# Chapter 4
# Agriculture and Food Production in China and the U.S.

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## 4.1 Introduction

This chapter discusses the main agricultural characteristics of the People's Republic of China (China) and the United States of America (the U.S. or often just "America"). Since these two nations are the two most important agricultural producers on the earth they merit a detailed comparative analysis. The comparison of these two nation's agriculture is not done on a point by point basis because for example the U.S. does not produce tea, silk or cashmere nor rely on rice as a dietary staple and China does not raise bison or avocados. Nor does each nation have a similar geographic distribution of arable lands, although the countries are of similar size. However, the following discussion does cover the spatial distribution and production of important crops raised in each nation and the major issues facing each country in the agricultural sphere. Where there are directly comparable issues and characteristics such as the similarity of the Loess Plateau in northern China and Palouse Plateau in eastern Washington State in the U.S. or the existence of a corn belt in both China and in the U.S. it is noted. There are in fact many similarities between agriculture in the U.S. and China since both nations are the number one, two or three leading producers for a wide range of

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commodities including corn, soy beans, wheat, eggs, pork, cattle and cotton. Both nations face similar issues with loss of high quality farm lands to urbanization and water supply and quality issues related to groundwater overdraft and non-point source pollution. Perhaps the most salient difference is that in China about 300 million people are engaged in agriculture on only about 7% of the world's arable land and produce about 19% of the world's food, supplying most of the needs of about 22% of the world's people. In America, about 2 million people are farmers, ranchers or fishermen (but only 960,000 are solely employed in it). These generally independent farmers have access to about 9% of the world's arable land (the most of any country, China is third after India) and use it to produce about 11% of the world's food. This bounty greatly exceed the needs of about 4.5% of the world's people, the surplus provides a significant proportion of the world's exports of many key crops like wheat, corn and soy beans. From these differences flow many other important characteristics such as the extensive nature and export orientation of U.S. agriculture and the intensive and self-reliant character of Chinese farms.

## 4.2 Agriculture in China

### *4.2.1 The Long History of China's Agriculture*

#### 4.2.1.1 Primitive Agriculture and Traditional Agriculture

The origins of China's agriculture can be traced back 10,000 years. Starting about seven or eight thousand years ago through about three thousand years ago, primitive agriculture was quite widespread. At first, agriculture in China mainly consisted of food gathering and hunting. Farm production formed a pattern that was wheat-dominated in Northern China and rice paddy-dominated in Southern China. Domestic rearing of livestock acted as a sideline to farming. The earliest livestock raised were dogs, pigs, chickens, and water buffalo. Gradually, the society formed a structure of configurative farming and animal husbandry, and produced a stable settled village life based on agriculture. Because of the fertile soil and warm dry climate and availability of rivers for irrigation, the Loess Plateau of the Yellow River (similar in soil and high potential for wheat production to the Palouse Plateau of eastern Washington State) became the earliest region where primitive agriculture emerged. (Lu 1984)

During the "Spring and Autumn" Period (770 BC–221 BC), China entered into the era of traditional agricultural. The characteristics and advantages of traditional agriculture is that by fertilization and intensive cultivation, crop yield per unit of land area is continuously improved with recycling of nutrients and maintenance of soil fertility. With the universal adoption of iron tools and the plow, there was a revolutionary change in China in that human labor was replaced by animal power. With traditional cultivation methods, the land was used with some fields kept fallow

in rotation with those used to grow crops. Green manure crops, especially legumes, were used in this crop rotation.

During this period, China built many famous water conservation and irrigation projects, such as the Dujiangyan Dam in Sichuan Province, the Karezin (called Qanats in Iran and Afghanistan) system in Xinjiang Province, the Great Canal, etc. Karezin are sub-surface channels used to provide a reliable supply of water for human settlements and irrigation in hot, arid and semi-arid climates. The Great Canal is the longest and earliest canal in the world. These projects not only prevented floods by controlling water flow, but also ensured irrigation by adjusting water distribution, which made a great contribution to the development of Chinese ancient agriculture (Zhou 2000).

At the same time, the theory of agriculture was developing rapidly, and people had more knowledge of soil and crops. With horticulture and animal husbandry developing to a considerable extent, man began to alter the natural environment and develop a variety of modes of agriculture.

At the earlier stage of the Traditional Agricultural era, Chinese agricultural production was centered on the Yellow River Basin. However, in the middle Tang Dynasty (618 AD–907 AD), because of war in the north and construction of irrigation projects in the south, the agricultural production center started to shift to the south. After the beginning of the Song Dynasty (960 AD–1279 AD), the middle and lower reaches of the Yangtze River became the new agricultural production center (Zhao and Chen 1999).

#### 4.2.1.2 Modern Agriculture

In order to meet the need of improved living standards and national development, traditional agriculture gradually was transformed into modern agriculture. In comparison with traditional agriculture, modern agriculture was no longer confined to farming and aquaculture. It has extended to include genetics, food processing, and information services, etc. Its continuous development is dependent on investment in new technology. With modern management theory and methods, production efficiency has improved by leaps and bounds.

Since the founding of the People's Republic of China in 1949, with the reclamation of land, redistribution of land to landless peasants, the building of hydraulic engineering works, the use of quality seeds, use of synthetic fertilizers and employment of advanced technologies, the efficiency of land utilization in China has greatly improved. It is a great achievement that China, with only limited and specialized imports of food, feeds 22 % of the world's population with only 7 % of the world's cultivated land. Thus a land once repeatedly scourged by famines (most seriously in 875, 1333, 1810, 1846, 1850, 1873, 1876–1879, 1896, 1907, 1911, 1928–1930 and 1959–1961) that killed hundreds of millions of people and helped seal the fate of several dynasties including the Qing Dynasty in 1912, is now self-sufficient in most foods and a net exporter of some agricultural products. (Sun 2003)

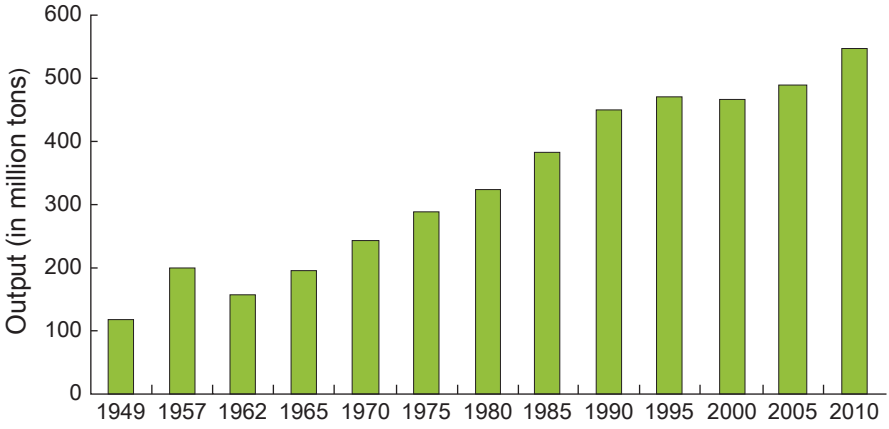


**Fig. 4.1** China's grain output change (1949–2010)

### *4.2.2 The Development and Characteristics of China's Agriculture*

#### 4.2.2.1 The Status of Agriculture

Agriculture is an important foundation of the national economy in China. Since ancient times there has been the argument "Food is the first necessity of man; grain is the first necessity of food". With the largest population in the world, China has a huge demand for food and food issues relate to social stability and the improvement of people's living standards, so that China attaches great importance to agriculture, especially grain production.

The Chinese Government adheres to a food security policy that is based on domestic self-sufficiency; the deficiency in grain production is made up by the proper use of import and export controls. The emphasis on the improvement of agricultural efficiency relies on scientific and technological progress and a national policy that firmly maintains the primary position of agriculture in the national economy. In the past 30 years, more than 20% of the world's growth in production of major agricultural commodities has taken place in China. As shown in Fig. 4.1, China's annual grain production has increased from 300 million metric t (in 1978) to 546 million metric t (in 2010) (National Bureau of Statistics of China 2011). The contribution of food aid to other countries by China ranked only after those of the United States and the European Union. This fact makes China an important force in safeguarding the world's food security. Due to frequent floods and droughts, there have been many periods of famine in Chinese history. But now the security of food supplies makes these famines a historical memory. Since the 1980s, China's grain self-sufficiency rate has always been maintained at more than 95%, which has made a great contribution to safeguarding the world's food supply and stabilizing international grain prices.

**Table 4.1** China's agricultural output and proportion of world's total output (2010)

| Major Agricultural Product | Output (thousand metric tons) | Proportion of World's Total Output(estimate %) | Rank of World's Output |
|---|---|---|---|
| Grain[a] | 546,410 | 22.00 | 1 |
| Pork | 50,712 | 47.34 | 1 |
| Beef | 6,531 | 9.98 | 3 |
| Chicken Eggs | 27,627 | 40.60 | 1 |
| Vegetables | 14,887 | 49.00 | 1 |
| Cotton | 5,961 | 24.10 | 1 |

[a] "Grain" includes "cereals", beans and tubers and "cereal" includes rice, wheat, corn, barley, millet and oats.

With the rapid development of China's agriculture, the output of major agricultural products has grown substantially. Many of China's agricultural products occupy an important position in the world. The production of pork, rice, vegetables, eggs, wheat, chicken, beef and cotton ranks among the highest in the world, as shown in Table 4.1. Along with the advance of globalization, the scale of China's import and export of agricultural products is constantly expanding. It has become one of the major exporting countries for fruit (ranked 1st), garlic (ranked 1st), tomato sauce (ranked 2nd), vegetables (ranked 1st), and tea (ranked 3rd) and the main importing country for soybeans, palm oil, cotton, and corn (National Bureau of Statistics of China 2011).

However, with economic development, China's industrial structure has changed significantly, which indicates that what once was a primarily agricultural country has been transformed into not only an industrial country, but arguably the world's leading manufacturer. The share of gross domestic product (GDP) and the proportion of the labor force employed in agriculture has decreased significantly (Fig. 4.2) since 1952. During the early days of the People's Republic of China (China), the proportion of primary (agriculture and related) industry in overall economy was as high as 51%. However, with the development of modern export oriented manufacturing, the proportion of primary industry has declined and has fluctuated. In the early 1980s, the proportion of primary industry was about 30%, with the proportion declining about 10% every 10 years after that. (China Compendium of Statistics 1949–2008, 2010). At present, the proportion of primary industry (including agriculture, forestry, animal husbandry, fisheries and related services, but excluding the mining and salt industries) accounts for only 10.1% of the total economy in 2010.

Along with the decline of the agricultural component relative to the total size of the entire national economy, the proportion of agricultural employees in the total population is declining. Among the remaining agricultural workers, a considerable number have begun to work away from their homes and have migrated to urban centers to seek employment in manufacturing, construction and service sectors. They spend the slack farming season doing other work. They move to relatively-developed areas and work there in construction, textiles or services industries, which

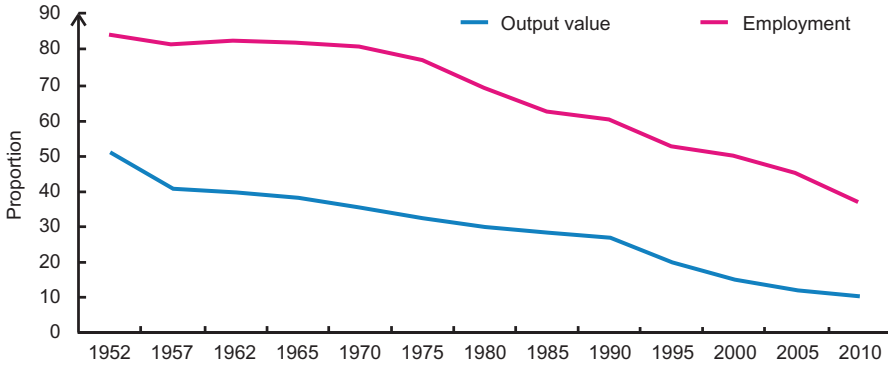


**Fig. 4.2** Proportion of output value and employment of China's agricultural industry

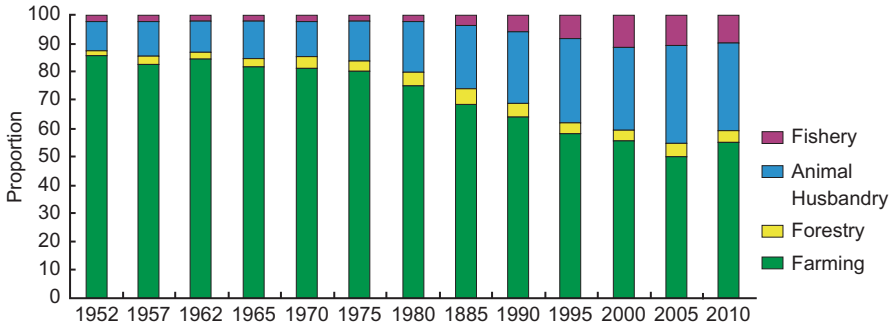


**Fig. 4.3** China's proportions of agriculture, forestry, animal husbandry and fisheries

belong to secondary or tertiary industries. They have formed a migrant worker stream that has flowed out of agricultural regions into economically developed cities and/or eastern and southern areas of the country.

#### 4.2.2.2 Changes in the Agricultural Structure

Accompanied by changes in the national economic structure, the internal structure of the agriculture sector itself has undergone changes (Fig. 4.3). Traditional monoculture agriculture has been transformed into a more complex mix in which agriculture, forestry, animal husbandry and fisheries coexist and develop. Farming accounts for a smaller proportion of the gross output value, while non-crop growing activities share is greater out of a growing value of total production.

Within the farming sector, the proportion of cereal crop acreage is declining, and the proportion of cash crops (such as cotton, vegetables, fruits or oil-seeds) and other crop acreage has increased accordingly. The internal production mix of cereal

crops has changed at the same time: corn production has increased, wheat and rice production have fallen in relative terms, and soybean production has fluctuated. (Liu 1996)

From a national perspective, the proportion of the economy devoted to farming has continued to decline and efficient and economical crop production is becoming the bright spot of this structural adjustment. The traditional timber-production-dominated forestry has started to focus on ecological conservation with sustained yield, multiple use and eco-tourism related forest management practices. With the profit margin for animal products like pork and chicken higher, the proportion of animal husbandry has increased. Fisheries (particularly aquaculture) has developed rapidly and changed from "wild-caught" fishing to "fish farming". In 2010, aquaculture accounted for 71.3 % of the total fisheries production. Some types of aquaculture are export oriented such as shrimp and tilapia production.

The output value of animal husbandry has grown substantially and the production of livestock and poultry has expanded. In 1985 and 1990, egg and meat (pork, beef and mutton) production in China both ranked first in the world. At present, China's per capita meat and egg production have both exceeded the world's average. The outputs of pork and eggs account for about 40–50 % of the total world production respectively. The rapid development of animal husbandry has both prompted, and is in response to, changes in the dietary preferences of the Chinese people. In the past, the proportion of grain and other plant food based calories in the diet was up to 90 %. Over the last 60 years, meat consumption by typical Chinese has increased tenfold. Because of the development of animal husbandry, the supply of animal-based food has increased, which makes a great contribution to adjusting the Chinese people's diet and improving their health and living standards. For example, the stature of young Chinese has increased due to a higher protein diet so that in many cases children are taller than their parents and much taller than their largely rice-fed grandparents. However, there is also an increase in obesity among young people in China, although not yet on an epidemic scale as is the current situation (discussed below) in the USA where about half the population are overweight and one third are obese.

#### 4.2.2.3 Changes in Agricultural Production Conditions

Since the reform and opening up of China starting in 1978, China's agriculture and rural economy have undergone tremendous changes and the production conditions have improved greatly. First, the level of agricultural mechanization has increased annually. According to statistics, the overall use of agricultural machinery has increased by more than seven times. The machine-sowing-and-harvesting acreage has increased every year, especially with respect to wheat, rice and soybean crops. Second, farmland irrigation, water conservation and other infrastructure has been gradually improved. The area of irrigated lands and irrigated areas that use mechanization and have access to electricity has increased significantly. Also, farms have adopted modern farm buildings and processes such as large scale greenhouses and concentrated animal feeding operations (CAFO's) that are typical of modern large scale


**Fig. 4.4** The distribution of high-quality farmland in China

scientific agriculture and animal husbandry practices. The area occupied by greenhouses has increased substantially; mainly these greenhouses are used for growing vegetables, fruits and seedlings. (National Bureau of Statistics of China 2010)

There are about 130 million ha of cultivated land in China, ranking it fourth in the world, with high-quality land only accounting for about 30% of the total (see Fig. 4.4). In recent years, the acreage of China's arable land has been on the decline. On the one hand, with the progress of industrialization and urbanization, the spatial extent of urban areas has grown and most of this growth has been due to the conversion of cultivated land into other uses. The areas such as coastal southeast China with extensive high-quality arable lands also are areas with high population

density and concentrated and rapidly-developing cities. Due to the overlap of these uses, urban sprawl has taken over many farming areas. This has led to permanent loss of arable land. Natural factors are the other main cause of loss of arable land. Land degradation due to desertification, salinization and soil erosion jointly pose a challenge to the preservation of arable land.

Nevertheless many measures are being taken to preserve the fertility of China's scarce arable lands. In different regions various targeted measures are being taken to improve soil fertility, such as use of biological or chemical modification. Crop rotation and conservation tillage is widespread in all regions. In arid and semi-arid areas of Northwest China, sand dunes are being stabilized by the use of shelterbelts. In the Northeast region, eastern plains region and coastal areas, saline-alkali lands are being reclaimed by a combination of biological and chemical methods, which includes the use of modified materials such a green manure, river mud, etc. In the Loess Plateau region, an area beset by severe soil erosion problems, planting trees and grasses, preventing excessive land conversion and reclamation of eroded lands are the main management practices being implemented. In areas such as those with steep slopes, previously plowed or grazed lands are terraced and transformed into orchards or forests and enclosed to limit erosion due to overgrazing and to limit the formation of rills and gullies in bare soils.

In the process of agricultural modernization, China has adopted a unique mechanized model. To solve the contradiction between the small scale of individual farms which are widely dispersed and the economies of scale of centralized mass production using modern farm machinery, the method of Trans-regional Operations of Farm Machines has been adopted. From the south to the north, wheat matures in a temporal sequence as the season advances. So does the appropriate time for harvest. By the trans-regional operations of combine harvesters, a small-scale farm can get temporary access to traveling mechanized harvesting technologies and skilled operators at the optimal time, thus making production both more efficient, intensive and technologically sophisticated. This trans-regional agricultural model was initiated spontaneously by farmers. Some early machine owners helped other farmers, in their village or the surrounding villages, during the busy period for harvest, which could also increase their income. Gradually, agricultural machinery cooperation was established in some places, with organized groups of farmers conducting cross-regional operations from south to north. In this process today, the Government assists in transportation and information sharing. The establishment of agricultural cooperation makes costly farm equipment more fully utilized, the rural labor force more flexible, and the farmers' incomes have also increased. Nowadays, this method has expanded from wheat harvesting to include sowing and harvesting of rice and corn, and other crops.

#### 4.2.2.4 The Life of the Peasants

At present (in 2012), rural households are the key component of agricultural production in China. With a large population and little farmland, Chinese agricultural

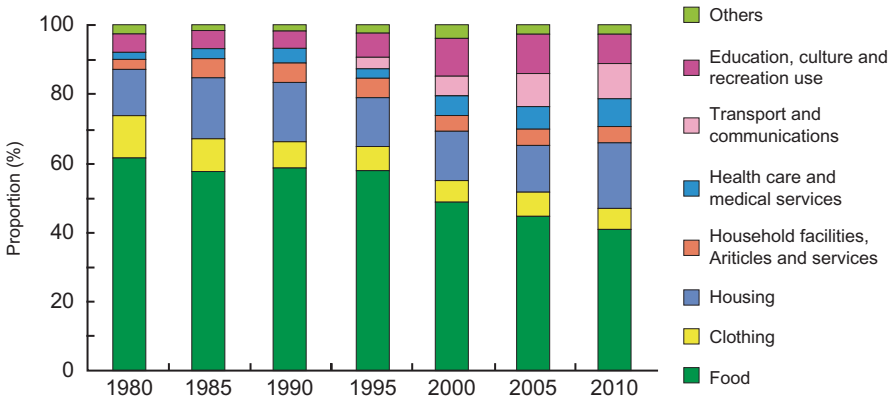


**Fig. 4.5** Chinese rural residents' consumption cost structure (1980–2010)

resources per capita are limited and the extent of rural households' land holdings is small. In China, agriculturalists have the right to the use of the land, but do not have the ownership of the land. The land is publicly-owned. Most agriculturalists have their own housing located on or near their farms or grazing areas, and they cultivate grain or vegetables for home consumption near their houses. In the winter or off season or during other slack periods, some of the younger people in the rural labor force migrate to more economically-developed areas to work supporting their families. In some areas, the proportion of migrant workers is quite large, leaving behind mostly the elderly, women and children in the villages.

Chinese farmers' living standards have improved substantially over the past 30 years. Previously, food income was the farmers' main income, and the income in kind accounted for a large proportion of effective income with little use of cash (and no access to credit). Today, farmers and herders income sources are becoming more market-oriented and more diversified and the structure of family income has changed totally. In 2010, national average rural per capita net income reached 5,919 Yuan (for reference this would have been about U.S. $ 1,100, but with a lower cost of living in rural China, the purchasing power of this income would be closer to $ 4,000 in the USA). However, there are regional differences in the increase in farmers' income. For example, in wealthy Guangdong Province, per capita income of farmers reached 7,890 Yuan, with farmers in Gansu province averaging only 3,308 Yuan. Non-farm employment opportunities in the eastern region make farmers' income in the eastern part of China significantly higher than in the central and western regions. In the meantime, rural residents' consumption structure also has changed. Culture, education and entertainment, healthcare, transportation and communications expenses (and opportunities) have rapidly grown. Housing expenses have remained a constant proportion of overall costs, while food expenses represent a decreasing share of overall family expenses (Fig. 4.5). Life in rural areas gradually has entered into an era of electrification and information technology with access to mass media and cellular communications. Nearly every family has a TV set, and most families have

washing machines and refrigerators. The rate of adoption of information technology equipment, such as telephones, mobile phones and computers, is becoming more and more rapid. (National Bureau of Statistics of China 2010a).

Although the living standards of farmers have greatly improved, there are still large differences between urban and rural areas. In addition, gaps in education, health care, and employment remain and need to be addressed. In parts of China, the living conditions of farmers and herders still need to be improved greatly. Various types of housing exist in rural China, and some are substandard mud brick houses or caves or in some areas temporary movable shelters. These modes of housing are traditional and use local materials, but are not always commodious, comfortable or easy to keep clean. Running water, indoor plumbing, electricity and drivable roads are not available in some rural areas. In the poorest areas, mostly in western China or mountainous areas, living conditions of some farmers and herders are still very primitive and difficult.

### *4.2.3 Patterns of Production*

As can be seen in Fig. 4.6, there is a demarcation between eastern and western China. This division is due to natural conditions, mostly precipitation and temperature patterns. This dividing line has an impact on the level of socio-economic development and dominant agricultural production modes. Thus, there is a distinct farming area in the east and a grazing (or pastoral) area in the west. The eastern area is also more economically developed, diversified and more densely populated (Xu 2002).

#### 4.2.3.1 The Eastern Agricultural Area

The Eastern agricultural area is located in the monsoonal region; the region spans the temperate, subtropical, and tropical zones from north to south. Annual precipitation of the area is more than 400 mm. With more level terrain and fertile soil, the eastern region is more suitable for farming than the western region. For this reason this area is the main production area for food crops such as wheat, rice, and corn. Thanks to its combination of moderate temperatures and adequate moisture, it is the main production area for various cash crops (such as vegetables, tea, fruits, etc.). This is in contrast to the U.S. which borders the Atlantic Ocean, Gulf of Mexico and pacific Ocean each of which has a beneficial influence on temperature and rainfall, this difference and the influence of three major mountain chains accounts for more widely dispersed areas of agricultural production and the absence of a simple demarcation between pastoral and crop dominated areas as in China.

Wheat grows in a wide range of areas in China (Fig. 4.7). Based on the planting season, wheat can be divided into two types–winter wheat and spring wheat. Winter wheat represents the vast majority of production accounting for 90% of the total. The Huang-Huai-Hai Plain is the major producing area of winter wheat. Winter wheat mainly is distributed in Henan, Anhui, Hubei and Jiangsu Provinces and there


**Fig. 4.6** Boundary between eastern agricultural and western pastoral area

is scattered (decentralized) production in the vast areas south of the Qinling-Huaihe Line (Fig. 4.8). Spring wheat is mainly concentrated in the Northeast, Inner Mongolia, some of the oases in Xinjiang Province, the Hexi Corridor of Gansu Province, the Guanzhong Plain in Shanxi Province and other scattered places in areas with cold winter temperatures and adequate soil conditions.

Rice is arguably the most important food crop in China. The Chinese people, especially residents of the south, have the age-old habit of eating rice and foods which use rice as an input (such as rice vinegar, rice flour, rice noodles, etc.). Nowadays, the sown area of rice accounts for about 1/4 of the total acreage of grain crops and the production accounts for about 1/2 of the total national grain output and more

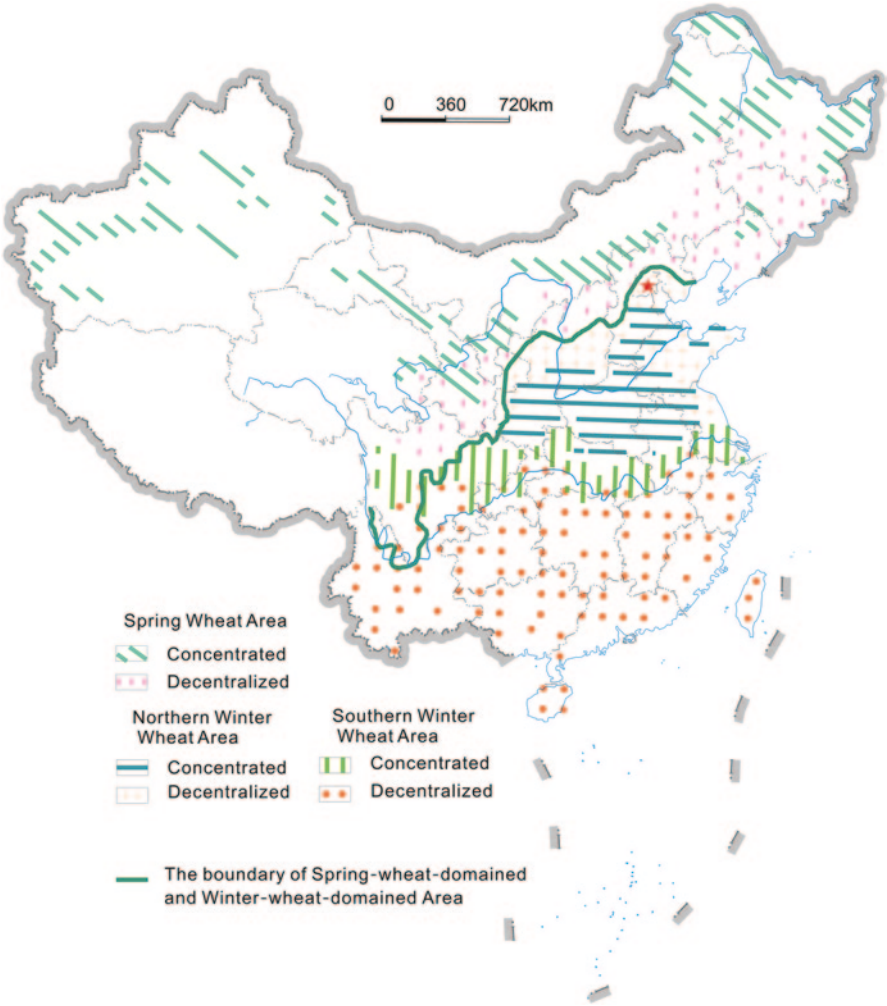


**Fig. 4.7** The distribution of wheat in China

than half of the value of grain sold. The distribution of rice is divided by the Qinling-Huaihe Line. The Yangtze River basin flood plain is the main rice growing area in the south, while rice planting in the north is more widely dispersed. Due to the suitable moisture and temperature conditions, Southern China, including Guangxi, Guangdong, Hainan and other provinces, is the main production area for double cropping (producing two crops per year) of rice (Fig. 4.8).

Corn production is widely distributed in China. The corn production regions extend from the northeast plains to the southwest, forming a "Corn Belt" (Fig. 4.9).

The corn belt in China has a different orientation than that of the USA discussed below and in detail in Chap. 10, but both are of vital importance economically.


**Fig. 4.8** The distribution of rice in China

Heilongjiang, Jilin, Liaoning, Hebei, Shandong, Shanxi, Henan, Sichuan, Guizhou, Yunnan and Guangxi Provinces are the main production areas.

Since the reforms and opening up of 1978, the center of China's food crop production has been moving progressively in a direction from the southeast toward the northwest. Before the 1990s, the focus of the production of food crops was in southeastern China. The southern area has ample water, adequate warmth, and sufficient sunlight and fertile soils. The longer rice growing season and the high yields made it the main grain producing area. With the development of the manufacturing oriented economy in the south, arable land resources have become more valuable and there has been a trend toward use of these scarce resources for freshwater aquaculture, or


**Fig. 4.9** The distribution of corn in China

orchards, vegetable crops and other cash crops (tea, flowers, medicinal herbs, etc.). At the same time, the average area devoted to corn production in the north has expanded gradually. Consequently, the center of food production is gradually shifting to the north and the west.

Eastern agricultural areas include three leading agricultural centers in China: the Northeast Plain, the North China Plain and the Yangtze River region (see Chap. 10). In addition, the southern region is the only area suitable for tropical and subtropical crops such as pineapples, mangoes, tea, etc. It is the most important area for cash crops in China, especially for fruits and sugar cane. It is also the main production base of aquaculture and silkworm rearing for silk manufacture. Farmers in the Pearl

River Delta convert the low-lying land, which is frequently flooded, into ponds in which they can raise fish and shrimp or plant water chestnuts, lotus root and other aquatic crops. Then they pile the sediment and silt which gradually accumulates in the ponds on the embankments, on which they plant mulberries. Silkworms are fed with the mulberry leaves, and the silk produced is used by the textile industry that is also based nearby. These interdependent and synergistic components of the Pearl River Delta agricultural system all form a unique mode of agricultural production with ecologically valuable and sustainable characteristics. With the development of commercial agriculture, the crops grown on the embankments, such as vegetables, fruits, flowers, corn, peanuts, etc. have diversified and their value has increased.

In addition, the Chinese aquaculture industry and fisheries industry are mainly concentrated in the eastern agricultural areas. Coastal areas in this region have well developed marine aquaculture. Marine aquaculture is mainly based on marine fishing. Going from north to south, there are four main fishing grounds–the Bohai Sea, the Yellow Sea, the East China Sea and the South China Sea. China's major rivers all pass through the eastern agricultural area. With the riverine resources, it is feasible to develop freshwater aquaculture. The Yangtze River Delta and the Pearl River Delta are the main aquaculture production areas in China. China has far more widespread aquaculture than the U.S. whose fishing industry is primarily oriented toward wild caught fish from the North Pacific Ocean off Alaska, and to the netting of shrimp in Gulf of Mexico waters (National Bureau of Statistics of China 2010b).

#### 4.2.3.2 The Western Agricultural Areas

The western agricultural area is located in the arid and semi-arid areas of China. Although the soils in this region tend to be infertile, the vast land area of the region provides unique conditions for efficient animal husbandry. In contrast with the concentrated animal feeding operation type of animal husbandry practiced in the eastern agricultural area, livestock grazing and even nomadic herding is dominant in the western agricultural area. Camels and sheep are the predominant species of livestock and the proportions of them in this region are 73 % and 63 % of the national total, respectively. In the alpine pastoral area, yaks and pian-cows (a cross between cattle and yaks) are the dominant species. Wool from sheep and goat wool (cashmere) are produced in this region due to the cold and dry climate and account for about 60 % and 52 % of the national total respectively.

The Inner Mongolia Autonomous Region is in the transition zone from the eastern plains to the Mongolian plateau and it is located between the semi-arid and arid regions. With low rainfall and large variability from year to year, adequate moisture for agriculture is an issue. Annual rainfall decreases from the east to the northwest. Because of the insufficient rainfall, crops in this area are only harvested once a year. However, the vast grasslands provide good conditions to develop a mixed agricultural model combining farming and animal husbandry. The northern part of

the region is dominated by pastoral areas, the central part is characterized by farming and pastoral areas, and the southern part is where agricultural areas are most prevalent. Dry land farming dominates the area, with cereals, flax and sugar beets being the main crops grown. In agricultural areas, the cultivated land is extensively farmed with low yields per hectare. Nonetheless, the grassland area in this region ranks first in the country. The eastern area of Inner Mongolia contains a high quality meadow steppe and grass fed animal husbandry occupies an important position here and therefore in China as a whole. Wool and cashmere and dairy foods are the main products (Sun 2003).

The climate of the Northwest portion of China (Xinjiang Province) is arid or drought prone, so that irrigated oasis-type agriculture and grazing herds in the desert are the major agricultural activities. The region possesses rich potential solar energy resources and the temperature conditions are in the most part suitable for agriculture. With intensive solar radiation and low relative humidity, diurnal temperature variations are very large (on the order of 12–16 °C) during the growing season. But the combination of sunlight, temperature, and soil moisture and soil fertility is not ideal for crops. The distribution of agriculture depends on water availability. Water is mainly obtained from the sparse rainfall on the windward slopes and from glacier melt water in streams that run off the mountains. If there is no irrigation, then there is basically no agriculture. There is only a small amount of dry land that is farmed in a few higher elevation areas of the foothills, but the production there is much lower than the irrigated low land (often below sea level) areas. The Hetao Plain, Hexi Corridor and the Yili region are the centers of wheat production in the area. The characteristics of animal husbandry in the desert area are nomadic and seasonal. In the winter, pastoralists graze their herds in the warmer lower elevation plains or basins, and in the summer they move to them to lusher mountain pastures. In addition, south Xinjiang is a major producer of high quality long-staple cotton; therefore this area is one of the three most important cotton producing centers in China. China is in turn the World's leading producer of raw cotton and cotton textiles.

The Qinghai-Tibet area is an important production area for grazing animals and forest resources. High terrain and low temperatures are its main natural characteristics. Most of the region is frigid and only suitable for thick coated grazing animals like sheep, goats and yaks. The southeastern portions of the region which have elevations of less than 4,000 meters above sea level can sustain hardy crops like potatoes and barley while thermophilic crops such as corn and rice can be planted only on the southern edge of the region in the valley bottoms of the Nien-ch'u River, Lhasa River and Chayu River. The main crops in this region are cold-resistant crops such as barley, wheat, peas, potatoes and rape seed (canola), which is cold tolerant when mature. Animal husbandry mainly relies on natural grasslands. Though underdeveloped and conducted on extensive unfenced lands, animal husbandry is still an important sector in this area in sustaining the sparse population, some of whom are semi-nomadic. In this area livestock with alpine characteristics, such as yak, Tibetan sheep, Tibetan horses, and cashmere goats are common.

### *4.2.4 Major Issues Associated with Chinese Agriculture*

In the context of global climate change and global economic integration, China's agriculture is facing some new challenges. At present, China is committed to a targeted process to address these issues, in order to promote sustainable agricultural development.

**Issue1: Loss of agricultural land resulting from urban sprawl** The expansion of most cities in China as in the U.S. is through the conversion of cultivated land on the margins of existing urban areas. Arable land in China has been reduced from approximately 130 million ha in 1996 to about 122 million ha at the end of 2010. The overlap of high-quality farm lands and urbanized areas has resulted in an obvious contradiction between the protection of farmland and the promotion of urban development, especially in northeastern China and southeastern coastal areas.

To solve this problem, the Chinese government has initiated efforts to improve land management laws and regulations, such as strictly enforcing the system of farmland protection, the introduction of a balanced system of requisition-compensation for farmland and the introduction of a land use control system. Also China has initiated the development of a comprehensive industrial policy that includes preservation of farm land as an objective. In addition, China attaches great importance to the development and reclamation of arable land reserve resources and efforts to improve efficiency of the use of resources. (Zhao and Chen 1999). This is also a major issue in the U.S.

**Issue 2: Agricultural inefficiency resulting from small-scale of operators** Since 1978, the implementation of the household contract responsibility system caused the development of scattered, small-scale production problems. Due to limited funds available to individual farmers, there are difficulties in purchasing efficient farming machinery, in constructing water conservation facilities or introducing advanced farming techniques. To solve these problems farmers spontaneously created local farmer organizations. Then a large-scale, industrial agriculture management model led by the government was introduced, which has improved land use efficiency and enhanced the market competitiveness of agricultural products. However, the overall level of adoption of economies of scale in agriculture has not greatly improved. In recent years, China has promulgated a series of policies to promote larger scale agriculture and industrial management. For example there are now resources available for the support of large enterprises which can help farmers in the construction of processing and distribution facilities for more efficiency. Also the government has been providing a variety of means to train farmers in modern scientific agricultural practices. This is not an issue in the U.S. where most farms are large scale although in many areas marginal farms of small size have disappeared either reverting to forest as in Appalachia and New England or being merged into larger scale successful farms.

**Issue 3: The contamination and degradation of agricultural lands** According to incomplete statistics, China's contaminated arable land is as much as 10 million ha which is about 10 % of the total. The pollution sources are various. Factories directly discharge toxic sewage and waste onto cultivated lands. Peasants use large amounts of chemical fertilizers and increasing quantities of synthetic pesticides. Over the long term these can build up in the soil and in aquatic ecosystems. Used mulches build up in agricultural soils. These organic materials can lead to soil compaction, hardening of the soil and the loss of fertility. From these and other processes soil degradation can occur and the productivity of contaminated land therefore declines.

China has made sustained efforts to solve the soil pollution problem in various ways. Public education efforts and outreach to farmers have been aimed at increasing environmental awareness. Laws have been developed and implemented to control pollution of farmland. In addition, soil testing and proper fertilizer use is widely promoted; the application of organic fertilizers has become increasingly common; the areas using green manure and returning straw to the soil have been greatly expanded; the use of appropriate levels of pesticides and use of plastic mulching to conserve water and reduce pests are increasingly implemented by farmers today (Sun 2003).

**Issue 4: Agricultural water conservation** China's water resources are as scarce as arable land resources; especially in arid areas, there is a sizeable gap between demand and available water. The annual consumption of irrigation water in China is about 4,000 billion $m^3$, accounting for about 60 % of the country's total water consumption. As a result of adoption of better irrigation methods, more crops are being produced today with only a modest increase in irrigation water consumption. However, waste of agricultural water still exists, mainly due to two factors. First, the utilization coefficient of irrigation water is low; the effective utilization of agricultural water use is only about 43 %, and the channel water conveyance losses accounted for more than 80 % of the irrigation water loss. These losses are due to seepage of water from unlined channels and evaporation of water from canals, reservoirs and other water bodies. Some of the water losses due to seepage can be regained in the form of recharge of groundwater aquifers. Second, the irrigation quota is generally high; in the traditional mode of furrow irrigation, actual irrigation deliveries are double the water actually required. This over irrigation does have the advantage of reducing the likelihood of salinization of the soil since it tends to flush out salts before they can accumulate.

Today agricultural water-saving systems have been constructed to alleviate water shortage and reduce waste. Mostly these technologies have been incorporated into irrigation projects. The methods used include low-pressure pipe irrigation techniques, sprinkler irrigation, micro-irrigation, impermeable membrane channel irrigation and improvements in traditional furrow irrigation methods such as better irrigation scheduling. Like urban sprawl, water conservation and pollution is a major and perhaps the single most important issue facing U.S. agriculture.

## 4.3 Agriculture in the U.S.

### *4.3.1 The Short History of Agriculture in the U.S.*

In contrast to China, a land where agriculture dates back at least six millennia, most of what is now the United States lacked organized large scale agriculture until the last few centuries and in some areas like the "High Plains" (see Chap. 10), it was not until the later part of the 19th century that organized agriculture developed. An important exception to this rule is in parts of the Mississippi Valley including parts of the Midwest "Corn Belt" where Native American societies such as the "Mound Builders" grew crops in areas with rich soils subject to periodic flooding. While the agricultural systems of indigenous tribes were rather primitive, the crops they raised including maize (corn), amaranth, squash, beans, chilies and potatoes were to become staples in many other parts of the world (Silverberg 1968). Not all of these "New World" crops were raised in what was to become the United States, but corn was an important early crop and one that continues to be associated with American agriculture and is currently the most valuable crop grown in the United States (Almanac of American Agriculture 2011).

Europeans first settled in what would become the United States (U.S.) in the tidewater areas of the mid-Atlantic states and New England, later immigrants moved into the coastal plains, the piedmont of the Appalachian Mountains with a few hardy souls like Daniel Boone moving through passes in this major mountain range of the eastern U.S. and into the Ohio and Tennessee River valleys. From there and from the river systems draining into the Great Lakes, settlers moved into the interior regions of the U.S. The interior regions of the U.S. did not see dense settlement except for small trading centers and a few cities such as Saint Louis and New Orleans situated along rivers, until the early years of the 19th century. At that time waves of immigrants from farther east began to push into areas such as Illinois and Iowa. These areas became States in 1818 and 1846 respectively, the date of statehood indicating they had a moderate and stable population. For example, Iowa had 46,000 citizen residents in the Census of 1840. These early settlers were mostly of English, German, Scottish or Irish extraction with most having come from the Northeastern states or Canada and they were mostly small independent farmers who cut down the forests present along river courses and used the logs to construct cabins. These pioneers planted a mixed crop of corn, wheat, and vegetables supplemented with orchards and livestock, particularly pigs and chickens. They found the prairie soils to be dominated by deep mollisols that sustained bumper crops from the outset of agriculture and did not lose fertility rapidly unlike areas with thinner soils further east in the Appalachian Mountains which most settlers had crossed to reach the area (Harding 2009).

In contrast to the Corn Belt of the Midwest (see Chap. 10), the High Plains of Kansas, Oklahoma, Northern Texas, Nebraska and parts of states like Wyoming, Colorado and New Mexico were a harsher environment. Rainfall was less plentiful,

native peoples had not built permanent settlements by in large but were nomadic following vast herds of bison and large numbers of elk and antelope and often raiding settled tribes and later European settlements. Tornadoes, hail, grass fires, swarms of locusts, hot dry summers and frequent periods of prolonged drought and harsh winters with unending wind and occasional blizzards all tended to retard settlement. Also surface water was not always available and little stone or wood for building fences or homes was available. Thus many early settlers built homes out of adobe (mud bricks) or sod. However, the prairie soil was, once it was plowed with strong steel plows that began to become available, capable of yielding a good crop of wheat when rains were favorable. The scale of farms and ranches was often vast and reapers pulled by teams of as many as 20 mules were invented to take advantage of the extensive flat acreage of farms. Also innovations such as barbed wire, which allowed exclusion of herds of cattle, better firearms, the advent of railroads, and the invention and perfection of the windmill all made settlement more feasible. Many would argue that the simultaneous near extermination of the bison and the almost complete relocation of the Plains Indian tribes created the favorable conditions for settlement by Europeans of the High Plains by the late 19th century (Hornaday 1889).

Another agriculturally important region especially for specialty crops such as grapes, vegetables, fruits, citrus, cotton and rice is California which has a warm dry climate with numerous rivers bisecting a great Central Valley. California has a different history from other agriculturally important regions, having first been settled in the 17th century by Spanish colonists who raised cattle for export of hides and tallow and they planted vineyards and fruit orchards. In 1848 gold was discovered and a huge influx of population followed as did rapid development of railroads and cattle ranching particularly in the Central Valley. Later in the 19th century a citrus industry developed in Southern California and a fruit raising industry in central and Northern California including in the area of Santa Clara County that is now referred to as Silicon Valley. Besides the Central Valley, the Napa Valley is an important agricultural region noted for vineyards. California has many specialty crops like artichokes, almonds and avocados.

## *4.3.2 The Development and Characteristics of American Agriculture*

### 4.3.2.1 America's Agricultural Regions

The United States is the world's third largest nation (China is the fourth largest). In such large countries there are many and diverse agricultural regions as well as many areas that lack agriculture entirely. In the USA, the most important agricultural regions include the coastal plain of the Atlantic Ocean and Gulf of Mexico, noted originally for tobacco production and today also for corn, swine and poultry production. The Florida Peninsula (noted for citrus crops that freezing temperatures

elsewhere endanger) is another import region. The region with the greatest value of crops is the Central Valley of California; this is because, although relatively small in area, it produces many high value specialty crops such as fruit, nuts and vegetables but also significant amounts of cotton. These regions, though important economically, are more specialized than the two great cereal growing areas of the United States: the Corn Belt of the Midwest and the Great Plains of which the High Plains is a part. Both of these regions are discussed in detail in Chap. 10. Also important is a less well defined region which could be termed the Mississippi Valley, this is an important area for soybeans, as well as corn, and rice and cotton. Many parts of both the High Plains and Corn Belt are inside the drainage basin of the Mississippi River, but this is an area covering more than a third of the U.S. Thus, it ranges in climate from sub-tropical (in Coastal Louisiana) to sub-arctic (at high elevations in Wyoming and Montana). However, the areas in Eastern Arkansas, Northern Mississippi, Missouri and parts of Louisiana that have rich soils and abundant rainfall are the most important agriculturally and are a center of soybean and cotton production. This chapter provides a broad overview of agricultural regions and a geographic portrait of the diversity and distribution of agriculture in America. The High Plains region is most noted for wheat production, the Corn Belt, is as the name implies, famous for corn. Since these cereals are the basis for animal feed, both regions are famous for production of livestock, with the Corn Belt best known for swine and the High Plains best known for cattle production. The map of the conterminous U.S. in Fig. 4.10 shows these two agricultural regions highlighted with the States that contain them labeled. It also shows various other specialized agricultural regions. These delineations are somewhat generalized.

#### 4.3.2.2 Major Agricultural Production Areas in America

North America and the United States of America specifically is blessed with a very diverse range of climatic and physiographic settings that allows many types of crops and animal products to be produced under good and in some cases nearly ideal conditions. Agriculture in the U.S. is generally conducted by large technologically and financially capable corporations and by family farms that have grown and adapted for generations. For example, the Gallo family vineyard in California has over five generations grown to become the largest wine producer in the world. This means that agriculture is conducted on a vast scale with specialization of farming and ranching and animal husbandry into spatially defined areas where only a few crops are raised with large inputs of capital and technology. These major agricultural regions may raise more than one crop or type of crop but many can be characterized by the dominant crop. Thus the Snake River Valley of Southern Idaho is ideally suited due to climate, soil, availability of water and cost of land to growing potatoes. The Wenatchee, Yakima and Chelan Valleys of the Eastern side of the Cascade Mountains in Washington State are ideally suited by climate, elevation, drainage and other factors to produce apples. The Indian Coast region of the Atlantic seaboard of Florida is ideally suited for growing grapefruit and central

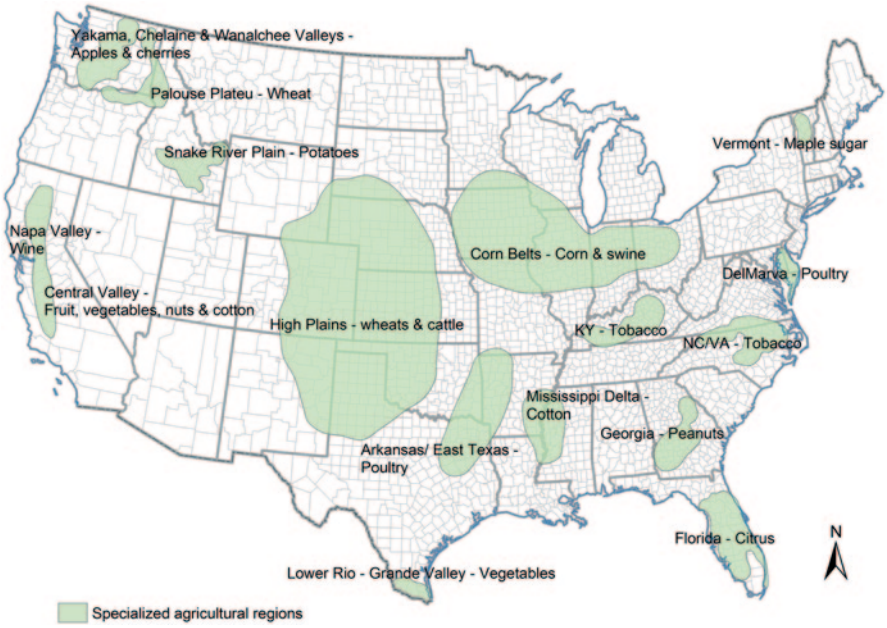


**Fig. 4.10** Major specialized agricultural regions of the conterminous U.S. Key areas noted for production of specific crops are delineated and labeled

Florida generally is very well suited, except in some swampy areas, to produce citrus crops largely due to the rarity of freezing weather. This is akin to areas in Fujian being most suitable for tea cultivation. But in the American context the degree of monoculture is greater in many of these regions. Some other crop growing regions are more diverse, so the "Corn Belt" is an area that also has many soybean farms or may grow soybeans in rotation with corn on the same farm. The abundance of corn in the Corn Belt means that swine and dairy cattle production is also common in this region. An area which is both diverse and specialized in terms of agricultural production is the Central Valley of California. This area is blessed with an equitable climate with dry sunny days and abundant runoff from rivers draining the Sierra Nevada Mountains. It is the center of vegetable production in the U.S. but also leads in many types of fruit and nuts. Generally, the quality of the soil and other aspects of the farmland and climate in the Central Valley mean that high value crops are dominant in this region. There are other areas besides the Central Valley with warm sunny weather, rich soils and extensive irrigation that produced bumper crops of fruits and vegetables. These areas include the lower Rio Grande Valley in Texas which is one such area famed for grapefruit but also noted for onions and other vegetables. The Central Valley of California and Rio Grande Valley produce considerable volumes of cotton, but the Mississippi Delta is more famous as a cotton producing region, farther upstream in Arkansas is the largest rice producing region

in the U.S., although the delta of the Sacramento River in California also produces rice. The High Plains is the heart of the wheat production area in the U.S., but large scale production occurs farther north in North Dakota and South Dakota. Another famed wheat production region is the Palouse Plateau of Eastern Washington State, an area with some of the highest yields of wheat in the world. This area is dominated by windblown loess type soils. In this it is akin to much of the interior of northern China and the area likewise also suffers high rates of erosion. In addition to areas such as the Central Valley of California, the High Plains and the Corn Belt that raise a fairly diverse range of crops, there are many productive regions that are more highly specialized. In general, climatic factors account for the preponderance of one crop or another in these regions.

In the Hawaiian Islands, there are three areas that are highly specialized. One is the Kona Coast on the well-drained steep slopes of the Mauna Loa Volcano on the West Coast of the big island of Hawaii. This area has rich well drained volcanic soils, a tropical climate and heavy rainfall that is ideal for coffee trees. This is essentially the only area in the U.S. where coffee trees can grow and the coffee that is raised there on small farms is very expensive selling for many times average coffee prices. On the other dryer side of the island in the rain shadow of a volcano is an area where the macadamia nuts are grown. (Kona Coffee Council 2011).

Although Florida is not tropical, but sub-tropical, it has a very temperate climate with abundant rainfall and infrequent freezing weather. This makes it suitable for citrus crops. The citrus region of Florida includes the central portion of the peninsula as well as a band along the coast including the Indian River area noted for grapefruit. Florida also produces oranges for juice, limes and tangerines. The citrus industry in Florida in 2010 produced fruit that was worth over $9 billion and directly employed 76,000 people (Florida Department of Citrus 2011) However, citrus production in Florida is declining with acreage falling from over 800,000 acres in 1970 to 500,000 in 2010. Much of the reduction has been due to conversion of orchards in central Florida into residential areas particularly around Orlando, home of Disney World. Another area that produces grapefruits as well as other vegetables particularly during the winter months is the region of southern Texas along the Rio Grande River. Unlike Florida which receives plentiful rainfall, this region is dry. But the large river that marks the border with Mexico provides irrigation water for the many crops and orchards that are found in the alluvial soils in the lower portion of the Rio Grande Valley which is also an important area for production of winter vegetables.

California is another state that benefits from a temperate (in some areas subtropical, in most Mediterranean) climate. The state is in general dry but the 4,000 m peaks of the Sierra Nevada Mountain range create a great climatic difference between the arid eastern portion of the state and the wetter western portion. However, there is generally not sufficient rainfall to grow the intensively raised crops found in the Central Valley. These crops depend of irrigation derived from the network of rivers that drain the Sierra Nevada. An extensive network of reservoirs and aqueducts connect the dryer southern portions of the State with water sources in the north and east of the State including the Colorado River that is fed by snow melt

in the Rocky Mountains as much as 2,000 kilometers to the north east. The dry climate in the Central Valley and other agricultural areas is in fact an advantage in many ways since it reduces pests. The Central Valley is actually composed of two large valleys with an area of about 58,000 $km^2$ that converge and have a single outlet into San Francisco Bay. They are the Sacramento Valley to the north and the San Joaquin Valley to the south. The value of agricultural production in the million hectares of agricultural land in these valleys totals over $ 20 billion and is about 8% of the value of total U.S. agricultural production. There are other areas in California like Monterey and Salinas, Southern California and the Napa Valley that add an additional $ 10 billion in production. Overall California is responsible for 14% of national agricultural production. Many of the crops that California is dominant in are high value specialty crops. Thus California in general, and the Central Valley in particular, are leaders in production of almonds, pistachios, olives, onions, peppers, cotton, artichokes, asparagus, spinach, lettuce, strawberries, celery, plums, peaches, pomegranates, oranges and grapes. Also vegetables eaten by ethnic groups are a California specialty, so crops like bokchoy, lemon grass, persimmons, jujube, sapote and bitter melons are raised in California (Umbach 1997). In addition to the Central Valley, California has another famous agricultural valley, the Napa Valley in Northern California noted for vineyards. Just as California is home to several major agricultural regions, it is the location for many specialized micro-climates created by a combination of proximity to the Pacific Ocean and many topographic features. One coastal area in Monterey County near Castroville is ideal for artichokes, another coastal area in Ventura and Santa Barbara counties is ideal for lemons and avocados although avocados in Santa Barbara county have had to compete with housing for millionaires and movie stars and special land use zoning and tax regulations have helped to maintain the avocado industry in towns like Carpenteria in this county. Other California towns are noted for plums, olives, raisins, broccoli and garlic and even in the arid and hot area of eastern California that is near or below sea level dates are produced in Indio while in the far north horse radish production is centered in Tule Lake and blackberries in McCloud. Many of these communities have annual festivals and feature their status as “world capital” of this or that product in their towns’ self- identification (see Fig. 4.11).

Other areas in the Western U.S. produce wines including areas in Washington State, but the mountain valleys of the Yakima, Wenatchee and Chelaine areas on the eastern side of the Cascade Mountains in Washington State are most famous for supporting production of apples and sweet cherries. Elevations of orchards range from 250 m to almost 1,000 m in this region. Apple orchards in this area occupy 175,000 acres and employ as many as 45,000 pickers at the peak of the harvest season in the fall. Many apples are put in cold storage and shipped out of the U.S. to world markets (Washington Apple Commission 2010). The migrant pickers generally have to travel long distances to follow the crops that are ready to be picked at different seasons, some may travel from Florida in the South-eastern edge to the U.S. to pick oranges all the way to Washington State in the Northwest corner of the country to pick apples in the Yakima and other valleys. These mountain valleys have cool and dry weather but do not have late freezes which can kill the buds on

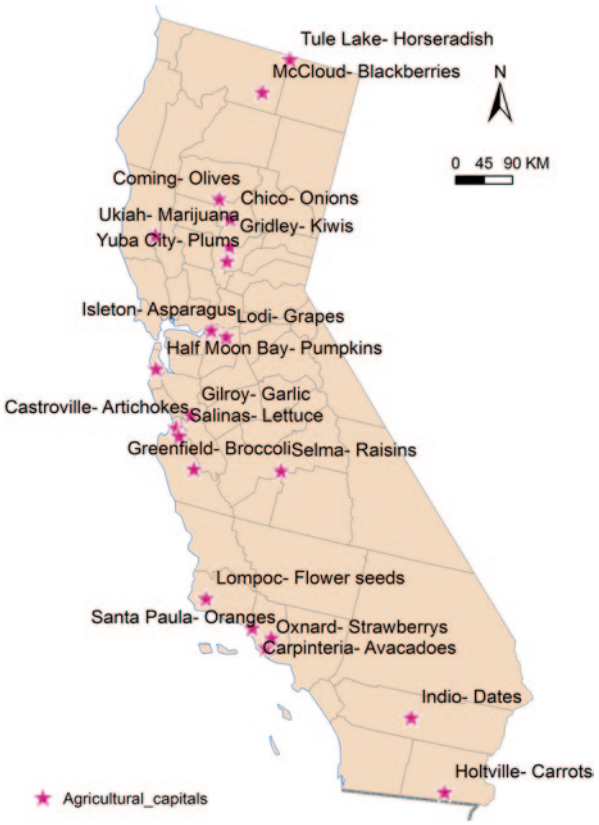


**Fig. 4.11** Map of California specialty crop centers. The Central Valley produces vegetables, fruit, nuts, cotton and rice also

orchard trees before they can set. Eastern Washington State is also an important area for wheat. In particular, the Palouse Plateau is a major wheat growing region. The rain shadow of the Cascade Mountains produces a dry climate. Also in this region loess soils like those in Northern China yield some of the greatest harvests per hectare of wheat on the planet.

The neighboring State of Idaho is famous for potatoes. In fact the state automobile license plate bears the motto: Idaho—Famous Potatoes. The sandy soils of the Snake River flood plain and dry climate with abundant water available from diversion of rivers running off nearby mountains and a cool climate are ideal for production of potatoes, particularly the russet variety. Recently dairy cattle production has increased in Idaho, partially as a result of dry climate and proximity to crops like alfalfa which is used for cattle feed. Alfalfa does well in alkaline soils in the semi-desert areas.

Farther east and south of Idaho, the High Plains is dominated by wheat and cattle as well as some production of corn and cotton. The surplus of grain generated in the High Plains is often used to feed chickens that have become dominant in the State of Arkansas and neighboring portions of north eastern Texas and eastern Oklahoma. Various factors have led to the development of huge chicken concentrated animal

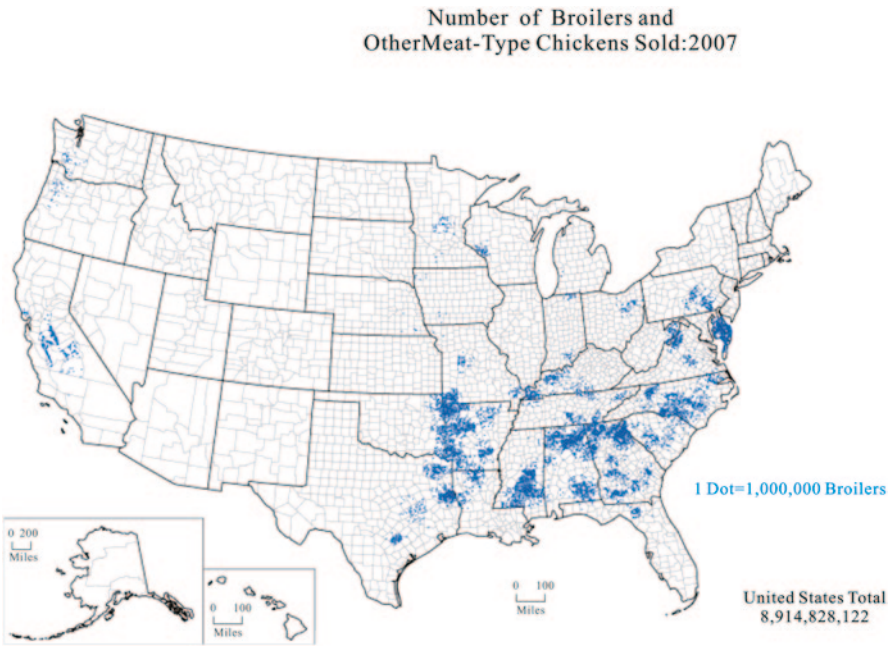


**Fig. 4.12** The concentration of chickens (each dot equals 1 million birds) in the south-eastern U.S. is notable, proximity to feed sources and a limited frigid days helps explain this. Note: broilers are chickens raised for meat. (Courtesy: USDA 2007 Census of Agriculture http://www.agcensus.usda.gov/Publications/2007/index.php)

feeding operations (CAFO's) in these states dominated by firms such as Tyson Foods and Pilgrim's Pride and Sanderson Farms. A map of U.S. poultry production for broilers (birds used to produce meat rather than lay eggs) is shown in Fig. 4.12.

Farther east in Arkansas along the Mississippi River is a center of rice production. In the U.S., rice production is limited and although rice is not a staple of the diet of most people in the U.S. it is growing in popularity especially among immigrants. The U.S. is a net importer of rice, especially from the Indian sub-continent and Thailand. Nevertheless, rice is grown in parts of the southern U.S. such as Texas, Louisiana, the Mississippi Delta, as well as the Sacramento Delta of California (Fig. 4.13).

The greatest extent of rice production is in the southeastern portion of Arkansas and the western portion of Mississippi, these areas are termed the Mississippi Delta region. This region is famous for cotton production. It is notable that this region although fertile and productive for agriculture is one of concentrated poverty. Perhaps this is due to a concentration of land ownership. Cotton is a plant that takes a toll on the fertility of soils and the deep alluvial soils of the Mississippi Delta has been able to sustain cotton after other regions that grew cotton switched to other crops.

Further north in the Mississippi River drainage basin in the State of Missouri and neighboring regions of States such as Illinois and Iowa and as for north as

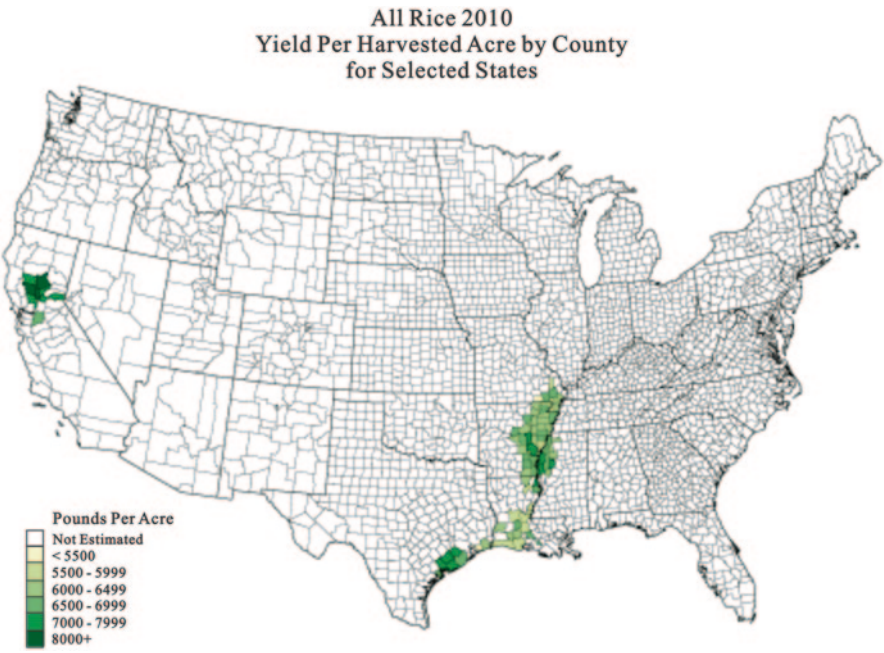


**Fig. 4.13** U.S. Rice production in 2010. The three main rice growing areas are the Mississippi Delta region in Arkansas and Mississippi, the coastal regions of Texas and Louisiana and the Sacramento River Delta region in California. (Courtesy: USDA 2007 Census of Agriculture http://www.agcensus.usda.gov/Publications/2007/index.php)

the Dakotas is the center of U.S. soybean production (Fig. 4.14). Soybeans are the second most valuable crop produced in the U.S. Soybeans are frequently grown in rotation with corn and are found in parts of the corn belt but also are grown farther south along the Mississippi River and its tributaries as well as farther north into regions of North and South Dakota. In 2010 a total of 90 million metric t of soybeans were raised on over 30 million ha in the U.S. The value of production in 2010 was $ 37.6 billion. Although production in 2011 is estimated to have declined due to drought, prices for soybeans have increased and estimates of revenues are higher for 2011 at $ 40.2 billion. Of the total U.S. soybean production 45 % was exported in 2011. The top soybean export market was China with exports of 895 million bushels. U.S. soybean production is not increasing as much as corn production and it is expected that Brazil will eventually overtake the U.S. as the world's top soybean producer (Figs. 4.14, 4.15 and 4.16). One of the other crops that farmers in the southern U.S. have diversified into in order to maintain the fertility of their soils is peanuts. Peanuts are legumes that help to fix nitrogen and maintain soil fertility. Peanuts are raised in many areas of the south.

The arid climate of the border area of Western Texas and Eastern New Mexico along with irrigation water diverted from the Rio Grande River is another center

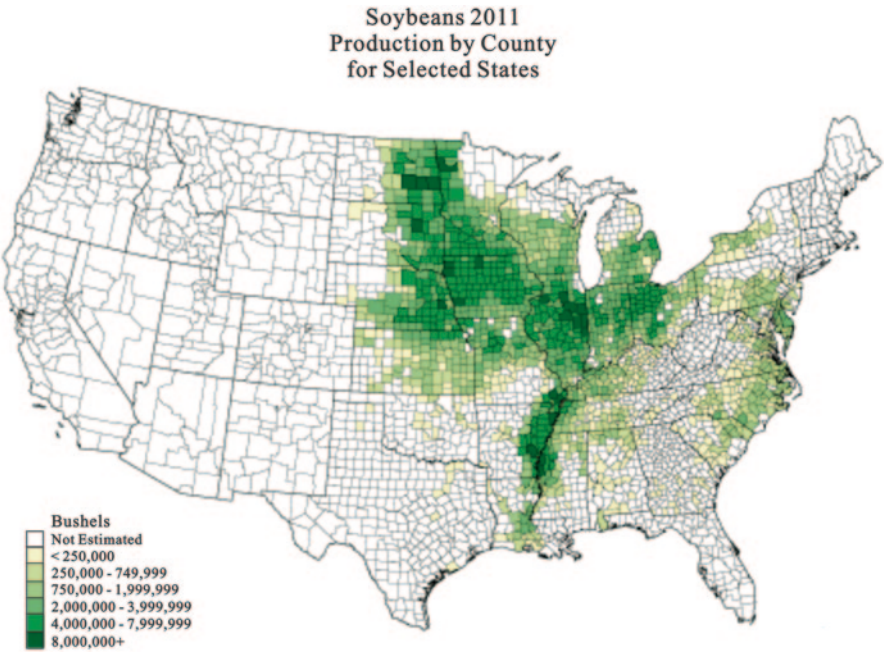


**Fig. 4.14** Soybean production is centered in the Mississippi River basin. Production is shown in bushels, there are 27.2 kg of soybeans in a bushel, the most productive counties yield over 200 million metric t a year. (Courtesy: USDA 2007 Census of Agriculture http://www.agcensus.usda.gov/Publications/2007/index.ph)

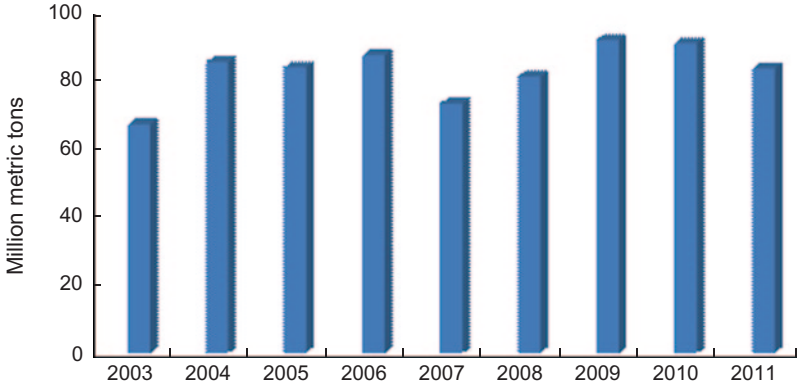


**Fig. 4.15** U.S. soybean production. The record production in 2009/2010 declined in 2011/2012, but prices are higher and second only to corn. (Courtesy: USDA)

of peanut production. Peanuts are susceptible to mold, in particular aflotoxin, and much of the peanut production in this area goes to poultry feed. Thus, a dry climate is ideal for bulk handling and storage of this crop.

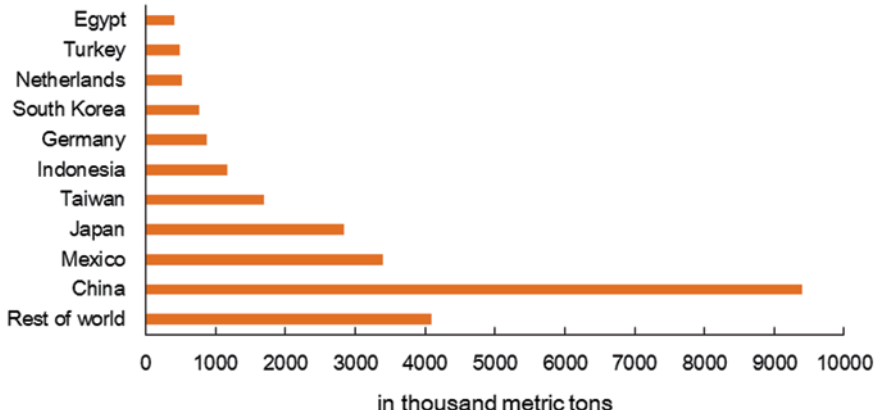


**Fig. 4.16** The U.S. is the World's top soybean exporter. Most U.S. exports go to Asia with China the largest single importer of U.S. soybeans. Courtesy: U.S. Department of Agriculture National Agricultural Statistical Service 2012. http://www.nass.usda.gov/Charts_and_Maps/A_to_Z/in-soybeans.asp)

### *4.3.3 Major Issues Associated with U.S. Agriculture*

There are many issues that impact agriculture in the U.S. These issues include most notably sustainable agriculture which in turn involves issues of soil and water conservation and minimizing negative externalities associated with agriculture such as water pollution, groundwater overdraft and odor which is most frequently associated with large-scale CAFOs (Environmental Health Sciences Research Center 2011). Also of importance and currently generating great controversy is the question of genetically modified (GM) foods and animals. Another important issue is the impact of food products on human health which traditionally had related to famine and food scarcity on a global level, but in the U.S. now ironically may be related to overabundance or at least excessive intake of certain foods associated with increasing obesity in American society. One final issue that is a problem in the U.S. in common with China is the conversion of agricultural lands. This includes the issue of the conversion land from one crop to another, the conversion of agricultural lands into non-agricultural uses (mostly for housing or commercial development) and the retention of farmland by various means such as use of zoning, tax incentives and the conservation reserve program (CRP) which is also related to sustainable agriculture.

**Issue 1: Sustainable agriculture** Sustainable agriculture is a set of practices designed to produce crops and animal products from the land while not, over the long run, diminishing the ability of the land to sustain that production. A related issue is avoiding negative externalities associated with production. Traditionally, this has involved minimizing soil erosion due both to water and wind. Many meth-

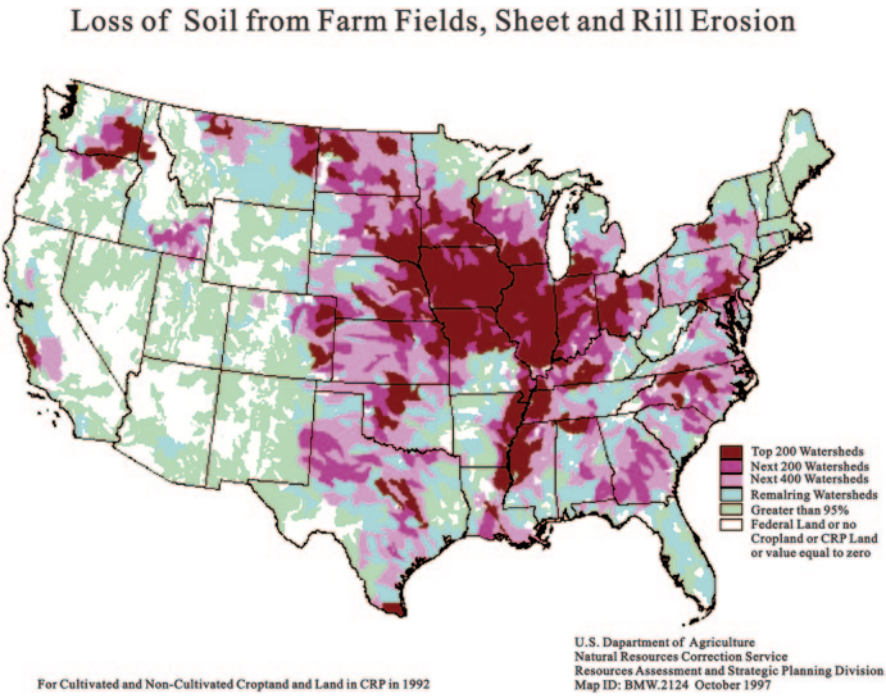


**Fig. 4.17** In the areas with the highest water related erosion up to 2 metric tons of topsoil can be lost per hectare per year. (Courtesy: U.S. Department of Agriculture Resource Assessment and Planning Division, Report on Conservation Reserve Program Lands 1987)

ods for this have been employed some of which are discussed in more detail in Chap. 10. However, in general, soil erosion can be reduced by using contour plowing, using strip cropping, maintaining buffer strips of natural vegetation along water courses, using gabions and check dams and geo-textiles on rills, ditches and gullies and by a variety of other methods to keep topsoil from being washed away. Wind erosion, which is a greater problem in the arid and semi-arid western U.S., can be controlled by conservation tillage, planting windrows (rows of tall trees) along the edges of fields and by maintaining grasslands in vulnerable areas. Grasslands can be maintained by reducing over-grazing, planting perennial grasses, through use of fire to promote healthy grasslands and/or by enrolling lands in the Grasslands Reserve Program (GRP) a program sponsored by the U.S. Department of Agriculture (USDA) which pays farmers and ranchers to maintain sensitive grasslands. Programs to control soil erosion were introduced by the Soil Conservation Service (now the Natural Resources Conservation Service or NRCS) in the 1930's and are implemented by numerous local soil and water conservation districts in agricultural areas throughout the U.S.; these work cooperatively with farmers and the USDA to reduce the erosion of top soils (Helms 1991). A map of the agricultural areas most impacted by water induced erosion is shown in Fig. 4.17. This map is delineated by watersheds. Wind erosion is a greater factor farther west, but water borne ero-

sion impacts lands with the greatest fertility and thus causes the greatest losses to agricultural productivity. The Corn Belt, the Palouse Plateau region, the Mississippi Delta region and certain parts of the High Plains are the areas most affected by water induced erosion.

Another aspect of sustainable agriculture is to promote conservation of water resources. Traditionally, this has taken the form of construction of water retention, flood control and irrigation reservoirs, aqueducts and diversion facilities by agencies such as the U.S. Bureau of Reclamation. These projects are primarily in the western U.S. More recently, structural civil engineering oriented water resources management has shifted to conservation measures aimed at reducing water consumption. This has taken the form of improved irrigation methods, use of more drought tolerant crops and in some cases taking lands out of production in dry years or discontinuing agriculture of lands subject to salinization. Directly related to agricultural water use is the on-going problem of over-draft of groundwater aquifers such as the Ogallala and Dakota in the High Plains. However, many other aquifers are also over-drafted, such as those in the valley of the Rio Grande River in Texas and New Mexico, coastal aquifers in California and parts of the Central Valley in California, parts of South Carolina and Florida (Floridian Aquifer) and several aquifers in Arizona (Salt River Valley) and Colorado (San Luis Valley). Related to this issue is the increase in salinization of soils, which is a particular issue in the rich Central Valley of California and in Arizona, but this has been reduced through use of buried tile (now plastic) drains. Another related issue is water pollution from agriculture; this primarily involves issues of non-point source pollution from pesticide residues in water, particularly of shallow aquifers and the issue of eutrophication of surface water bodies due to run-off of nutrients from fertilizers and animal wastes. Fertilizers and concentrated animal wastes in run-off causes eutrophication. This process is due to an over-abundance of limiting nutrients such as available nitrogen and phosphorus that cause growth of algal blooms that subsequently die and whose decomposition uses up available oxygen in aquatic environments, particularly in shallow or stagnant lakes and canals that in turn results in conditions in which fish cannot survive. Controlling water pollution involves many strategies, which include reducing erosion, using less toxic pesticides and implementing integrated pest management which uses natural predators like spiders, beneficial insects and selected use of targeted pesticides. Many of the most toxic, and persistent pesticides such as those chlorinated hydrocarbons with a tendency to bio-accumulate have been banned from use in agriculture in the U.S. starting in the 1970's; these banned chemicals include DDT and lindane and the soil fumigant DBCP. Also water pollution can be controlled by timing and better control of pesticide applications, which in the U.S. are frequently applied by "crop dusting" aircraft that now use geographic information systems and global positing systems to precisely control pesticide application and avoid over-spraying or spraying near water.

Finally, sustainable agriculture can be extended to include the conservation of habitat and diversity. This is partially achieved through the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP) and Grasslands Reserve Program (GRP) administered by the Natural Resources Conservation Service (NRCS 2010). These programs pay farmers an annual fee (rental payments) for agreeing

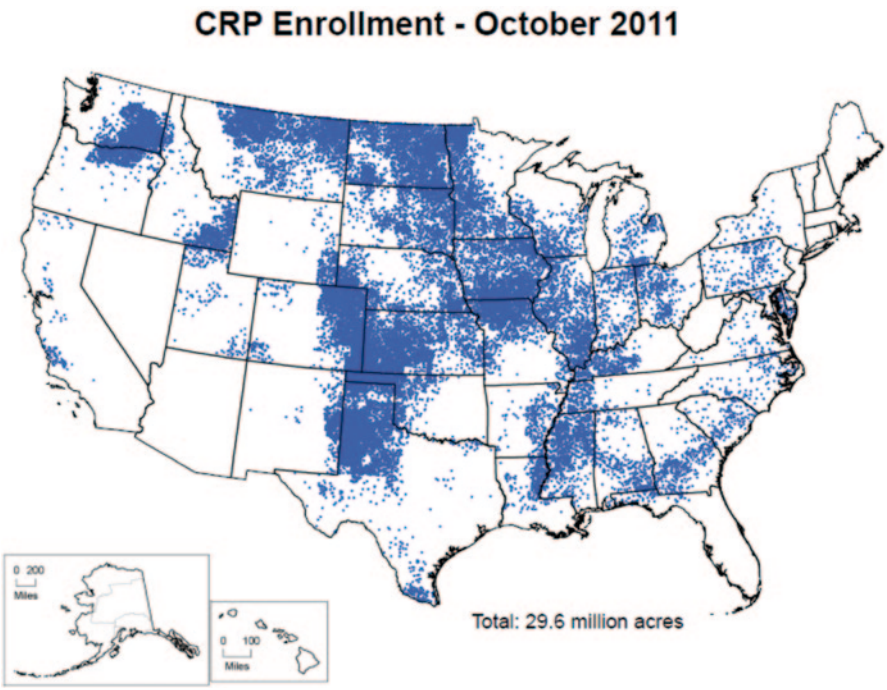


**Fig. 4.18** The Conservation Reserve Program pays farmers not to farm on lands vulnerable to erosion and substitute sustainable natural vegetation for habitat and erosion control. Each dot equals 405 ha of protected lands. (Courtesy: U.S. Department of Agriculture, Farm Service Administration 2011 http://www.fsa.usda.gov/Internet/FSA_File/crpenrolldotden1211.pdf)

over a number of years not to farm on lands vulnerable to erosion or that have special habitat characteristics, such as being wetland or grassland areas. The programs are an adaptation of a program started in the 1930's to support agricultural prices by curtailing production of crops grown in surplus of the then low demand for them. However, it now takes the form of a land, water and habitat conservation oriented approach. In 2011, 29 million acres of farm lands were enrolled in the CRP program, the WRP had 2.3 million acres of wetland areas under protection and the GRP had 335,000 acres of grasslands enrolled in it: for the extent of the CRP See Fig. 4.18.

There are many other aspects of sustainable agriculture in the U.S., but erosion control, water conservation, water pollution minimization, and preservation of sensitive habitat are among the more important aspects of the concept. It is an idea originally associated with soil and water conservation that has been embraced in the U.S. starting in the 1930's and is becoming increasingly important in the last two decades. The supporters of the concept are also starting to embrace the issue abatement of the effects of global climate change, both in terms of assessment of how climate change may impact agricultural productivity, crop selection and management but also in terms of global carbon balance. This link between sustainable land management and the global carbon cycle is particularly important in the area of silvaculture and forestry. In the U.S. context, forestry is usually a separate discus-

sion from agriculture, but many forest lands, particularly those in the south are on private lands and are operated as tree farms and are located on land that was at one time devoted to crops such as cotton.

**Issue 2: CAFO's and GM foods** Large scale concentrated animal feeding operations (CAFO's) have a range of negative externalities associated with them. Swine CAFO's and cattle feedlot operations are discussed in detail in Chap. 10, but all large concentrations of animals including aquaculture and poultry CAFO's generate concentrated animal wastes that contribute to surface water pollution. Another issue of concern is the build-up of nitrite in groundwater that can occur near facilities such as cattle feed lots. Other nitrogenous wastes can cause eutrophication of surface waters.

Scientific farming on an industrial basis not only has developed the modern CAFO, but also has made changes in animal feeds, animal waste management and is responsible for the creation of genetically modified (GM) plants and animals. Genetic engineering related innovations have been among the most controversial in agriculture. The issue of genetically modified (GM) crops and animals is one that is complex. At present many genetically modified seeds are used in U.S. agriculture. Mostly these are seeds that grow crops such as soybeans that are resistant to herbicides that ordinarily would kill both the crops and the weeds that typically infest them. The genetically modified seeds may have other attributes such as insect resistance, higher yield, plant disease resistance or drought or cold tolerance. There is some consumer resistance to consuming genetically modified foods and there are real concerns that alteration of physiological processes in a plant may confer undesirable characteristics on the food made from it. For example, the food created from the GM crop might become the source of allergic reactions in sensitive persons. Conversely, genetic modification opens the promise of crops that are naturally resistant to pests with a concomitant reduction in the use of toxic pesticides, which are themselves a source of human and ecological health concerns. Also soil fertility and water conservation might be achieved with development of better nitrogen fixation or better drought resistance or ground cover characteristics, etc. in crops (National Research Council 2010).

The use of GM seeds is increasing rapidly. In 2010, 81 % of all soybeans, 64 % of cotton, 29 % of corn and 23 % of canola globally were grown from plants which originated from GM seeds and in the U.S. the use of GM seeds is even higher (see Fig. 4.19). The most common modification in GM seeds is herbicide tolerance (HT), where plants are given a gene that allows farmers to spray them with the weed killer glyphosate, without harming them. Sixty-one percent of GM crops carry this gene. The other commonly seen trait is the addition of a gene from the soil bacteria Bacillus thuringiensis that renders plants noxious to insects (called Bt). About 17 % of GM crops carry this Bt trait. About 22 % of GM crops contained both genes. The addition of multiple modifications raises concerns, as it adds to the complexity of the compounds that the plants produce, some of which may end up in the human diet. GM crops have been commercially planted in the U.S. since 1996. A total of 29 countries worldwide now plant GM crops, with the United States planting the

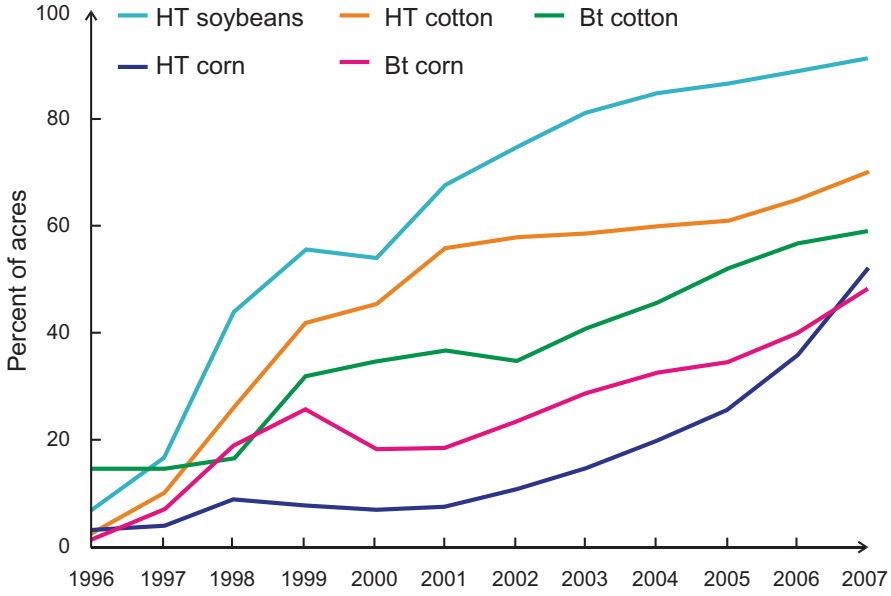


**Fig. 4.19** Herbicide tolerant (HT) soybeans are near 100% of acreage, with rapid increases in corn and cotton acreage using GM seeds that have either insect resistant (Bt) or herbicide tolerant (HT) traits. (U.S. Department of Agriculture Economic Research Service 2012. http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx)

most, at 165 million acres in 2010. (International Service for the Acquisition of Agri-biotech Applications 2011).

**Issue 3: Obesity and healthy eating** Food has long been something that was in short supply. Famine has impacted many parts of the world. China has suffered from many famines in its long history. The early European settlers in America had poor diets during their first few years, but soon the abundance derived from the largely virgin soils of the New World produced an abundance of food. At many times in U.S. history, the major issue was finding markets for this bounty. The food production in the U.S. has reflected consumer tastes, but agri-business companies have also tried to shift those tastes. The development of fast food restaurants and instant gratification of the desire for sugar and fats has produced a fundamentally unhealthy diet among most Americans. In 2012 the majority of Americans adults were overweight and about a third were obese. The most profound change in typical American physiognomy in recent years has been the growth in the waistlines of children and young adults (see Fig. 4.20). This is a result of many trends. Cultural and spatial factors are also important since childhood obesity is much higher is some parts of the U.S. such as the south as shown in Fig. 4.21. One is a more sedentary life style than in past years. Another important cause is a shift in food production and consumption toward meats (chicken and pork in particular) but also an increase in intake of high fructose corn syrup (HFCS) and refined cane sugar. High

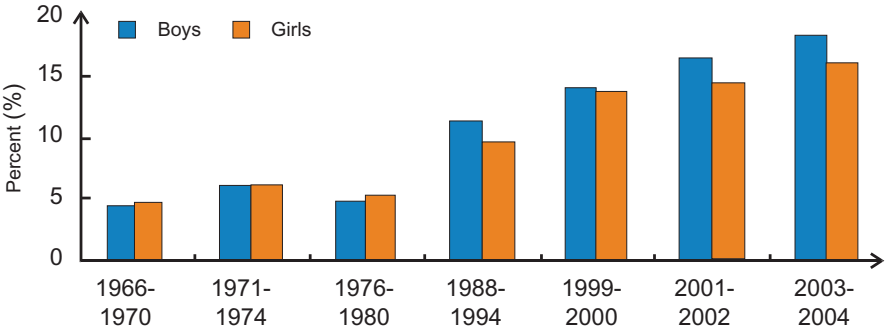


**Fig. 4.20** Between 1966 and 2004 the percentage of overweight children has quadrupled. (U.S. Department of Health and Human Services Assistant Secretary for Planning and Evaluation 2010, http://aspe.hhs.gov/health/reports/child_obesity/)

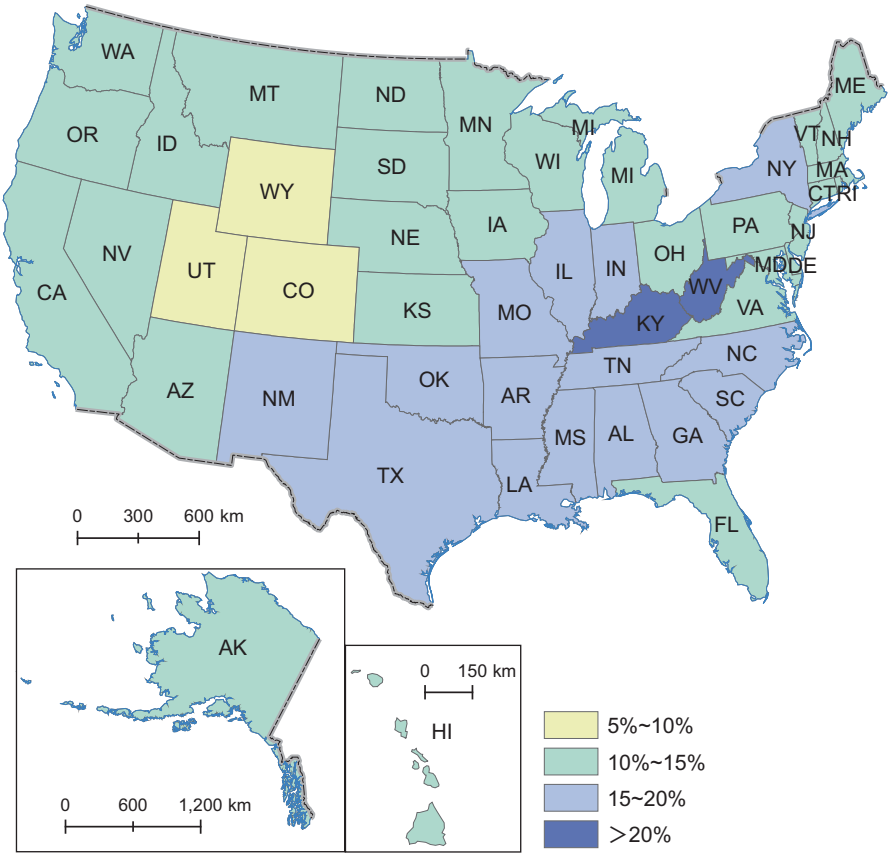


**Fig. 4.21** Obesity in children is higher in the South and highest in the Appalachian region in Kentucky and West Virginia. It is lowest in the West in states of Wyoming, Colorado and Utah. (National Conference of State Legislatures 2010, http://www.ncsl.org/Portals/1/oldsite/programs/health/obesitymap.jpg)

fructose corn syrup in particular has been singled out as source of obesity (Bray et al. 2004). It is the primary sweetener used in beverages and represents about 16% of the caloric intake of the average American. Americans consume far more sweetened beverages than in the past, but also before the 1970's those beverages were sweetened with cane sugar. Nutritionists have developed evidence that fructose is particularly likely to produce obesity and consequently diabetes, heart disease, stroke and certain cancers like breast and colon neoplasms. But other foods are associated with heart disease such as foods high in cholesterol and saturated fats. The agricultural industry would argue that changes in production and food composition are driven by consumer demand and economic factors and in fact the costs of some products like HFCS sweetened beverages per calorie are low compared to fresh fruits and vegetables. Many unprocessed fruits and vegetables, particularly organic ones, are quite costly as a source of calories. Part of the reason is that in many areas of the U.S., particularly inner cities, there is a shortage of markets that sell a wide range of fresh fruits and vegetables or organic and unprocessed foods. This in turn has led to several important societal trends. There is an effort by many groups including the Federal Government to try to address availability of healthy foods. One trend is the growth of organic farms, farmers markets, and urban and community gardens and the development of an integrated organic foods industry. U.S. sales of organic foods and beverages have grown from $ 1 billion in 1990 to $ 26.7 billion in 2010. Sales in 2010 represented a 7.7% growth rate over 2009 sales. Experiencing the highest growth in sales among organic products during 2010 were organic fruits and vegetables, with sales up 11.8% over 2009 sales (Organic Trade Association 2011). Another response has been to try to educate the public in nutrition and the health consequences of food choices. The entire food industry has responded in various ways to these trends, such as developing many more diet and low calorie foods and particularly beverages, changing the offerings at fast food restaurants to include salads, fresh fruit, oatmeal, fruit juices and milk instead of just hamburgers, french fries and soda sweetened with high fructose corn syrup. These may be primarily cosmetic changes, such as the effort to rename high fructose corn syrup as "corn sugar" on product packaging. They may involve greater changes in perceptions than in the realities of food production and consumption (Hsu 2012). Nevertheless, industry has made some major adaptations, such as the growth in offerings of organic products, the increase in production of "diet" and "lean" and "whole" foods and more offerings and emphasis on those foods like salmon and tuna fish that contain fish oils that have omega 3 fatty acids that are linked to heart health. Also many farms now manage their animals with less use of pens and more use of pastures and use less antibiotics and/or hormones (Rao 2012).

**Issue 4: Conversion of agricultural land** Conversion of agricultural land to other uses is an on-going issue in the U.S. as in China. Historically, there was a pattern of conversion of forested land and grassland to cropland. Later some of the more marginal cropland reverted to grazing land and forests. In the 20th century many areas of wetlands were drained and/or filled, and this has resulted in the loss of perhaps half of the historic acreage of wetlands in the U.S (Environmental Protection Agency 2011). Crops raised in the U.S. have changed over time. Thus, areas in the

South that once grew a mixture of food crops for subsistence such as corn, sweet potatoes, and swine might have switched to indigo as a cash crop when the plant was a valuable source of dyes in the 18th century, then to cotton after the perfection of the cotton gin in the early 19th century, then to peanuts in the early 20th century as the fertility of the soil was exhausted by lack of soil conservation and over-production of cotton. After the Second World War, with growing use of synthetic fertilizers and pesticides, the same land might have been used to raise soybeans and now it may be used to grow corn due to high current prices produced by demand related to production of fuel grade ethanol. The conversion of land from raising one crop to another still maintains the land in a condition fit for agriculture and in some cases, as in leaving the land fallow in rotation or raising legumes, it may increase the fertility of the land. Conversion of land from agriculture to forest (or grassland or wetland) also preserves the ability of the land to raise crops at a future date, as well as having other benefits such as helping to remove carbon dioxide from the atmosphere, and reducing the potential for soil erosion. Conversion of land from agriculture and/or forestry type uses to residential, commercial or industrial uses represents a qualitative shift and is an ongoing process in the U.S. The sprawl of cities facilitated by the automobile and the low density suburban single family home centered development pattern has characterized land use in the U.S. over the period from the end of the Second World War to the present time. In particular, suburban sprawl has characterized the years after 1980 through 2008, especially in the Western U.S. and has resulted in a profound shift in land use patterns. Many areas of once productive farmlands have been converted to residential housing and related land uses. In most of the years since 1970 between 1 million and 2 million acres of agricultural land has been lost annually in the U.S. to development. However, most of the land that was converted from agricultural uses is classified as grazing land or pasture, not prime crop land. Between 2002 and 2007, 4,080,300 acres of crop lands were converted to other developed uses. Between 1982 and 2007, 41,324,800 acres of rural land (i.e., cropland, pasture, range, land formerly enrolled in the CRP, forest and other rural land) were converted to other developed uses. During the 25-year span from 1982 to 2007, every state lost prime farmland. States with the biggest losses of agricultural land included Texas (1.5 million acres), Ohio (796,000 acres), North Carolina (766,000 acres), California (616,000 acres) and Georgia (566,000 acres). Between 2002 and 2007, 7,491,300 acres of rural lands were converted to developed uses. This is an average annual conversion rate of 1,498,200 acres (American Farmland Trust 2011).

The conversion of farmland to industrial uses is much less common today, although it certainly took place in the past century, particularly in States like Michigan and Ohio. Some areas of rich farmland have more recently been converted to a mix of housing and light industry, for example in California, where the fruit orchards of the Santa Clara Valley have become the technology parks and housing of the "Silicon Valley' and in Southern California where orange groves have been replaced by technology firms and the entertainment industry. However, most of the lost acreage has been supplanted by housing and retail establishments. Many types of retail firms rely on large "big box" stores located on the edge of existing communities.

Thus one frequently sees a farmer's field on the outside of a medium sized town which happens to be located on the edge of a major road or highway transformed into, for instance, a new Wal-Mart store, or a car dealership or home improvement center. Frequently, this was prime farmland, since the retailers want large flat areas for their stores, parking lots and associated smaller retailers, restaurants and gas stations located in the "pad" and these characteristics may be associated with better farm land. Also such retail establishments can afford to pay enough to purchase prime crop land, something that other buyers may not be able to do. But retailers are not the largest user of formerly agricultural acreage, the most common reason for land use changes is associated with suburban residential developments. In many areas premium prices are paid for larger lots in gated or otherwise planned subdivisions which often offer amenities such as golf courses.

Overall, the amount of cropland in the U.S. has not declined sharply over the last few decades, what has changed more greatly is the amount of grazing land which has declined. Most of the lost pasture and other grazing land are being converted into residential uses; some of the more fertile pastures have been converted into cropland replacing other croplands that have been converted to residential uses. What has increased in the U.S. is the area occupied by housing and the area occupied by forests. However, in specific areas where cropland is the major land use, urbanization has had a significant impact on cropland. Thus for example, the recent growth of the suburbs of Chicago, Minneapolis, Cincinnati and Saint Louis has all been in areas that were formerly farm lands.

## 4.4 Comparison of the Agricultural and Food Production in China and the U.S.

The agricultural foundation of China and the United States differs in resource endowments and historical development. With population tied to the land, less arable land resources and a long history of development, China has developed a famous tradition of precision farming. Driven by business concerns from its early years American agriculture flourishes because of its rich natural resources. Today, the total area of cultivated land in China is less than the United States with a decreasing trend, while the arable land in the United States changes little in relative terms. Thus, the gap in the area and quality of the cultivated land between the two countries is widening. Besides, China has nearly 30% of the population engaged in agricultural production, while in the United States those engaged in agricultural production account for only about 2% of the national population. There is a huge disparity between the two countries on the amount of labor involved in agriculture. Due to the huge differences in resource endowments, China and the United States have different focuses in the agricultural technology development process. With fewer people and more land, agricultural technology development in America tends to emphasize labor savings, while in China, the contradiction between space needed

for people and land need for farming guide technology development which tends to favor conservation of land oriented technologies and methods.

In addition, there are great differences in agricultural technology and service support system related to agricultural development between the two countries. The development of agricultural productivity in the United States is built on top of the development of the most advanced technology. As early as the 1980s, the United States began to adopt biotechnology had adopted the widespread use of computer information technologies including GIS and GPS for agricultural development. The U.S. government provides the basis for agricultural education, training, research and conversion of agricultural technology. With a relatively low level of agricultural support, China has an urgent need to increase the investment in agricultural science and technology. For a long time, agricultural development in both China and the United States has benefited from the protection and support of the government, such as financial assistance, and commodity price protection, but the methods of financial support differ. The developed system in America providing support and services in agricultural research credit and machinery is what China can learn from.

Due to the limited funding and technical support and considerable population, China mainly has developed labor-intensive agriculture. Characterized by lack of alternative funding and technology and inefficient agricultural production, Chinese agriculture is in stark contrast to the capital and technology-intensive agriculture in America. The United States has the world's largest commercial agricultural production.

The differences and comparative advantages of the agricultural production in America and China, makes for a good basis of complementary agricultural trade. Both of them are the world's most important agricultural production and trade powers. With the agricultural trade dependence gradually increasing, the two countries are essential agricultural trade partners with each other. Agricultural production and trade cooperation of the two countries is conducive to the promotion of bilateral trade and is a win-win development.

## 4.5 Conclusions

China is a country with a very ancient tradition of agriculture and a population of more than 1.3 billion people; 51.3% were living in rural areas in 2010. These are China's most fundamental national characteristics. Thus agriculture is of primary importance in China and defines its physical, environmental, economic and cultural characteristics to a large degree. This also makes Chinese agriculture critical to the world economy and food price stability. Because much of China's land is not suitable for agriculture, intensive and efficient agriculture must be practiced on the scarce lands that are suitable. Ultimately 7% of the world's land must help feed 22% of the world's population. China's farmers are meeting this challenge with the help of scientists, engineers and educators. During the past 30 years, Chinese agriculture has rapidly developed, with increased agricultural production. Agricultural production conditions continue to improve, and farmers' living standards continue

to advance. However, as a developing country China has issues with investment in agricultural related infrastructure, research and environmental protection. China has become a large agricultural export country and played an important role in the world food market's supply and demand. However, due to natural conditions and development history, there are still large differences in living standards between urban and rural areas and between the eastern and western parts of China.

America has a much shorter history of agriculture than China, but in that brief time its farmers, scientists, engineers and educators have been responsible for many historic innovations in agricultural production such as invention of the cotton gin (1794), mechanical reaper (1831), steel plow (1837), grain elevator (1842), barbed wire (1874), and milking machine (1879) all the way through development of many important agricultural chemicals such as glyphosate herbicides (1970) and more recently development of GM seeds and foods. Agriculture in the U.S. involves a declining and now surprisingly small proportion of a much smaller population than in China. Thus of about 318 million people in the U.S. in 2010 less than 2% were involved directly in agriculture and only 960,000 depend on farming, ranching or fishing for their livelihoods. Nevertheless, these few agriculturists are able to produce a vast surplus of agricultural commodities, in excess of domestic demands in most cases. Thus the U.S. while the world's third most important agricultural producer, after China and India, is the world's leading exporter of many types of food such as cereals, and meat. Agriculture in the U.S. faces a number of important challenges most notably loss of high quality farm lands. A network of land grant funded state agricultural research universities have pioneered the development of methods for sustainable agriculture. The question remains however, can the U.S., China and the other countries like India and Brazil work internally and cooperate internationally to expand production while minimizing externalities like pollution and negative social consequences like loss of the viability of small farms. The long term survival of the billions of people on earth depends on the effective leadership efforts in these spheres in both the People's Republic of China and the United States of America.

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