articles of the same area. Is it the same? How different is it? Make a list of differences or changes. Create a compare/contrast chart with the information.
2. There are many reports that the Fertile Crescent is “drying up.” Explain how humans have affected this area and if it is possible to restore it to its once bountiful splendor.

Thinking Critically

1. Imagine that you were alive and owned a greenhouse and florist retail shop during and just after World War II. What effects would the war and its aftermath have on you as the owner?
2. You are thinking about taking a vacation to a historically accurate 1920s farm. This farm uses only equipment available before 1929. What will you expect to see when observing the workers plowing, cultivating, and harvesting crops? Please explain which equipment they might be using and which equipment you would not see in this operation.

SAE for ALL Opportunities

1. **Immersion: Research SAE**—Research the history of domestication for a specific species. Conduct a Research SAE to examine differences in traits between wild and domestic versions of the same species.
2. **Immersion: Research SAE**—Examine heirloom varieties of crops and vegetables. Conduct a Research SAE to determine the preferences of people when comparing heirloom and modern varieties of the plants.
3. **Immersion: Placement SAE**—Speak with your local historical society or agricultural commodity groups to develop a Placement SAE related to collecting, cataloging, or preserving agricultural history in your area. Share your findings as an agricultural communicator.

SAE for ALL Check-In

- How much time have you spent on your SAE this week?
- Have you logged your SAE hours?
- What challenges are you having with your SAE?
- How can your instructor help you?
- Do you have the equipment you need?

LESSON 1.3

Future of Agriculture, Food Systems, and Natural Resources Management

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Essential Question

What is being developed to help increase agricultural production and efficiency?

Lesson Objectives

After studying this lesson, you should be able to:

- Examine factors that determine the future of agriculture, food systems, and natural resources.
- Explain the areas of technology that will affect the future of agriculture, food, and natural resources.
- Analyze your role in the future of agriculture, food systems, and natural resources.

Words to Know

coding

engineering

information system

informed consumer

sustainable

sustainable agriculture

sustainable energy

technology

trend

Before You Read

Be prepared to read this lesson with paper for recording questions. As you read the lesson, record any questions that come to mind. Indicate where the answer to each question can be found: within the text, by asking your teacher, in another book, on the internet, or by reflecting on your own knowledge and experiences. Pursue the answers to your questions.



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Figure 1-24. Experts in the 1960s had a very different idea of how society would look today. *What do you think the world will look like in 50 years?*

In the mid-twentieth century, it was hypothesized by a group of scientists that by the year 2010, most Americans would have an at-home “computation terminal,” drive a flying car, and eat mainly freeze-dried foods, **Figure 1-24**. While it is true that most homes today do have computers, these well-qualified experts missed the mark on many of their predictions.

We may not be able to predict the future, but careful study of past changes and the factors that drove those changes will give us a better idea of what the future holds for agriculture, food systems, and natural resources management. Taking a close look at evolving technologies and their involvement in the agricultural industry will give us a better idea of how the future of agriculture will affect us as individuals and society as a whole.

Driving Factors

To determine what will drive the future of agriculture, food systems, and natural resources, we need to use our deductive thinking skills to examine what has happened to create the agriculture of today. When we look at the things that have stimulated change in the past, we can see that most changes required three main factors: population growth, consumer demands, and long-term sustainability.

Population Growth

The first factor in determining the future of agriculture, food systems, and natural resources management is population growth. As stated in Lesson 1.1, *agriculture* is the art and science of cultivating plants, animals, and other life forms for use by humans to sustain life. Because agriculture is production for human use, it would make sense to conclude that the future of agriculture is directly dependent on the number of people who will be on the planet.

According to the Population Division of the United Nations, the world population is projected to grow to 9.7 billion by the year 2050, **Figure 1-25**. This number is based on continual growth at the pre-COVID-19 levels, and adjusted for a slow in population growth due to COVID-19 impacts. More than half of the world population lives in urban areas, away from the land required to produce their food. This fact requires the timely shipping of fresh goods and adds more pressure to those involved in production agriculture.

Think about how the rate of global population increase will affect agriculture. How does a rapid population increase affect the overall need for change in agricultural systems? In the early twentieth century, agriculturalists simply put more land into production. The issue facing agriculture now is that arable land is decreasing at an alarming rate. According to the American Farmland Trust, more than 175 acres of arable farmland is lost every hour to development. That adds up to more than three acres per minute. The only remaining option for the agricultural industry is to adapt for the future by developing efficient ways to produce agricultural commodities with the land currently in production.

Did You Know?

At current population growth rates, the global population increases by one person every 0.36 seconds. That is an increase of around 169 people per minute.

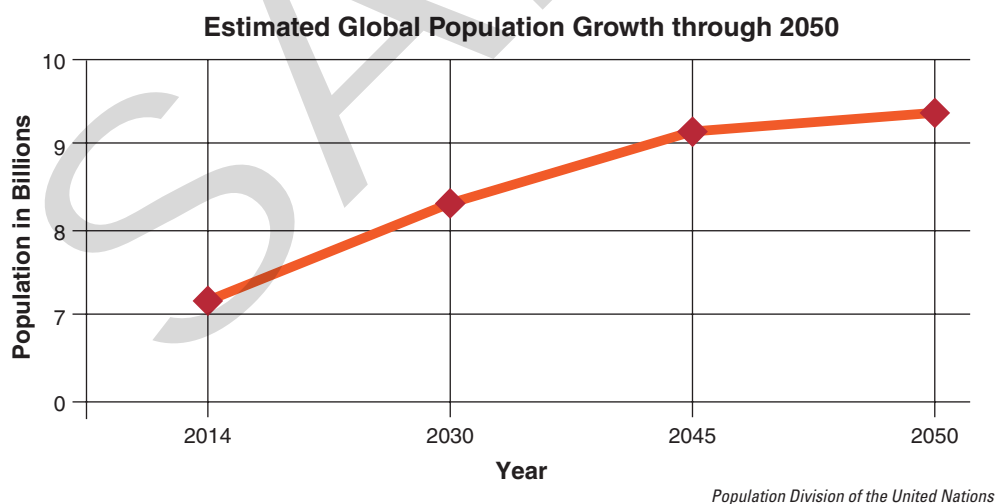


Figure 1-25. With such a quickly growing population, today's agriculturists are under increased pressure to produce enough food to meet the growing demand.

Consumer Demands

Like any industry, agriculture relies on consumers to purchase and use the commodities produced. Production agriculturalists are constantly working to develop and promote products that consumers will find desirable. Oftentimes, trends will emerge in consumer demands that become the driving factor in agricultural production. A **trend** is the general direction that something is developing or changing. Understanding exactly what the consumer will desire is important in projecting what future agricultural products might be.

When the desire for leaner pork products emerged in the 1970s, the industry modified to breed swine that carried less body fat. The swine we raise today look nothing like the swine we raised prior to the shift. A more modern example of consumer demands driving change in the agricultural industry is the increase in desire for gluten-free products. As more and more consumers desire products that are made without gluten, those involved in food processing and production are continually exploring methods for creating new products without this ingredient. These goods are marketed to a growing group of gluten-free consumers. The gluten-free market, which was once a very small component of the total food production industry, gained in popularity and production in a short amount of time because of consumer demands, **Figure 1-26**.

Can you think of ways consumers drive agricultural production? Food and beverage experts predict that healthy snacks that can be consumed away from home, alternatives to sugar as a sweetener, and plant-based milk products will continue to drive production in the next decade. Agricultural producers work to stay ahead of trends in eating to ensure food products will be available when consumer demand peaks.

Sustainability

Another important factor that will determine the future of agriculture, food, and natural resources management is the concept of sustainability. When something is **sustainable**, it can be used without being used up or permanently damaged. In terms of our natural environment, sustainability is based on everything we need to survive and depends on our natural environment and how we take care of it.

Sustainability related to agriculture, food, and natural resources can be looked at in terms of energy sustainability or agricultural sustainability. **Sustainable energy** is energy that can be used to meet current needs without compromising the ability to meet future energy needs. For example, solar energy, wind energy, and geothermal energy are renewable energy sources that can be harnessed indefinitely. Agriculture and natural resources play an important role in energy sustainability through renewable energy sources. The future of renewable energy is definitely a factor that will affect the future of agriculture, food systems, and natural resources management.



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Figure 1-26. The increased market for gluten-free products is an example of how consumer demands will play a role in the future of agriculture, food systems, and natural resources. *Can you name food products that were brought about by consumer demands?*

Sustainable Agriculture

Sustainable agriculture is the process of producing agricultural products using techniques that protect the environment and all living beings while allowing agricultural land to maintain production for many years. Because agricultural land is lost daily to development, using sustainable agricultural practices allows producers to ensure that the land currently in production is

being managed in a way that will not reduce its ability to produce food and fiber for future generations. Specific sustainable agricultural practices are discussed in Chapters 13 and 15, with a focus on preserving soil health.

Over the last three decades, agriculturalists have increasingly focused on sustainable practices, largely driven by the loss of productive land. In almost every commodity area, farmers and ranchers are producing more agricultural products in ways that are mindful of continued production. Some examples of these practices include reduction of tillage in areas with erosion issues, recycling animal waste as renewable energy to power agricultural production, and reclaiming water for reuse in production settings, **Figure 1-27**.

Did You Know?

Careful stewardship by farmers has spurred a nearly 50% decline in erosion of cropland by wind and water since 1982. (American Farm Bureau Federation)

Technology and Agriculture

Technology is the application of scientific knowledge, tools, or processes for practical purposes. As the global population, consumer demands, and sustainability factors lead to changes in the industry, scientific principles will be used to make changes and bring about new technology. Advances in technology that will affect the agricultural industry include technological advances in engineering, biotechnology, and information systems.

There is a large need for those who will develop new advancements in agriculture. If you are interested in a career in agriculture and in developing new technology, you have great opportunity to find a position in the area of your choice.

Engineering

Engineering is the branch of science concerned with designing and building new machines, power systems, and structures. This section of technology is incredibly important to agriculture since it relies heavily on equipment to cultivate, harvest, and process raw products. Many of the advances in agriculture are made through more efficiently engineered equipment, **Figure 1-28**.

The future of the agricultural industry will depend on engineering advances that allow more commodities to be grown on the available land. Agricultural engineering has already developed advanced machines that are in use. These include remote-controlled tractors and harvesting equipment, planting equipment that tests the soil and plants different varieties in the same field, and small drone aircraft designed for monitoring crops and livestock, **Figure 1-29**.

Biotechnology

The next area of technology that is important to the future of agriculture, food, and natural resources is biotechnology. Simply stated, *biotechnology* is a collection



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Figure 1-27. Sustainable agriculture involves making management decisions that will protect the usefulness of the environment for future generations. Production agriculturists, homeowners, and business owners can use reclaimed water to irrigate their landscaping. *What actions can you take in your daily life to conserve water?*



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Figure 1-28. Have you ever thought about how specialized agricultural machinery must be? This is just one example of a specialized machine, which fills ice cream cones for individually frozen treats.



Manu_Padilla/Shutterstock.com

Figure 1-29. Drone technology continues to improve production methods. Drones can map fields, determine crop quality, help move livestock, and provide accurate options for applying weed and pest control. *Are there any restrictions on using these types of drones? If so, what are they?*

of scientific techniques used to modify plants, animals, and microorganisms to improve the following attributes:

- Longevity
- Disease resistance
- Drought resistance
- Flavor
- Adaptability

Scientists are working on creating organisms that will withstand conditions outside of arable environments, including land that has too much salt or too little water for traditional crops, **Figure 1-30**. The application of biotechnology may be a way to solve many production issues facing agriculture. Biotechnology allows changes to be made

Did You Know?

Advances in biotechnology have allowed a gene from the Arctic flounder to be transferred to plants such as tomatoes and strawberries to ease their susceptibility to cold.



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Figure 1-30. Biotechnology is working to develop new varieties of crops that can grow in areas that have not historically been arable land. *Do you foresee drawbacks with this technology?*

more quickly than traditional animal and plant breeding. A thorough discussion of biotechnology, including the processes used and social concerns, is in Lesson 5.3. Currently, many agricultural products are being used that have been developed using biotechnology. What changes do you think the future holds?

Information Systems

Information systems include the equipment and software that are used to collect, filter, process, and distribute information. In other words, these are the systems used to process data. Vast networks of computers and mobile devices are used in the agricultural industry, making this section of technology one of the most rapidly growing contributors to the future of agriculture, **Figure 1-31**.

An advantage to increasing the use of information systems technology in agriculture is increasing the amount of precise data collected about production and commodity yields. Having precise information of how much of a commodity is being produced under certain conditions allows producers to make better management decisions and customize production to maximize yields. Some examples of information systems technologies that are being developed and used include items such as:

- A smartphone accessory that can test cattle blood for diseases
- A combine that collects harvest yields accurate to the square foot of a field
- Specialized harvesting equipment that can be programmed to pick crops when they are at the perfect color ripeness
- A dairy system that monitors production of each individual cow through a computerized ankle band
- Farmbots that can travel through fields and manually kill weeds or harvest specific crops

You and the Future of Agriculture

The future of agriculture, food systems, and natural resources definitely includes young adults such as yourself. Whether you choose to pursue a career in agriculture that helps shape the future or are simply a consumer of agricultural products, you will play a role in the path that the future will take.

Production

Is production agriculture for you? If you enjoy working with a specific agricultural commodity, you may want to be involved in producing the crops or livestock needed to help feed the global population of the future. You can be involved in production agriculture even if it is not your main employment. In fact, according to the USDA, 91% of families who own a farm have at least one household member with an off-farm job. That means that much of our agricultural production is done by those who enjoy producing agricultural commodities even though it is not their main source of employment.

Consumption

Even if production agriculture is not something you want to pursue as a career, you will still have a place in the future of agriculture, food, and natural resources. By eating, purchasing clothing, and using any of the thousands of products that are developed from



kung_tom/Shutterstock.com

Figure 1-31. This robot uses artificial intelligence to pick tomatoes at exactly the correct ripeness. *What other applications can you think of for this technology?*

Coding in Agriculture

Do you know how to code? **Coding** is the process of writing computer languages that can be used to guide computer programs, automate machines, and develop artificial intelligence in computers and machinery.

There is a great demand for coding in agriculture. Modern tractors use multiple computer systems, including global positioning systems (GPS) that guide equipment through fields with precision. Agriculture is using more automation on everything from planting to cultivating, and through harvest and processing. If you do not know how to code, search for online resources available to get you started. You may also speak with a computer science teacher, find a mentor, or enroll in a community-based class.



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agricultural commodities, you will be a lifelong consumer. Becoming an informed consumer is an important step to fulfilling your role in the future of agriculture, food, and natural resources. The two main steps of becoming an informed consumer are as follows:

- Knowing the origin and understanding the processes used to produce agricultural products
- Making decisions about trends in products

Informed Consumers

In the beginning of the lesson, you read how consumer demands will help determine the types of products produced in the future. The products you purchase are included in these consumer demands, **Figure 1-32**. Understanding where agricultural products come from and the production processes used to produce them will prepare you to make smart consumer decisions. Reading this textbook and enrolling in high school agricultural classes will give you a good foundation in your understanding of the agricultural industry. It will also help you become an **informed consumer**.



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Figure 1-32. Your choices will help determine the future of agriculture, food, and natural resources. *What choices will you make as a consumer?*

Career Connection

Market Research Analyst

Market research analysts use a variety of tools to determine consumer demographics, sales trends, and buying habits, along with developing projections for future consumer demands. Market research analysts collect and interpret data from consumers to project future trends.

Education—Most market research analysts have a four-year degree in a field related to communication, statistics, or business administration.

Salary—According to the Bureau of Labor Statistics, annual salaries range from \$40,000–\$120,000, with a median salary of \$71,000. Visit the bureau’s website to learn about employment levels, outlook for the position, and salaries by regions of the country.

Job fit—This job may be for you if you like working with both people and numbers, if you have a natural curiosity about why people buy certain items, or if you enjoy interacting with all types of people.



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SAMPLE

Lesson 1.3 Review and Assessment

Lesson Summary

- The future of agriculture, food systems, and natural resources will be driven by three main factors: population growth, consumer demands, and sustainability.
- To fulfill the needs and desires of people in the future, the agricultural industry will need to use new technologies to bring about change.
- Many technological advances that will lead to increased production of agricultural commodities are being made in engineering, biotechnology, and information systems.

Vocabulary Review

Match the vocabulary terms listed in the *Words to Know* to the correct definition.

- A. coding
- B. engineering
- C. information system
- D. informed consumer
- E. sustainable
- F. sustainable agriculture
- G. sustainable energy
- H. technology
- I. trend

1. The process of writing computer languages that can be used to guide computer programs, automate machines, and develop artificial intelligence in computers and machinery.
2. The application of scientific knowledge, tools, or processes for practical purposes.
3. The equipment and software used to collect, filter, process, and distribute information, or to process data.
4. The branch of science and technology concerned with the design, building, and use of engines, machines, and structures.
5. The process of producing agricultural products using techniques that protect the environment and all living beings while allowing agricultural land to maintain production for many years.
6. A person who is knowledgeable about the agricultural processes and origins of agricultural commodities who can make good decisions based on this knowledge.
7. When something can be used without being used up or permanently damaged.
8. The general direction that something is developing or changing.
9. Energy that can be used to meet current needs without compromising the ability to meet future energy needs.

Know and Understand

Answer the following questions using the information provided in this lesson.

1. Why should we study past changes in the agricultural industry?
 - A. To preserve history in case climate change affects production
 - B. To become a well-rounded agricultural scholar
 - C. Studying past changes and their driving factors will give us a better idea of what factors will affect future development
 - D. Because all things in agriculture are cyclical, and no new changes will be developed
2. What are the three main factors driving changes in the agricultural industry?
 - A. Population growth, consumer demands, long-term sustainability
 - B. Climate change, sustainability, social pressures
 - C. Population growth, climate change, price of fuel
 - D. Consumer demands, producer preferences, online shopping habits

3. Why does the distance between urban dwellers and the land where food is produced add pressure to those involved in production agriculture?
 - A. Urban dwellers are producing most of their own food so producers are not needed
 - B. Most urban dwellers have a large knowledge of agriculture
 - C. Food will generally spoil before it can reach most consumers
 - D. Food products must be delivered in a timely manner and longer distances require more transport time
4. What is the estimated world population for the year 2050?
 - A. 3.4 billion
 - B. 7.2 billion
 - C. 8.7 billion
 - D. 9.7 billion
5. Which of the following would be considered a trend in agricultural production?
 - A. Shortage of bananas in high hurricane years
 - B. Consumers desiring more plant-based protein alternatives
 - C. Grocers refusing to carry food from a certain producer
 - D. Gluten-free consumers protesting at a local bakery
6. Something that is used without being used up or permanently damaged is considered _____.
 - A. technology
 - B. information systems
 - C. sustainable
 - D. marketable
7. What drives trends in agricultural production?
 - A. Consumer demands
 - B. Producer preferences
 - C. Fuel costs
 - D. Natural disasters
8. Solar energy, wind energy, and geothermal energy are all examples of _____ energy sources.
 - A. antiquated
 - B. renewable/sustainable
 - C. modern
 - D. nonrenewable
9. The use of sustainable practices by agricultural producers is _____.
 - A. decreasing
 - B. increasing
 - C. remaining the same
 - D. nonexistent
10. Advances in technology that will affect the agricultural industry include advances in _____.
 - A. information systems
 - B. engineering
 - C. biotechnology
 - D. All of the above.
11. An informed consumer knows the food's origin, understands the processes used to produce food, and _____.
 - A. consults scientists before purchasing food
 - B. makes decisions about trends in products
 - C. buys whatever food is on sale
 - D. eats only local foods

12. Which of the following has *not* been accomplished with biotechnology?
 - A. Increased longevity
 - B. Disease resistance
 - C. Drought resistance
 - D. Increased toxicity
13. Which of the following is *not* a technology currently available in agricultural production?
 - A. Robots that can pick plants based on color of ripeness
 - B. Computerized chips to record exact milk production in cattle
 - C. Microchips to send alerts each time a hen lays an egg
 - D. Smartphone application to test blood in cattle
14. What percent of American farm households have one member with an off-farm job?
 - A. 31%
 - B. 51%
 - C. 71%
 - D. 91%
15. What will be your role in the future of agriculture, food systems, and natural resources?

Analyze and Apply

1. We know that new technologies will affect the future. Design a new technology in agriculture, food systems, or natural resources management and explain how you think this new technology will affect the future.
2. The future will depend on the changes that are made in the agricultural industry today. Find a current issue related to a new trend in agriculture, food systems, or natural resources management. An easy way to find them is to search the news online for “new technology in agriculture.” For your issue, play the role of the market analyst and answer the following questions: What is the trend? What types of consumers do you think are most likely to like the new trend? What impact will this trend have on agricultural production? What do you project will happen with this trend one, five, and ten years in the future?

Thinking Critically

1. Research shipping methods used by growers in the United States. Create a table that shows the most common transportation methods. List situations where retailers request things such as unrefrigerated storage for some produce and the ways in which they could be resolved.
2. Research the topic of food preservatives. What would happen if we did not use food preservatives? Are there natural alternatives? Are they as effective as synthetic ones? Has biotechnology made advances in making harvested foods last longer? What are the pros and cons of using or not using food preservatives? Do additional research to find expert opinions, associated costs, and other relevant information.

SAE for ALL Opportunities

1. **Immersion: Research SAE**—Select a commodity area and research specialized equipment used to cultivate, harvest, or process that commodity. Share your results through a webcast, YouTube video or blog to educate others on your findings.
2. **Immersion: Research SAE**—Conduct a social science Research SAE to determine which consumer trends might be most popular in your area.
3. **Immersion: Internship/Placement SAE**—Volunteer or intern at a local engineering firm that specializes in fabricating agricultural machinery.

SAE for ALL Check-In

- How much time have you spent on your SAE this week?
- Have you logged your SAE hours?
- What challenges are you having with your SAE?
- How can your instructor help you?
- Do you have the equipment you need?

Chapter 1 Skill Development

STEM and Academic Activities

1. **Science**—Investigate current research programs in biotechnology. Choose a research program with a particular focus that interests you. Prepare a report on the scientific methods used in this program. Explain how the results affect the agricultural industry.
2. **Technology**—Research environmental issues related to horticulture and find out what role technology has played in its advancement. Choose two specific topics and write a report explaining how technology has helped (or hurt) efforts in these specific areas to become more environmentally friendly.
3. **Engineering**—Choose a piece of agricultural machinery and research the changes in the machinery since it originated. Determine how mechanical advancements have made the machinery more efficient. What changes do you foresee in the future of this equipment?
4. **Social Science**—Choose a civilization from the past and research land ownership customs of that civilization. Write a report comparing and contrasting those customs with customs generally followed by people today.
5. **Language Arts**—Many famous writers have written poems about farming. Conduct research to find and read one or more poems written by famous poets. Note the rhythm of the words and the speech patterns. You may want to read the poem aloud or have someone read it aloud while you listen. Using the poems you have read as inspiration, write your own poem about agriculture. Consider setting your poem to music. Share your poem with the class.

Communicating about Agriculture

1. **Reading and Speaking**—With a partner, make flash cards of the *Words to Know* listed at the beginning of each lesson. On the front of the card, write the term. On the back, write the phonetic spelling as found in a dictionary. Practice reading the terms aloud, clarifying pronunciations where needed.
2. **Speaking and Listening**—In small groups, review the key terms listed at the beginning of each lesson. For each term, discuss the meaning of the term and describe the term in simple, everyday language. Record your group's initial description, and then make suggestions to improve your description. Compare your descriptions with those of the other groups in a classroom discussion.
3. **Reading and Speaking**—Complete a timeline listing the major agricultural advancements over the past 100 years. Research agricultural history in the past 100 years. Determine the ten most important advancements in agriculture during that period. Explain to a partner the timeline sequence and the reasons why each event/invention was important.
4. **Speaking and Listening**—Using pictures from magazines or free online resources, create a collage of agricultural advances over the past 100 years. Include the dates and names of the people involved. Show and discuss your collage in a group of four to five classmates. Are the other members of your group able to determine the succession of advancements that you included in your collage?



5. **Reading and Speaking**—Select a historical era that interests you. Using at least three resources, research the agricultural history of that era. You may narrow the topic to a particular area of interest (mechanical advances, technological advances, biotechnology, etc.). Using the information gathered through your research, write a report. Present your report to the class using visuals such as PowerPoint or create a short video formatted as a documentary.
6. **Reading and Listening**—In small groups, discuss the main topics in the chapter. Ask questions of other group members to clarify concepts or terms as needed.

Extending Your Knowledge

1. What is agriculture? Conduct research to gather people's perceptions about agriculture. Ask at least one person born in every decade (go back as far as you can find participants) to draw a picture of what they think about when you say the word agriculture. Compare and contrast the differences between the drawings collected by yourself and your classmates.