Lesson 1: Agriculture: What Is It?

The concept and definition of agriculture has changed during the years. Early definitions focused on farming of crops and raising of livestock. Today agriculture has evolved to encompass a much broader scope and to include many related careers.

What Is Agriculture?

The term agriculture is derived from Latin words meaning the science and art of cultivating the soil. This definition may have described agriculture in the early days of our nation but is not accurate today.

Changes in society, demand for more food, and greater variety of foods have prompted changes in agriculture. Traditionally, agriculture has been defined as providing food and fiber for the increasing world population. Used by many in the past, this definition may limit the new and emerging career areas of agriculture.

Today's more encompassing definition of agriculture is as follows:

All aspects of the global food, fiber, and natural resources systems including

- the development, production, processing, marketing, and distribution of food and fiber products;
- the health and nutrition of food consumption;
- the use, conservation, and maintenance of environmental and recreational resources; and
- the related scientific, economic, sociological, political, and cultural characteristics of the food, fiber, and natural resources systems.

Figure 1.1 shows the increasing world population trend. Many people employed in agricultural careers will be needed to help meet the world's needs for food, fiber, shelter, and conservation of natural resources, as well as many other areas. As a result, there are and will be a variety of careers and opportunities in agriculture.

Agriculture in Your Daily Life

Agriculture is the largest industry in the United States, providing employment for over 22 million people. The industry is larger than the steel, transportation, and automotive industries combined. Agriculture provides much more than just quality food and fiber products for U.S. and world consumers.

Approximately 20% of the U.S. population derives its livelihood from agribusiness. These careers are related to the work involved in taking food and fiber from the farm to the consumer. In contrast, less than 2% of Americans are involved in farming or production agriculture. The job title of farmer is one of over 200 rewarding and diverse careers in agriculture. Changing world food needs and rapidly developing technology mean that agricultural career opportunities will continue to grow.

Americans enjoy low food costs compared to all the items they buy. The average American family spends approximately 11% of its disposable

Figure 1.1 - World Population Growth

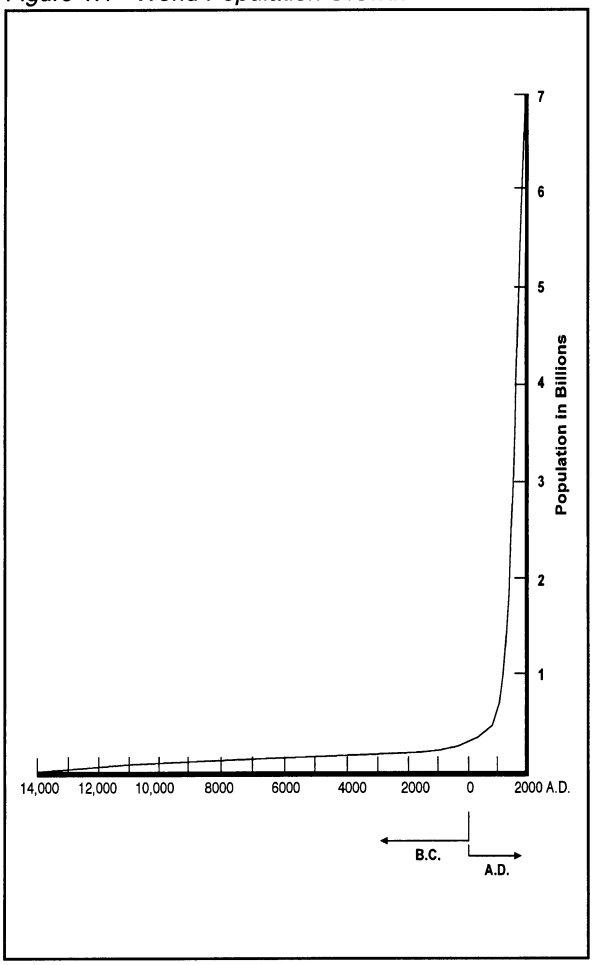
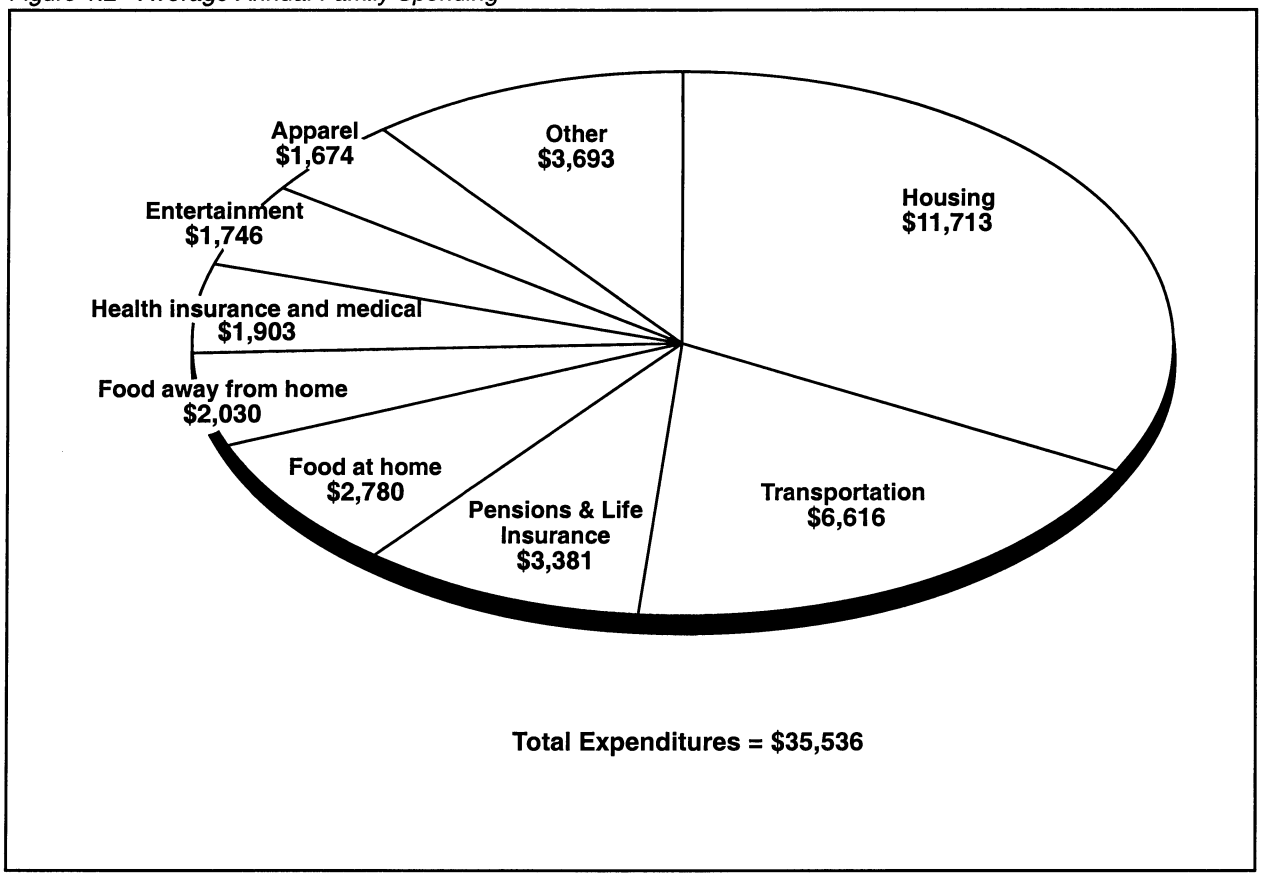
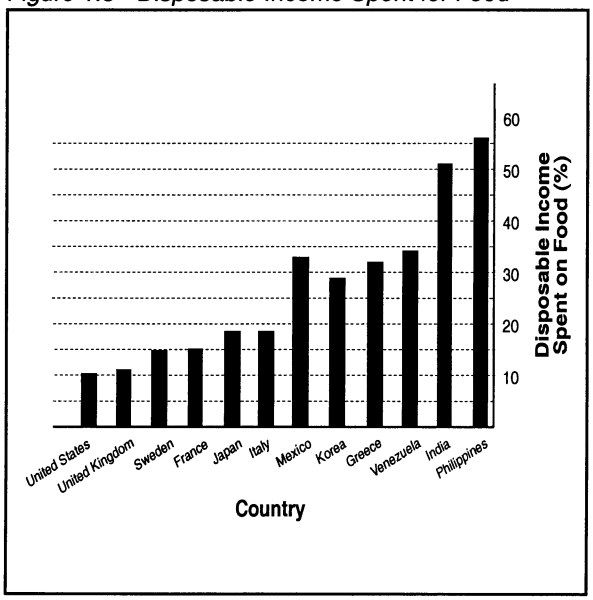


Figure 1.2 - Average Annual Family Spending



income on food. (Disposable income is income after taxes, also known as take-home pay.) This means that for every $1.00 a family has to spend, 11 cents is spent on food. Figure 1.2 shows the major areas where the average family spends its money.

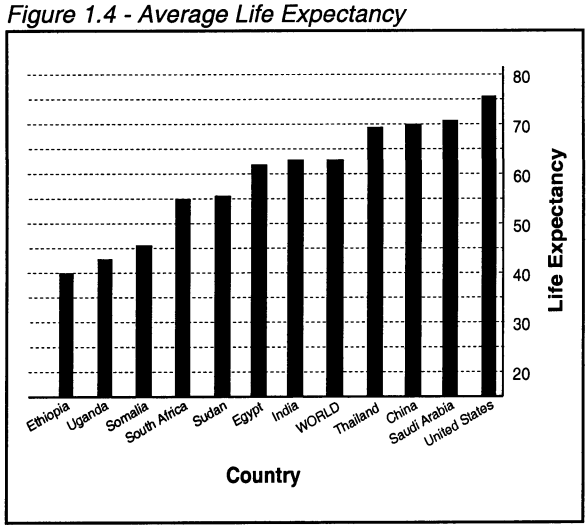
Figure 1.3 - Disposable Income Spent for Food



Americans spend less money on food than people in other countries. This is possible because of high production levels, new technology, efficient transportation, and many other factors. Figure 1.3 shows what percentage of disposable income other countries spend.

Agricultural research and a healthy food supply have contributed to a much longer life expectancy. For example, researchers at the University of Missouri Agriculture Experiment Station discovered Aureomycin, which led to the use of antibiotics for human health. Research on animal tuberculosis eventually led to the development of a vaccine to prevent tuberculosis in humans. Agricultural research has helped to solve many human health and nutrition problems. These advancements in agriculture and medical science have made good health and longer lives a reality. As shown in Figure 1.4, the average life expectancy in the United States is the highest in the world.

Figure 1.4 - Average Life Expectancy



Agriculture generates millions of dollars of taxes. Taxes help support the local, state, and national governments. Many rural school districts receive a major portion of their funding from agricultural property taxes.

Major Sectors of the Agricultural Industry

There are many different ways to categorize the major sectors of agriculture; however, a common and accepted classification system is as follows.

Agricultural systems technology - Engineers plan and design machinery, equipment, and structures used in agriculture. Agricultural technicians play a key role in keeping all operations functioning smoothly and profitably through proper installation, repair, and maintenance. Examples of careers in this sector are agricultural electrician, agricultural engineer, and engine technician.

Agricultural processing and marketing - This sector involves processing, inspecting, grading, packaging, distributing, and marketing agricultural commodities (corn, soybeans, beef, pork, etc.) as they move from the source of production to the consumer. Examples of careers in this sector are meat department manager, food scientist, grain elevator manager, and citrus processor.

Agricultural supplies and services - People employed in this sector play an important role in selling items or services needed by the general public. Many times this sector has been identified as agribusiness. Examples of careers in this sector are agricultural journalist, genetic engineer, agricultural loan officer (banker), and veterinarian.

Forestry - The management and business practices associated with timber and trees provide agricultural careers in this sector. Examples of careers in this sector are park ranger, forester, and timber manager.

Horticulture - This fast-growing career sector of agriculture involves the major areas of floriculture, fruits and vegetables, nursery/landscape, and turf grass. Examples of careers in this sector are floral designer, landscape architect, and turf grass specialist.

Production agriculture - Accounting for less than 10% of all agricultural careers, this sector involves producing crops and livestock. In general, a job title in this sector would be farmer, producer, or rancher, and could be more specific depending on what is produced on the farm or ranch in the United States. Examples of career titles are beekeeper, livestock herdsman, and grain producer.

Natural resources - The conservation of our air, soil, water, and wildlife is becoming increasingly important. Examples of careers in this sector are fish and wildlife specialist, soil conservationist, and water quality specialist.

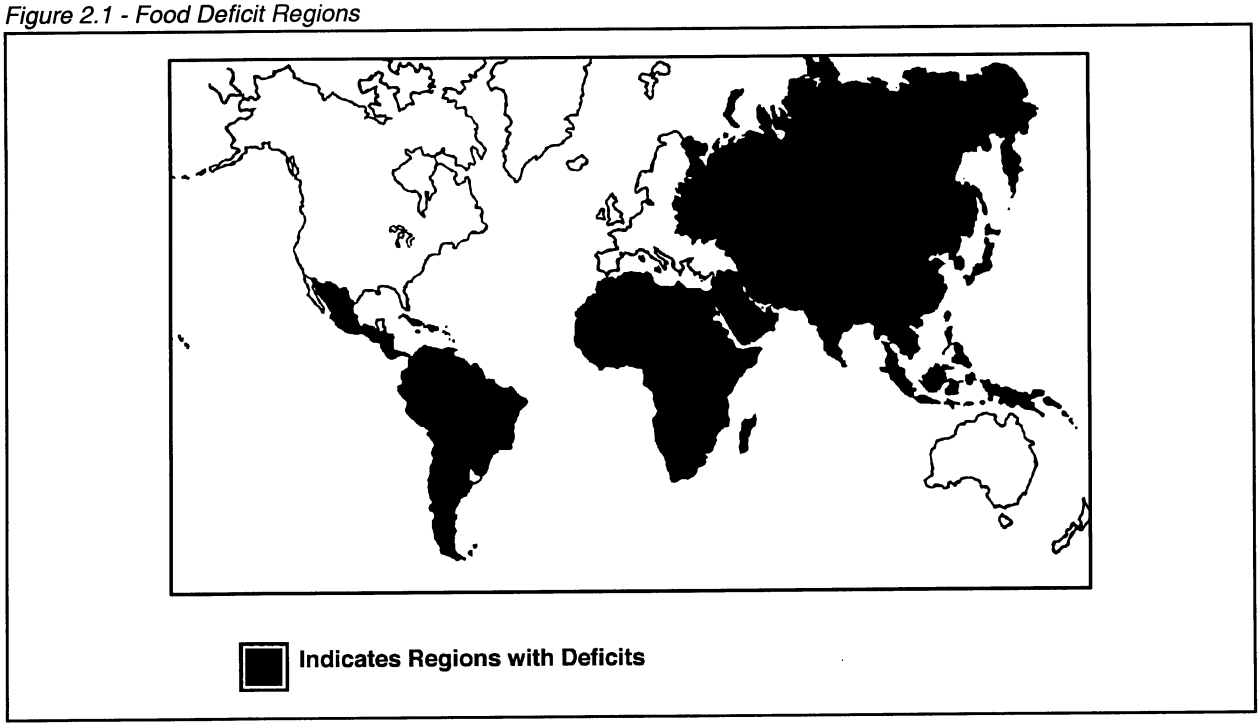
Summary

Agriculture is more than farming. The definition of agriculture has evolved to include career areas in seven major sectors of the agricultural industry. The global aspect of agriculture is concerned with the increasing world population. The country's largest employer is agriculture. Several major benefits are provided by agriculture including a low food cost compared to other countries and helping to increase the life expectancy of humans. Agriculture benefits everyone each and every day.

Lesson 2: Agriculture in the World

This lesson is about the role of agriculture in the world. Billions of people in the world depend on agriculture to provide them with food, clothing, and shelter. Most of these items are provided by a small number of countries that produce enough food for export, with the United States being a leader in this area. In addition, the United States imports key food items that cannot be grown in our climate.

Figure 2.1 - Food Deficit Regions



An export is a product that is transported from the United States to a foreign country, primarily by shipping. An import is a product that is brought into this country from another country. Trade balance refers to the value of goods exported from the United States compared to the value of imports.

Importance of Agriculture in the World

Agriculture is an important industry in the world economy. At the most basic level, agriculture produces the food, clothing, and shelter that the world population needs for survival. However, some countries cannot produce the food needed to feed their citizens. Figure 2.1 shows the regions in the world with food deficits. Other countries are fortunate to produce more than they need. Countries with a surplus can export food to countries that have food shortages.

Countries that export agricultural products may use the income to buy other products on the world market. Countries will buy goods for a variety of reasons. Some will buy goods, such as medical supplies, that improve the quality of life for their citizens. Others will buy weapons and equipment to improve their military power.

Agricultural science and technology has provided medicines and pharmaceuticals for many people in the world. These advances have helped to improve the quality of life and have contributed to a longer life expectancy.

The United States exports large amounts of agricultural products to other countries. Agricultural exports generate billions of dollars of income for the United States. Income obtained from the sale of agricultural products enables the United States to import goods needed to maintain a high standard of living in this country. In 1999, major U.S. imports consisted of crude oil and refined petroleum products, automobiles, consumer goods, and food that cannot be grown in the U.S. climate.

Agricultural Differences in the World

Climate affects the growing of plants, crops, and animals in the world. Temperature and precipitation are two major factors that influence the type of production agriculture that is possible in a country. For example, the tropical climate of Central America is ideal for producing specialty crops such as bananas that cannot be grown in other areas of the world. Countries that are closer to the equator have longer growing seasons and can produce crops, especially fruits and vegetables, almost year-round.

There are thousands of different types of soil in the world, each with a high, medium, or low fertility level. When combined with the soil's ability to drain or hold water, a soil may or may not produce a crop. Topography is the shape of the ground surface as determined by such major features as hills, mountains, or plains and indicates the slope of the land. Land that is hilly is difficult to farm and may lose valuable topsoil through erosion. Topography has a large influence on soil drainage.

Economic development is another factor that explains agricultural differences in the world. Many countries have a very low standard of living. These countries can be classified as developing, which means they are evolving from a less-developed status to an industrialized level. Less-developed countries are characterized by low incomes, poor health care, low literacy rates, and a shortage of money. As a result, they do not have the technology, skill, or management level to produce a high quality and quantity of food and fiber for their people. The developed countries of the world are characterized as having excellent educational systems, using modern technology in agriculture, and having a marketing and distribution system to provide agricultural products for use by their population or for export.

Agricultural Commodities Produced in Major World Regions

Because of agricultural differences in the world, a variety of commodities are produced in various continents. For example, Africa is known for its production of cotton, metals, and petroleum products. Asia produces such commodities as rice and tea. Australia is a leader in producing wheat, sheep, and wool. Europe is associated with floriculture, potatoes, cereal grains, and textiles. North America is a leader in corn, soybeans, beef, pork, and wood products, while South America is associated with coffee, soybeans, metals, and wood products.

Primarily due to growing conditions, especially climate, the United States must depend on other countries to produce certain agricultural commodities. For example, the United States imports food products such as bananas from Costa Rica and Ecuador; cashews from Brazil and India; coffee from Columbia, Brazil, and Mexico; olives from Spain, Morocco, and Greece; and peppers from Mexico.

Role of U.S. Agriculture in the World Market

Producers in the United States produce enough food to feed the entire population in the United States and to export to many foreign countries. Over 95% of the world's consumers live outside United States borders. Some countries with large populations or limited natural resources do not produce enough to feed their people. Although the United States is not the only provider of food and fiber products in the world, many countries purchase U.S. products.

Agricultural exports are vitally important to the U.S. economy and totaled $61.8 billion in 1998. Table 2.1 lists the top five exports by value.

Table 2.1 - Top Five U.S. Exports

Exported Product	Value
Soybeans	$6.1 billion
Coarse grains (corn, oats, barley, sorghum, and rye)	$5.0 billion
Consumer food (beef, pork, and lamb)	$4.0 billion
Wheat	$3.8 billion
Cotton	$2.5 billion

Table 2.2 lists the leading countries that purchased U.S. agricultural exports in 1998.

Table 2.2 - Leading Purchasers of U.S. Exports (1998)

Country	Amount of Agricultural Exports Purchased	Percent of U.S. Agricultural Exports
Japan	$12.1 billion	19.6%
European Union (15 countries)	$10.0 billion	16.3%
Canada	$9.0 billion	14.6%
Mexico	$6.3 billion	3.9%
South Korea	$2.4 billion	3.9%

The United States also plays a key role in providing assistance to countries that cannot produce the food needed for their citizens. Technical and educational assistance is provided to some developing countries. In addition, the U.S. Department of Agriculture (USDA) administers a number of foreign food assistance programs. Through humanitarian efforts, many needy countries receive emergency assistance from food that is shipped from the United States.

Summary

Agricultural products play an important role in the world economy. Agriculture varies from country to country primarily due to climate and technology. Imports supply countries with agricultural products that cannot be produced in that country. The United States continues to play a key role in providing assistance to countries that cannot produce the food and other products needed for their citizens. Such programs involve providing technical and educational assistance to developing countries.

Lesson 3: Agriculture in the United States

The United States produces an abundant variety of agricultural products for use at home and abroad. Agriculture is the largest industry in the United States and has impacted history in many ways.

Agricultural Production

Agricultural products are produced in every state. However, different areas produce different crops and animals for a variety of reasons. Agricultural production is concentrated in areas with favorable growing conditions.

Climate is an extremely important growing condition. Many crops produced in the southern United States would not survive the colder growing conditions in the north. The length of the growing season is related to this factor. In general, the growing season lengthens in relation to how far south the area is located.

Water is needed to produce agricultural crops. Areas that receive limited rainfall must use irrigation to produce crops. Temperature extremes in summer and winter months may also limit the crops or livestock that can be produced in some areas.

Soil conditions, such as topography and fertility, affect what crops can be grown. In general, livestock production is located where crops grown for livestock feed is readily available.

Success of Agriculture in the United States

The United States is a world leader in the production, processing, and marketing of agricultural products. Much of the wealth Americans enjoy as a nation can be attributed to the tremendously successful agricultural industry.

A combination of factors contributes to the success of agriculture in the United States. The fertile soil in this country is some of the finest in the world. Growing conditions, such as temperature and rainfall, are very favorable for producing a variety of crops.

America has been blessed with many leaders and inventors who have made important agricultural discoveries. Scientists and researchers have developed technology that has been adopted by agribusiness to improve production and efficiency. Finally, an advanced and extensive transportation and marketing system has been developed to make agricultural products available to consumers.

Goals of Agriculture

The long-standing goal of agriculture has been to provide food, clothing, and shelter for humankind. That has not changed, but several important goals have been added in recent years.

Food safety and the environment have become critical issues for the agricultural industry. As a result, ensuring food safety and protecting the environment have become important aspects of agriculture's efforts to feed, clothe, and provide shelter for the increasing world population.

Agriculture has been a leader in using technology for production and agribusiness. Technology is considered the practical application of science. Knowledge gained from scientific research is used to create equipment, processes, machines, and new varieties of plants and animals. These technologies are used to improve production methods on farms, and to improve the processing

and marketing of agricultural products. Two examples are computers used to monitor the environment of livestock and grain facilities, and genetically modified organisms (GMOs) like Bt corn that resists the corn borer.

Evolution of U.S. Agriculture

The importance of agriculture in the United States can be traced to a point in history before this land was a nation. Most of the first settlers who set foot on the land that was to become the United States were farmers. These early colonists produced crops under ideal growing conditions and exported agricultural products to England.

As people moved west, this expansion opened new land and opportunities. Farmers and ranchers claimed large areas of land. The growth and development of the United States were made possible by the ability of farmers and ranchers to efficiently produce agricultural products.

This efficiency has allowed the United States to shift from a nation of farmers to an agribusiness economy. At the time of the American Revolution, over 90% of the colonists made their living as farmers. Today, that percentage is less than 2%. However, the scientific and technological advances in agriculture have made it possible for approximately 20% of the U.S. population to be employed in agribusiness.

Many advances have taken place in agriculture due to management, technology, and agricultural research. In general, crop yields have increased and meat animals have become leaner and more cost efficient in converting feed stuffs to meat or milk. Table 3.1 provides historical evidence of this progress.

Historical Impact of Changes in Agriculture

As the United States grew, agriculture contributed to its growth. Inventions such as the cotton gin by Eli Whitney (1793) and the grain combine (1836) enabled American farmers to increase agricultural production. In 1837, John Deere began manufacturing plows, thereby making the soil much easier to work. Barbed wire was invented in 1867 and helped to manage cattle herds and sheep flocks.

John Froelich built the first gasoline tractor in 1892. Tractors came into general use in the 1920s and 1930s, and replaced horses in supplying farm power. As the need to increase crop yields grew, American researchers responded with the development of hybrid seed corn in 1922. The 1950s brought the adoption of commercial fertilizer by producers and increased mechanization. Herbicides and insecticides gained popularity in the 1960s, and the 1970s brought confinement structures for raising livestock and the increased use of artificial insemination of livestock.

Computers started to play an integral role in farm operations and agribusinesses in the 1980s. There was less emphasis on the plow as a tillage method in the 1980s, and erosion control measures such as conservation tillage gained popularity. Agriculture in the 1990s was characterized by increased use of emerging technology such as the global positioning system (GPS). During the mid-1990s, the first crops improved through biotechnology were commercialized. In 1997 a sheep was genetically cloned from adult cells. These are just a few of the advances that enabled agriculture to supply the food and fiber needs of a growing United States and world population.

Table 3.1 - Progress of American Agriculture

Year	Hours of labor required to produce 100 bushels of corn	Corn yield (bushels/acre)	Percent of U.S. population that are producers	Number of people fed by one U.S. producer
1850	85	20	64	<1
1900	38	25	38	2
1950	12	38	12	27
Today	2	135	1.8	135

Legislation played a key role in the development of agriculture. In 1862, the U.S. Congress passed the Morrill Act. This act granted land to each state to establish land-grant colleges to teach agriculture and mechanical arts. The University of Missouri-Columbia was developed as a land-grant college. Sanborn Field on the University of Missouri-Columbia campus is the oldest Agricultural Experiment Station west of the Mississippi River.

In 1914, the Smith-Lever Act established the Extension Service as a way to educate producers. The Smith-Hughes Act of 1917 established agriculture, home economics, trade, and industry in high schools. See Table 3.2 for a listing of the events.

Table 3.2 - Significant Events in the History of Agriculture

Year	Event
1793	Eli Whitney invented the cotton gin.
1836	The grain combine was patented.
1837	John Deere plows were first manufactured.
1862	The Morrill Land-Grant College Act was passed.
1867	Barbed wire was invented.
1892	John Froelich built the first gasoline tractor.
1914	The Smith-Lever Act established the Extension Service.
1917	The Smith-Hughes Act was passed.
1922	Hybrid seed corn was developed.
1950s	Mechanization increased and commercial fertilizer was adopted.
1960s	Herbicides and insecticides gained popularity.
1970s	Use of confinement structures increased and artificial insemination of livestock began.
1980s	Use of conservation tillage and computers increased.
1990s	Global positioning systems (GPS) technology emerged.
Mid-1990s	First crops improved through biotechnology were commercialized.
1997	A sheep was genetically cloned from adult cells.

Summary

The United States is fortunate to have ideal growing conditions for the production of a variety of crops and livestock. Many inventors, legislators, researchers, scientists, and entrepreneurs were instrumental in the development of agriculture in the United States. They have contributed to the efficiency and productivity of American agriculture. At the same time, agriculture has remained true to its goal of providing food, clothing, and shelter as well as fulfilling the recent goals of protecting the environment, ensuring a safe food supply, and using technology to benefit consumers.

Lesson 4: Agriculture in Missouri

Missouri is one of the nation's leading producers of a variety of high-quality agricultural products. Farming and agribusiness have a rich heritage in the state. This lesson will review the agricultural commodities produced in Missouri, the importance of agriculture to the state, and how agriculture has changed in Missouri.

Commodities Produced in Missouri

Missouri is a leading agricultural state. Based on statistics for 1998, Missouri ranks second in the United States for the number of farms. The state ranks high in the production of several agricultural commodities. Missouri is second in number of beef cows produced and fourth in grain sorghum and hay production. Grain sorghum and hay are used for livestock feed. The abundance of pastureland reduces the effect of erosion and provides an ideal environment for cattle grazing. Cattle producers in states with more grain production buy Missouri feeder calves for their feedlots. Table 4.1 lists Missouri's ranking in the United States.

Although national rankings are not available, other agricultural commodities deserve mention. In Missouri, nearly 2500 firms are involved in logging and wood products manufacturing. These businesses employ more than 33,000 people and contribute $3 billion each year to Missouri's economy. In 1998 there were 323 horticultural businesses that produced almost $68 million in sales. They operated over 7 million square feet of greenhouses. Missouri is a large supplier of Golden and Red Delicious, and Jonathan apples.

More than 40 million pounds of apples are produced annually.

Table 4.1 - Missouri's 1998 Ranking in the United States

Category/Commodity	Rank
Number of farms	2nd
Beef cows	2nd
Grain sorghum	4th
Hay (all types)	4th
Turkeys raised	5th
Concord grapes	6th
Rice	6th
Soybeans	6th
Hogs and pigs	7th
Cheese	9th
Watermelons	9th
Broilers	10th
Corn	10th
Winter wheat	11th
Cotton	12th
Ice Cream	12th
Tobacco	12th
Eggs	14th
Milk	15th

Importance of Agriculture in Missouri

Diversified is the word most commonly used to describe Missouri agriculture. The environmental factors of geography, vegetation, climate, and soil fertility vary throughout the state. As a result, agricultural production varies in a similar manner. Table 4.1 is evidence of this variety and diversity. In 1999 the value of agricultural products produced in Missouri was approximately $4.5 billion.

Producers have selected agricultural commodities to raise based on the environmental factors in their area. For example, the rich and productive soils of Missouri's northwest, central, northeast, and southeast regions are ideal for crop and livestock production. The hilly and wooded areas of the Ozarks provide timber, pasture, and favorable weather for growing fruits and vegetables.

Missouri is among the nation's leading purebred livestock producers with livestock and related products accounting for slightly over 50% of the state's agricultural receipts. Large quantities of hogs are raised in the north and north central part of Missouri. Hay production, pastureland, beef cows, and dairy cows are most highly concentrated in the southwest.

The leading production areas of soybeans (Missouri's largest cash crop), corn, wheat, and grain sorghum are found in the northern third of the state, the west central area, and the Bootheel of Missouri.

More than 30% of Missouri is forested. The state is a leading producer of wooden pallets, charcoal, and walnut products. Lumber, hardwood flooring, wine barrels, and treated wood products are exported to other countries as well as being used in Missouri and the rest of the United States.

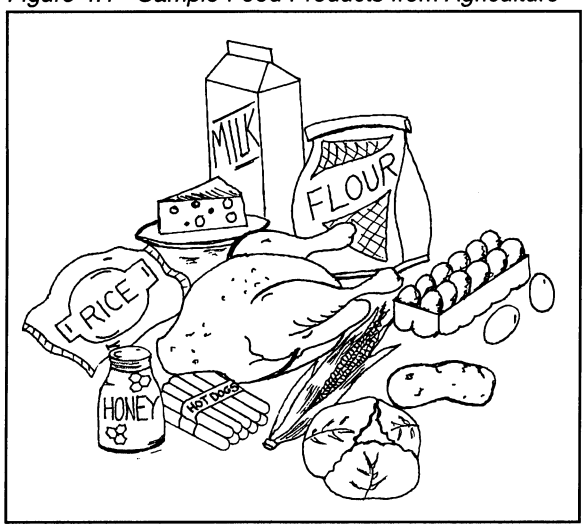
Missouri is a leading producer of grapes. This produce is marketed fresh and made into jams, jellies, juices, and wines.

Missouri operates trade offices in countries such as Brazil, Chile, Japan, Korea, Mexico, and Thailand in response to overseas demand for Missouri agricultural products.

Production of agricultural commodities on the farm is only part of the importance of agriculture to Missouri's economy. Agribusiness, the other key component, employs more than 15% of Missouri's labor force. That is one of every six workers in Missouri, or more than 400,000 people.

The agricultural processing and marketing sector of agriculture provides job opportunities for many people in the state. The processing of products raised on Missouri farms by almost 2,000 Missouri firms provides employment for approximately 92,000 persons. These people earn more than $1.8 million in annual wages. Processing by these businesses adds over $7 billion to the value of the basic farm products.

Figure 4.1 - Sample Food Products from Agriculture



It is not possible to list all the major agricultural businesses in Missouri, but several deserve noting due to their national and international scope. Monsanto and Ralston Purina are two well-known businesses located in St. Louis. Farmland Industries, the largest farm cooperative in the United States, and Dairy Farmers of America, the nation's largest dairy cooperative, are both based in Kansas City.

Missouri Agriculture Has Changed

Agriculture in Missouri has and will continue to change. The number of farms in Missouri dropped approximately 12% during the decade of 1980-1990. This was primarily in response to the agricultural crisis.

Since that time, the decline in the number of Missouri farms has slowed and stabilized. Medium-size farms have declined the most in the past, while large-size farms have increased. As a result, the average size of farms has increased.

The number of small-size farms has stabilized as the rural areas have become a favored place to live and raise a family. Most of the families living on small-size farms have dual incomes from jobs off the farm and they treat their farm business as a hobby or specialty farm.

The average age of producers has increased and lower numbers of people under the age of 35 have selected farming as a career. Agricultural businesses, however, are hiring more employees, especially females.

Producers are continuing to adopt new technology in an attempt to be as efficient as possible. Special attention has also been directed toward practices that conserve soil and maintain quality water supplies. Special interest groups have challenged agriculture to have high standards in regard to those areas as well as directing livestock producers to evaluate the livestock industry.

Most recently, agriculture has witnessed economy-of-size principles being applied to farms and businesses. The trend has been toward larger farming operations with more acres and livestock numbers, the formation of farmer cooperatives, and the consolidation of agricultural businesses. Combining agricultural businesses with biotechnology, pharmaceutical, and food companies has resulted in unique mergers and the development of the life sciences industry.

The number of businesses involved in biotechnology and life sciences are increasing in Missouri. Businesses, such as Monsanto, have selected the St. Louis area to locate their research facility.

Summary

Agriculture is very diverse in Missouri and is the most important industry. Agricultural production provides raw products, agricultural business, and career opportunities that directly contribute to the state's economy. More than 15% of Missouri's labor force is employed in agribusiness. Missouri products are used by consumers in the state, across the United States, and throughout the world. Missouri has changed and will continue to change agriculturally. However, the importance of the industry to the economy of the state will continue.

Lesson 5: Advances in Agricultural Technology

Agriculture and agricultural research have improved the quality of life in the United States. The abundance of quality food products, healthier diets, and low-cost food products are the result of a progressive agricultural industry. This lesson is about recent advances in technology and future changes expected in agriculture.

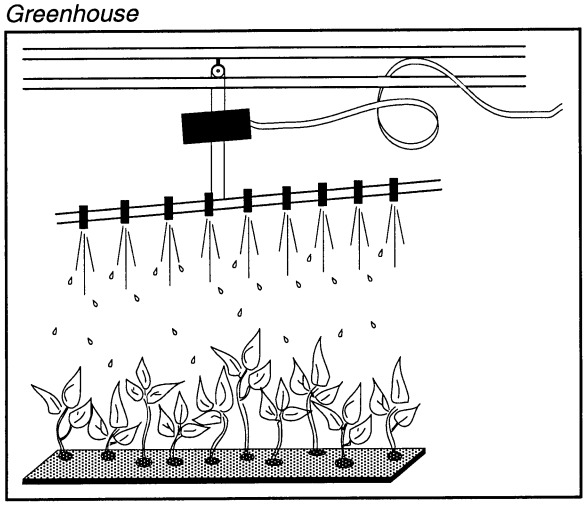
Recent Changes in Agriculture

Agriculture has changed and will continue to change as technological advances are made. The following information is a summary of some of the current changes in agriculture.

Computers - Management records for producers and agribusinesses are maintained on a computer. Consulting and management advice, commodity price updates, and communication by e-mail and the Internet through a computer have become standard procedures in agriculture. Computers are used to monitor the environment of livestock and grain facilities. Animals even have computer chips containing genetic information that can be scanned into a computer.

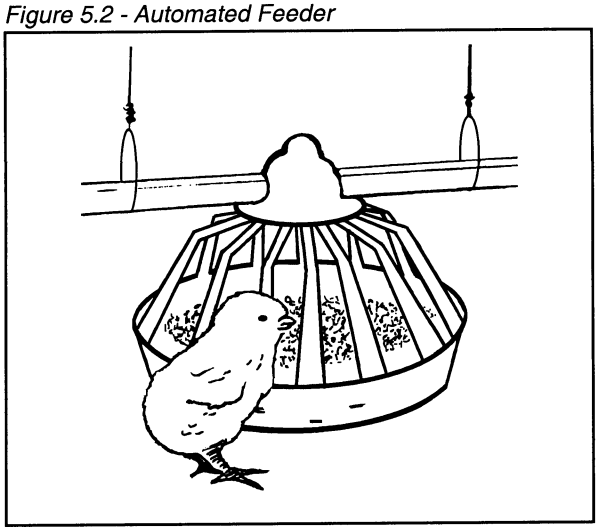
Mechanical - The use of electronic monitoring devices, laser-guided equipment, surveying instruments, and robotics have been used in various phases of agriculture. Technology is being used to reduce human labor costs. Reducing the cost of labor to produce, process, market, and transport food and fiber products helps to reduce the cost of production.

Figure 5.1 - Automated Watering System in a Greenhouse



Livestock management - Automated systems of feeding, watering, and waste disposal have reduced the amount of manual labor involved in caring for animals. Totally controlled environments have helped improve animal efficiency. Buildings to house animals have increased in size and also in concentration in areas favorable for production.

Figure 5.2 - Automated Feeder



Embryo transfer - This process involves taking eggs from genetically superior donor females and implanting them in recipient females. This allows multiple offspring from one animal to be born in 1 year. For example, a cow can produce eight calves in 1 year.

Cloning - This process involves reproducing a fertilized egg to create a genetically identical individual. In this process, reproduction of superior genetics is possible. Currently, cloned embryos are available for purchase by producers.

Genetically-modified crops - One of the most controversial subjects to arise in agriculture in recent years involves the development of genetically-modified organisms, or GMOs. Bt corn controls the corn borer insect by creating a substance that is toxic to the worm when it attacks the corn plant. Soybeans with herbicide resistance allow for better control of weeds, thus improving soybean yields.

Precision agriculture - Through satellite technology and yield monitors, global positioning systems (GPSs) have allowed producers to be more efficient. Soil and crop management can better fit the different conditions found in each field. "Farming by the inch" is possible through this new technology.

Future Changes

By the year 2040, some experts predict that the world population will double. Feeding and clothing these additional billions with a limited supply of suitable farmland poses a tremendous challenge.

Will research and new technology help agriculture meet this huge task?

In the future, biotechnology and precision agriculture will help increase production of crops and food. As a result, crop yields will continue to increase and machinery and animals will become more cost efficient. Traditional agricultural products will take on value-added dimensions as new uses are discovered for by-products. For example, recycled newspapers and soybean flour are being combined to make countertops and paneling for homes.

Research in science, agriculture, food, and health will result in new technology and unique products. For example, medicines and vitamins may be genetically engineered into plants or animals. In this way, the correct dose of anticancer medicine or just the right amount of vitamins would be consumed when eating a bowl of corn flakes or a hamburger.

Implications of Change

All of these changes in agriculture will help to feed and clothe the increasing world population. At the same time, agriculture must preserve the environment and maintain water and air quality.

Worldwide, 6 million square miles of land is used for the production of food. Surprisingly, this is the same amount as in the 1950s. And yet during this time, world agricultural productivity tripled. Clearly, the future challenge is to continue increasing productivity with about the same amount of land.

The United States will continue to be a world agricultural leader. Almost one-fourth of the most productive agricultural land is in the United States. Approximately 30% of all U.S. agricultural production goes to export markets. In the future, global trade will increase and more people will recognize its importance. As agriculture adapts to meet the needs of its global customers, new career opportunites will be created in areas such as biotechnology, marketing, commodity trading, agricultural science, economics, agribusiness, sales, computer technology, communications, international relations, transportation, and plant science.

Summary

Agriculture has and will continue to change. The fundamental goal will be to continue to produce quality food and fiber for the increasing population.

New technology and research will help to increase productivity without compromising resources. Preserving natural resources is a top concern for everyone in agriculture. There will be many career opportunities in agriculture as the demand for food and fiber continues to increase.

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