

KEY ISSUE 1

Where Did Agriculture Originate?

- Invention of Agriculture
- Comparing Subsistence and Commercial Agriculture

Agriculture is deliberate modification of Earth's surface through cultivation of plants and rearing of animals to obtain sustenance or economic gain. Agriculture originated when humans domesticated plants and animals for their use. The word *cultivate* means "to care for," and a **crop** is any plant cultivated by people.

Approximately one-half of the people in less developed countries are farmers. The overwhelming majority of them grow enough food to feed themselves, but little more. Developing countries are home to 97 percent of the world's farmers. In contrast, fewer than 2 percent of the people in the United States are farmers. Yet the advanced technology used by U.S. farmers allows them to produce enough food for people in the United States at a very high standard, as well as food for many people elsewhere in the world.

In each society, farmers possess very specific knowledge of their environmental conditions and certain technology for modifying the landscape. Within the limits of their technology, farmers choose from a variety of agricultural practices, based on their perception of the value of each alternative. These values are partly economic and partly cultural. How farmers deal with their physical environment varies according to dietary preferences, availability of technology, and other cultural traditions. Farmers select agricultural practices based on cultural perceptions because a society may hold some foods in high esteem while avoiding others.

Invention of Agriculture

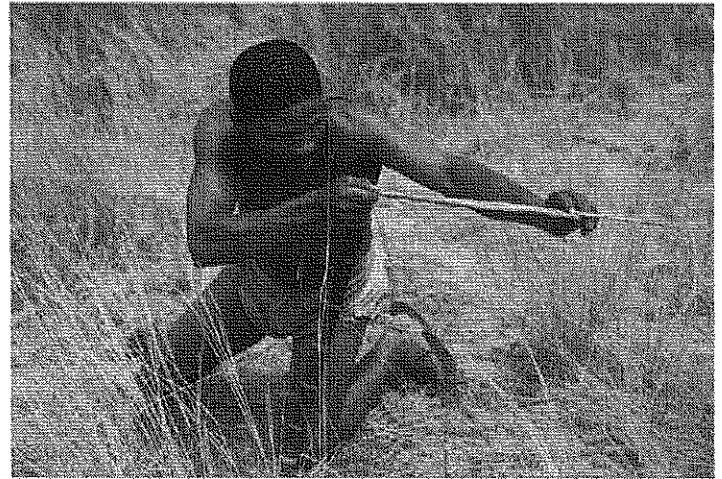
The origins of agriculture cannot be documented with certainty because it began before recorded history. Scholars try to reconstruct a logical sequence of events based on fragments of information about ancient agricultural practices and historical environmental conditions. Improvements in cultivating plants and domesticating animals evolved over thousands of years. This section offers an explanation for the origin and diffusion of agriculture.

HUNTERS AND GATHERERS

Before the invention of agriculture, all humans probably obtained the food they needed for survival through hunting for animals, fishing, or gathering plants (including berries, nuts, fruits, and roots). Hunters and gatherers lived in small groups of usually fewer than 50 persons because a larger number would quickly exhaust the available resources within walking distance (Figure 10-2). The men hunted game or fished, and the women collected berries, nuts, and roots. This division of labor sounds like a stereotype but is based on evidence from archaeology and anthropology. They collected food often, perhaps daily. The food search might have taken only a short time or much of the day, depending on local conditions.

The group traveled frequently, establishing new home bases or camps. The direction and frequency of migration depended on the movement of game and the seasonal growth of plants at various locations. We can assume that groups communicated with each other concerning hunting rights, intermarriage, and other specific subjects. For the most part, they kept the peace by steering clear of each other's territory.

Today, perhaps a quarter-million people, or less than 0.005 percent of the world's population, still survive by hunting and gathering rather than by agriculture. Examples include the Spinifex (also known as Pila Nguru) people, who live in Australia's Great Victorian Desert; the Sentinelese people, who live in India's Andaman Islands; and the Bushmen, who live in Botswana and Namibia. Contemporary hunting and gathering societies are isolated groups that live on the periphery of world settlement, but they provide insight into human customs that prevailed in prehistoric times, before the invention of agriculture.



▲ FIGURE 10-2 HUNTING AND GATHERING A Bushman in Botswana prepares his bow and arrow for hunting.

AGRICULTURAL REVOLUTION

Learning Outcome 10.1.1

Identify the major crop and livestock hearths.

The **agricultural revolution** was the time when human beings first domesticated plants and animals and no longer relied entirely on hunting and gathering. When did the agricultural revolution occur? About the year 8000 B.C., the world's population began to grow at a more rapid rate than it had in the past. Geographers and other scientists believe that the reason for the sudden population increase was the agricultural revolution. By growing plants and raising animals, human beings created larger and more stable sources of food, so more people could survive.

Scientists do not agree on whether the agricultural revolution originated primarily because of environmental factors or cultural factors. Probably a combination of both factors contributed:

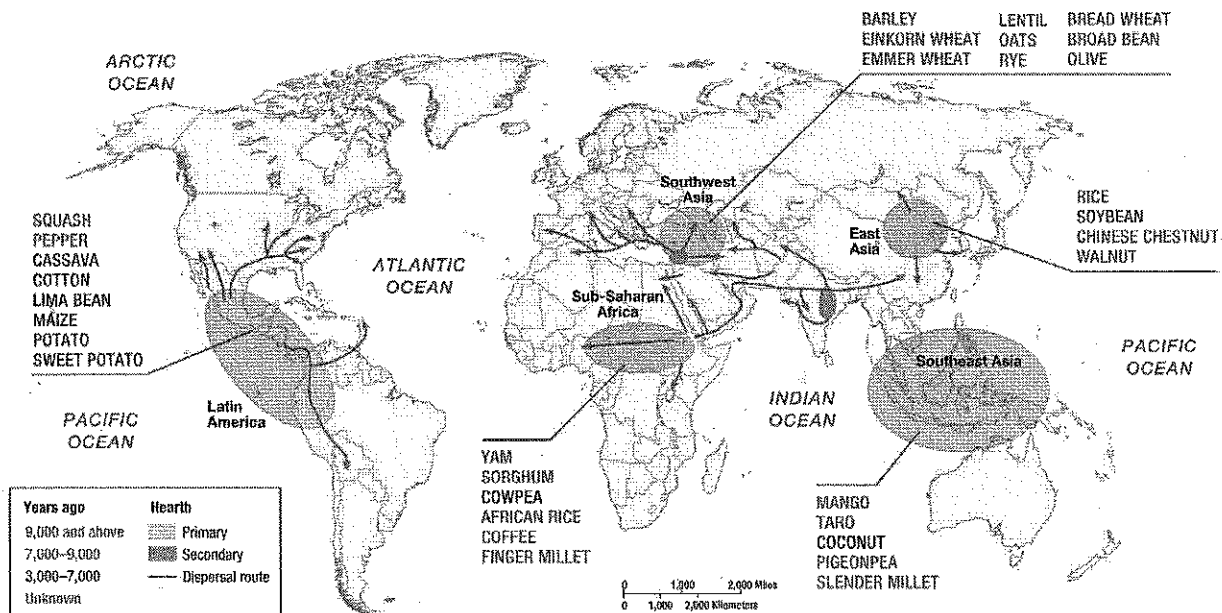
- **Environmental factors.** Those favoring environmental reasons point to the coinciding of the first domestication of crops and animals with climate change around 10,000 years ago. This marked the end of the last ice age, when permanent ice cover receded from Earth's mid-latitudes to polar regions, resulting in a massive redistribution of humans, other animals, and plants at that time.
- **Cultural factors.** Human behavior may be primarily responsible for the origin of agriculture. A preference for

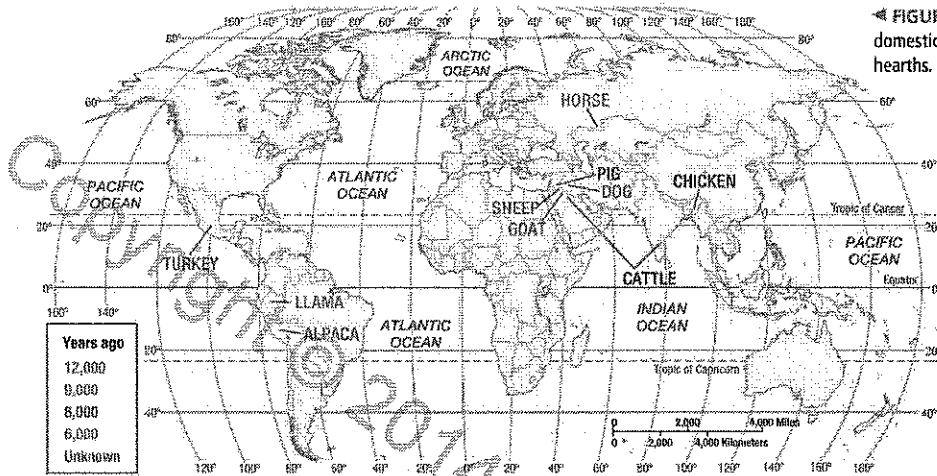
living in a fixed place rather than as nomads may have led hunters and gatherers to build permanent settlements and to store surplus vegetation there. In gathering wild vegetation, people inevitably cut plants and dropped berries, fruits, and seeds. These hunters probably observed that, over time, damaged or discarded food produced new plants. They may have deliberately cut plants or dropped berries on the ground to see if they would produce new plants. Subsequent generations learned to pour water over the site and to introduce manure and other soil improvements. Over thousands of years, plant cultivation apparently evolved from a combination of accident and deliberate experiment.

CROP HEARTHES. Scientists also do not agree on how agriculture diffused or why most nomadic groups convert from hunting, gathering, and fishing to agriculture. They do agree that agriculture originated in multiple hearths around the world:

- **Southwest Asia.** The earliest crops domesticated in Southwest Asia are thought to have been barley and wheat, around 10,000 years ago (Figure 10-3). Lentil and olive were also early domestications in Southwest Asia. From this hearth, cultivation diffused west to Europe and east to Central Asia.
- **East Asia.** Rice is now thought to have been domesticated in East Asia more than 10,000 years ago, along the Yangtze River in eastern China. Millet was cultivated at an early date along the Yellow River.
- **Sub-Saharan Africa.** Sorghum was domesticated in central Africa around 8,000 years ago. Yams may have

▼ FIGURE 10-3 CROP HEARTHES Agriculture originated in multiple hearths. Domestication of some crops can be dated back more than 10,000 years.





◀ FIGURE 10-4 ANIMAL HEARTHES Animal domestication also originated in multiple hearths.

been domesticated even earlier. Millet and rice may have been domesticated in sub-Saharan Africa independently of the hearth in East Asia. From central Africa, domestication of crops probably diffused further south in Africa.

- **Latin America.** Two important hearths of crop domestication are thought to have emerged in Mexico and Peru around 4,000 to 5,000 years ago. Mexico is considered a hearth for beans and cotton, and Peru for potato. The most important contribution of the Americas to crop domestication, maize (corn), may have emerged in the two hearths independently around the same time. From these two hearths, cultivation of maize and other crops diffused northward into North America and southward into tropical South America. Some researchers place the origin of squash in the southeastern present-day United States.

Pause and Reflect 10.1.1

Which crops appear to have reached the present-day United States first, according to Figure 10-3?

ANIMAL HEARTHES. Animals were also domesticated in multiple hearths at various dates. Southwest Asia is thought to have been the hearth for the domestication of the largest number of animals that would prove to be most important for agriculture, including cattle, goats, pigs, and sheep, between 8,000 and 9,000 years ago (Figure 10-4). Domestication of the dog is thought to date from around 12,000 years ago or possibly earlier in Southwest Asia, East Asia, and/or Europe. The horse is considered to have been domesticated in Central Asia; diffusion of the domesticated horse is thought to be associated with the diffusion of the Indo-European language, as discussed in Chapter 5 (Figure 10-5).

Printed by Jonathan Linne (jonathan.linne@mpis.k12.mn.us) on 10/13/2014 from 205.215. valid subscription date represented.

Inhabitants of Southwest Asia may have been the first to integrate cultivation of crops with domestication of herd animals such as cattle, sheep, and goats. These animals were used to prepare the land before planting seeds and, in turn, were fed part of the harvested crop. Other animal products, such as milk, meat, and skins, may have been exploited at a later date. This integration of plants and animals is a fundamental element of modern agriculture.

That agriculture had multiple origins means that, from earliest times, people have produced food in distinctive ways in different regions. This diversity derives from a unique legacy of wild plants, climatic conditions, and cultural preferences in each region. Improved communications in recent centuries have encouraged the diffusion of some plants to varied locations around the world. Many plants and animals thrive across a wide portion of Earth's surface, not just in their place of original domestication. Only after 1500, for example, were wheat, oats, and barley introduced to the Western Hemisphere and maize to the Eastern Hemisphere.

▼ FIGURE 10-5 HORSES IN KAZAKHSTAN The horse is thought to have been domesticated in this region roughly 6,000 years ago.



Comparing Subsistence and Commercial Agriculture

Learning Outcome 10.1.2

Describe the major differences between subsistence and commercial agriculture.

The most fundamental differences in agricultural practices are between those in developing countries and those in developed countries. Farmers in developing countries generally practice subsistence agriculture, whereas farmers in developed countries practice commercial agriculture. **Subsistence agriculture**, found in developing countries, is the production of food primarily for consumption by the farmer's family. **Commercial agriculture**, found in developed countries, is the production of food primarily for sale off the farm. The main features that distinguish commercial agriculture from subsistence agriculture include: the percentage of farmers in the labor force, the use of machinery, and farm size.

PERCENTAGE OF FARMERS IN THE LABOR FORCE

A priority for all people is to secure the food they need to survive. In developing countries most people are subsistence farmers who work in agriculture to produce the food they and their families require. In developed countries the relatively few people engaged in farming are commercial farmers, and most people buy food with money earned by working in factories or offices or by performing other services.

In developed countries, around 5 percent of workers are engaged directly in farming, compared to around 44 percent in developing countries (Figure 10-6). The percentage of farmers is even lower in North America—only around 2 percent. Yet the small percentage of farmers in the United States and Canada produces not only enough food

for themselves and the rest of the region but also a surplus to feed people elsewhere.

The number of farmers declined dramatically in developed countries during the twentieth century. The United States had about 60 percent fewer farms and 85 percent fewer farmers in 2000 than in 1900. The number of farms in the United States declined from about 6 million in 1940 to 4 million in 1960 and 2 million in 1980. Both push and pull migration factors have been responsible for the decline: People were pushed away from farms by lack of opportunity to earn a decent income, and at the same time they were pulled to higher-paying jobs in urban areas. The number of U.S. farmers has stabilized since 1980 at around 2 million.

USE OF MACHINERY

In developed countries, a small number of commercial farmers can feed many people because they rely on machinery to perform work rather than on people or animals (Figure 10-7). In developing countries, subsistence farmers do much of the work with hand tools and animal power.

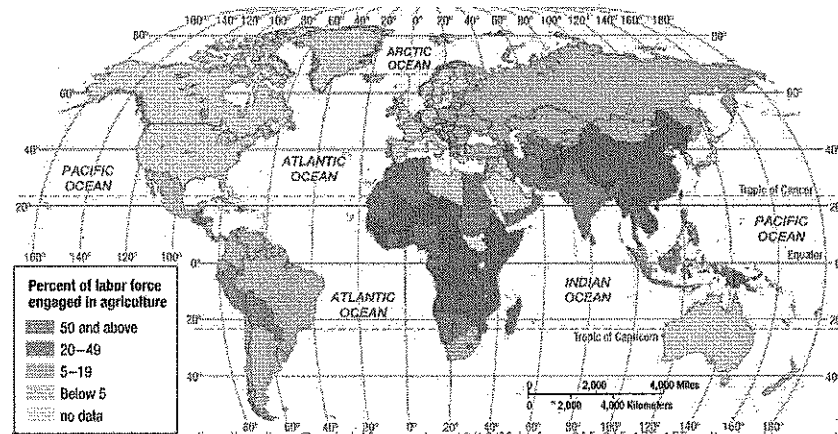
Traditionally, the farmer or local craftspeople made equipment from wood, but beginning in the late eighteenth century, factories produced farm machinery. The first all-iron plow was made in the 1770s and was followed in the nineteenth and twentieth centuries by inventions that made farming less dependent on human or animal power. Tractors, combines, corn pickers, planters, and other factory-made farm machines have replaced or supplemented manual labor.

Transportation improvements have also aided commercial farmers. The building of railroads in the nineteenth century and highways and trucks in the twentieth century have enabled farmers to transport crops and livestock farther and faster. Cattle arrive at market heavier and in better condition when transported by truck or train than when driven on hoof. Crops reach markets without spoiling.

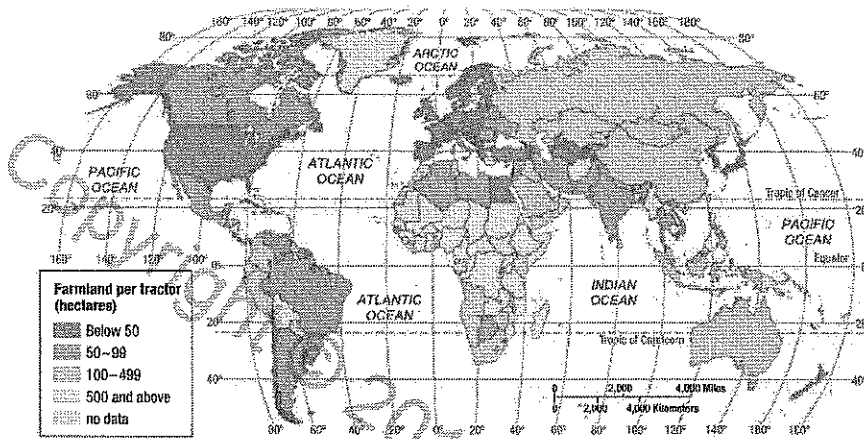
Commercial farmers use scientific advances to increase productivity. Experiments conducted in university laboratories, industry, and research organizations generate new fertilizers, herbicides, hybrid plants, animal breeds, and farming practices, which produce higher crop yields and healthier animals. Access to other scientific information has enabled farmers to make more intelligent decisions concerning proper agricultural practices. Some farmers conduct their own on-farm research.

Electronics also help commercial farmers. Farmers use Global Positioning System (GPS) devices to determine the precise coordinates for spreading different types and amounts of fertilizers. On large ranches, they also use GPS devices to monitor the location

▼ FIGURE 10-6 AGRICULTURAL WORKERS The percentage of the workforce engaged in agriculture is higher in developing countries than in developed countries.



Printed by Jonathan Limre (jonathan.limre@people.k12.nh.us) on 10/13/2014 from 205.215.177.155 authorized to use until 3/27/2020. Use beyond the authorized user or valid subscription date represents a copyright violation.



▲ FIGURE 10-7 AREA OF FARMLAND PER TRACTOR Farmers in developing countries have more hectares or acres of land per tractor than do farmers in developed countries. The machinery makes it possible for commercial farmers to farm extensive areas, a practice necessary to pay for the expensive machinery.

of cattle. They use satellite imagery to measure crop progress and yield monitors attached to combines to determine the precise number of bushels being harvested.

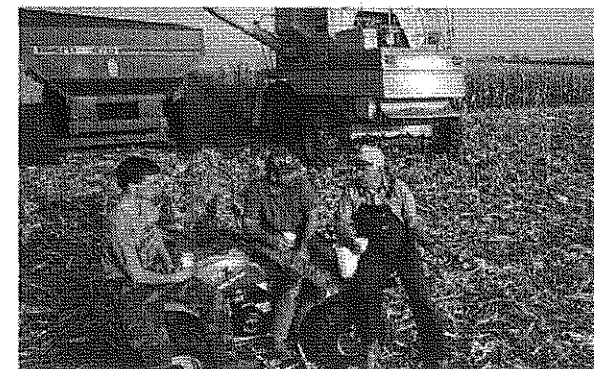
Pause and Reflect 10.1.2

What other electronics, in addition to GPS devices, might help a farmer on a very large farm?

FARM SIZE

The average farm is relatively large in commercial agriculture. Farms average 161 hectares (418 acres) in the United States, compared to about 1 hectare (2.5 acres) in China (Figure 10-8). Large size partly depends on mechanization. Combines, pickers, and other machinery perform most efficiently at very large scales, and their considerable expense cannot be justified on a small farm. As a result of the large size and the high level of mechanization, commercial agriculture is an expensive business. Farmers spend hundreds of thousands of dollars to buy or rent land and machinery before

▼ FIGURE 10-8 FARM SIZE The average size of a family farm in China is much smaller than in the United States. (left) Family farm in Anhui Province, China. (right) Family farm in West Brooklyn, Illinois.



Printed by Jonathan Linne (jonathan.linne@mpfs.k12.mn.us) on 10/13/2014 from 205.215.177.0, authorized to use until 8/27/2020. Use beyond the authorized user or valid subscription date represents a copyright violation.

beginning operations. This money is frequently borrowed from a bank and repaid after output is sold.

Commercial agriculture is increasingly dominated by a handful of large farms. In the United States, the largest 5 percent of farms produce 75 percent of the country's total agriculture. Despite their size, most commercial farms in developed countries—90 percent in the United States—are family owned and operated. Commercial farmers frequently expand their holdings by renting nearby fields.

Although the United States had fewer farms and farmers in 2000 than in 1900, the amount of land devoted to agriculture increased by 13 percent, primarily due to irrigation and reclamation. However, in the twenty-first century, the United States has been losing 1.2 million hectares (3 million acres) per year of its 400 million hectares (1 billion acres) of farmland, primarily because of the expansion of urban areas.

CHECK-IN: KEY ISSUE 1

Where Did Agriculture Originate?

- ✓ Before the invention of agriculture, most humans were hunters and gatherers.
- ✓ Agriculture was invented in multiple hearths beginning approximately 10,000 years ago.
- ✓ Modern agriculture is divided between subsistence agriculture in developing countries and commercial agriculture in developed countries. They differ according to the percentage of farmers, use of machinery, and farm size.



▲ **FIGURE 10-10 AFRICAN FOOD** The girl is carrying cassavas in Tanzania. At home, these roots will be pounded to break up the fibrous texture and cooked into a porridge.

yams. Sugar is the leading source of dietary energy in Venezuela.

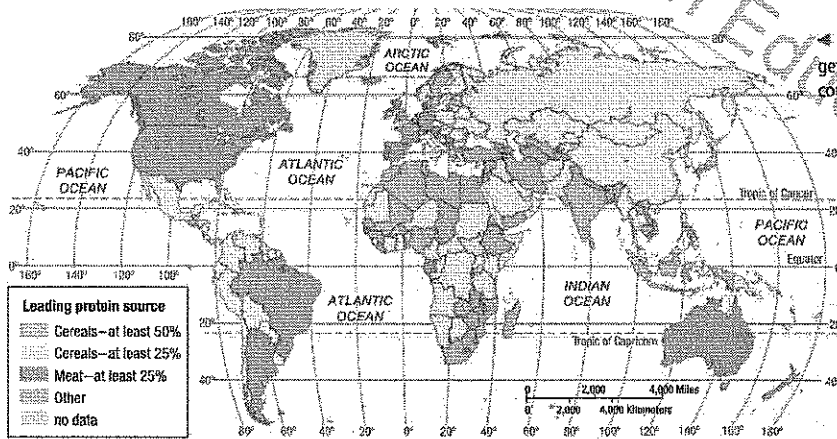
Pause and Reflect 10.2.1

Which of the three main cereal grains is most prevalent in your diet?

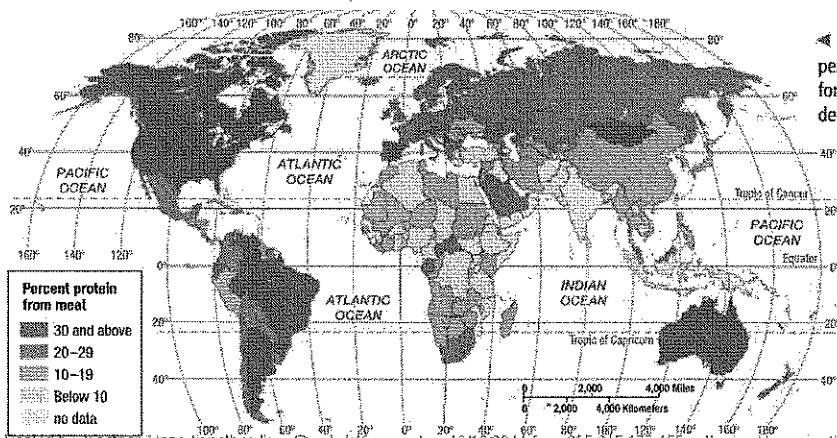
SOURCE OF NUTRIENTS

Protein is a nutrient needed for growth and maintenance of the human body. Many food sources provide protein of varying quantity and quality. One of the most fundamental differences between developed and developing regions is the primary source of protein (Figure 10-11).

In developed countries, the leading source of protein is meat products, including beef, pork, and poultry (Figure 10-12). Meat accounts for approximately one-third of all protein intake in developed countries, compared to approximately one-tenth in developing ones. In most developing countries, cereal grains provide the largest share of protein.



◀ **FIGURE 10-11 PROTEIN BY SOURCE** People get most of their protein from meat in developed countries and from cereals in developing countries.



◀ **FIGURE 10-12 PROTEIN FROM MEAT** The percentage of protein from meat is much higher for people in developed countries than for those in developing countries.

Nutrition and Hunger

Learning Outcome 10.2.2

Explain the global distribution of undernourishment.

The United Nations defines **food security** as physical, social, and economic access at all times to safe and nutritious food sufficient to meet dietary needs and food preferences for an active and healthy life. By this definition, roughly one-eighth of the world's inhabitants do not have food security.

DIETARY ENERGY NEEDS

To maintain a moderate level of physical activity, an average individual needs to consume at least 1,800 kcal per day, according to the UN Food and Agricultural Organization. The figure must be adjusted for age, sex, and region of the world.

Average consumption worldwide is approximately 2,800 kcal per day, or roughly 50 percent more than the recommended minimum. Thus, most people are getting enough food to eat. People in developed countries are consuming on average twice the recommended minimum, approximately 3,600 kcal per day (Figure 10-13). Austria and the United States have the world's highest consumption, approximately 3,800 kcal per day per person. The consumption of so much food is one reason that obesity is more prevalent than hunger in developed countries.

In developing regions, average daily consumption is approximately 2,600 kcal, still above the recommended minimum. However, the average in sub-Saharan Africa is only 2,400 kcal, an indication that a large percentage of Africans are not getting enough to eat. Diets are more likely to be deficient in countries where people have to spend a high percentage of their income to obtain food (Figure 10-14).

Pause and Reflect 10.2.2

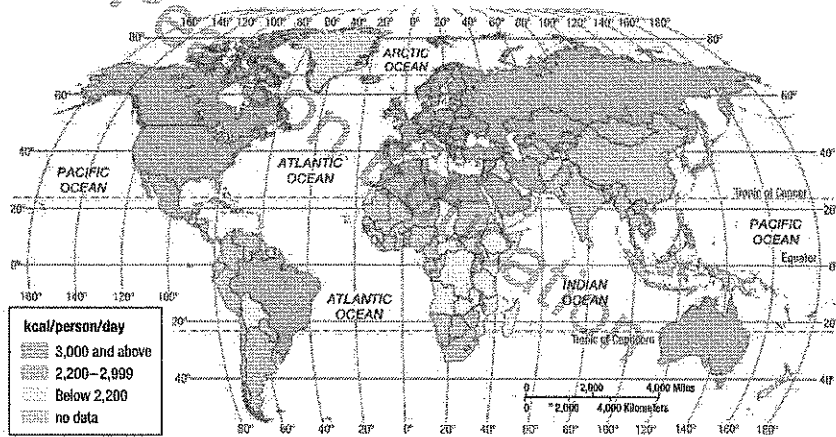
How many kilocalories are in a Big Mac? You can use Google to find the answer. How does one Big Mac compare to the daily caloric intake of the average African?

Printed by Jonathan Linne (jonathan.linne@complext.com) on 08/27/2020. This document is authorized for use until 8/27/2020. Use beyond the authorized user or valid subscription date represents a copyright violation.

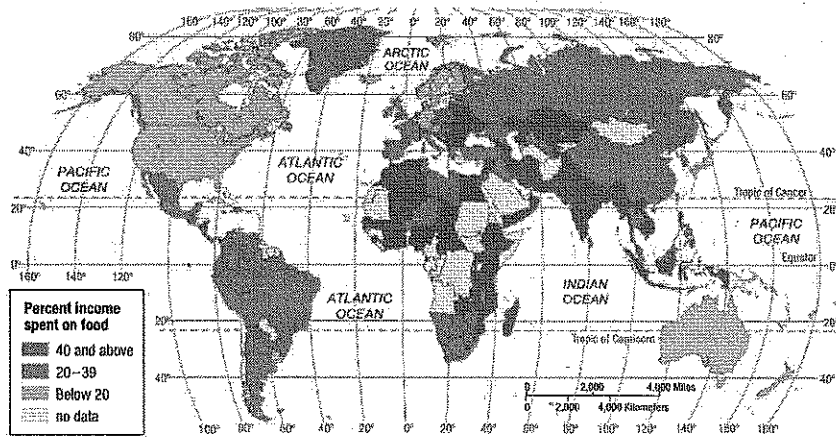
UNDERNOURISHMENT

Undernourishment is dietary energy consumption that is continuously below the minimum requirement for maintaining a healthy life and carrying out light physical activity. The UN estimates that 870 million people in the world are undernourished; 99 percent of the world's undernourished people are in developing countries. India has by far the largest the number of undernourished people, 225 million, followed by China, with 130 million (Figure 10-15). One-fourth of the population in sub-Saharan Africa, one-fifth in South Asia, and one-sixth in all developing countries are classified as undernourished (Figure 10-16).

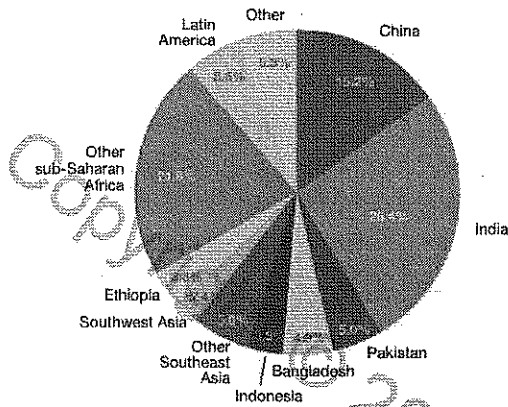
Worldwide, the total number of undernourished people has not changed much in several decades (Figure 10-17). With population growth, though, the percentage of undernourished people has decreased. Among developing regions, East Asia, led by China, has had by far the largest decrease in number undernourished, and South Asia and



▲ FIGURE 10-13 DIETARY ENERGY CONSUMPTION Per capita caloric intake is approximately 3,600 kcal per day in developed countries and 2,600 in developing countries.



▲ FIGURE 10-14 INCOME SPENT ON FOOD People spend on average less than 20 percent of income for food in developed countries compared to more than 40 percent in developing countries.



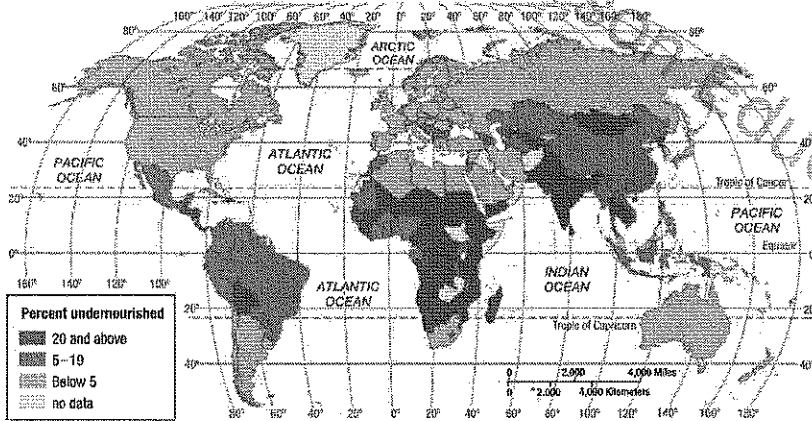
▲ FIGURE 10-15 DISTRIBUTION OF UNDERNOURISHMENT More than half of the world's undernourished people are in South Asia and East Asia.

sub-Saharan Africa have had the largest increases. Southeast Asia, led by Myanmar and Vietnam, has also had a large decrease.

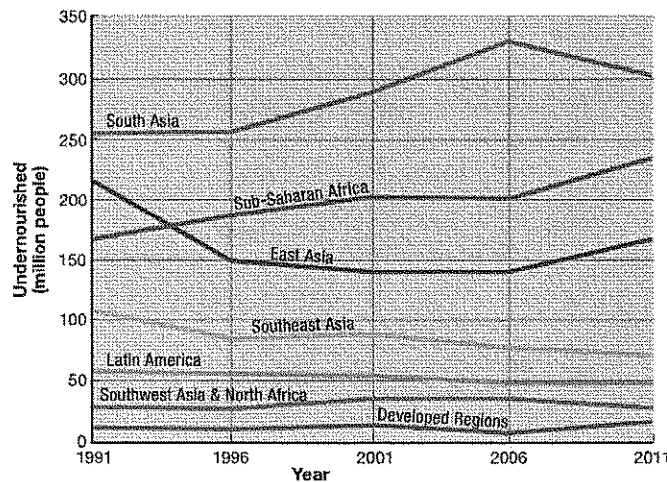
CHECK-IN: KEY ISSUE 2

Why Do People Consume Different Foods?

- ✓ Most food is consumed in the form of cereal grains, especially wheat, rice, and maize.
- ✓ People in developed countries consume more total calories and a higher percentage through animal products.
- ✓ Most humans consume more than the recommended minimum calories, but undernourishment is widespread in Asia and sub-Saharan Africa.



◀ FIGURE 10-16 EXTENT OF UNDERNOURISHMENT Less than 5 percent of the population is undernourished in developed countries compared to 15 percent in developing countries.



◀ FIGURE 10-17 CHANGE IN UNDERNOURISHMENT South Asia has seen the largest increase in number of undernourished people.