

Chapter 9

Urbanization, Urban Form and Adaptation: A Comparison of Four U.S. and Chinese Cities

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9.1 Introduction

Urbanization has been a fundamental dynamic over the past millennium in the social and economic history of most regions across the globe. There are four processes by which human environments and economic livelihoods have changed through urbanization and modernization. First, urbanization processes result in the spatial concentration of populations, occurring through the migration of rural populations to urban centers. Second, urbanization is associated with land use changes including the shift from agricultural to urban activities. Third, urbanization modifies natural landscapes to support expanding urban footprints. Finally, urbanization is associated with a shift of dominant economic activities from agricultural production to manufacturing, service and tertiary activities. In addition to the above changes, urbanization has also been accompanied by shifts in culture and life style. The proliferation and extension of human settlements, through which relatively dense settlement patterns are extended into agricultural and natural lands and rural populations are incorporated into urban economies and cultural modes, is an important spatial expression of urbanization. The term “sprawl” is frequently used to describe dispersed and fragmented urban expansion patterns typically associated with weak physical and environmental planning.

The industrial revolution of the nineteenth century stimulated rapid urbanization processes. In the United Kingdom, urban population exceeded rural population for the first time in 1851. Worldwide, urbanization processes occurred relatively slowly

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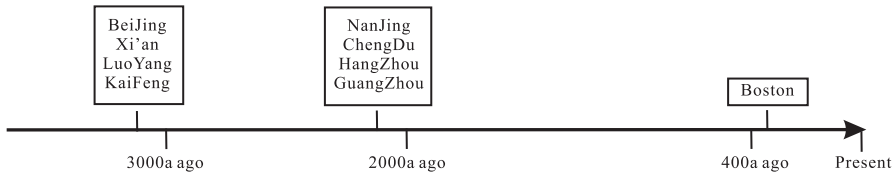


Fig. 9.1 The emergence of cities in China and the U.S. in the historical perspective

during the early nineteenth century to the early twentieth century then accelerated from about 1920 to 2000 as the annual average urban population growth rate exceeded above 0.3%. In twenty-first century, researchers anticipate that the growth rate will return to a slower rate. Due to the differences in industrialization and economic development as well as social and cultural factors, urbanization in different countries and regions shows considerable disparity in its form and characteristics.

China has a long history of urbanization (Fig. 9.1). The four major ancient capital cities of China (*Beijing*, *Xi'an*, *Luoyang* and *Kaifeng*) are all more than 3,000 years old. Several other major cities including *Nanjing*, *Hangzhou*, *Chengdu* and *Guangzhou*, have a history extending more than 2,000 years. Until recently, however, the growth of cities in China has been relatively slow, only heating up after World War II. In 1949, Mainland China had only 132 cities, with an urbanization rate of only 7.3%. By 2009, China had 655 cities, with increases of 46.6% of the population living in urban areas.

Compared to China, America is a relatively new country with only about 400 years of history. Urbanization in general has been strongly influenced by immigration, which in the U.S. has had both internal and external phases. As late as 1870, the proportion of urban population in the U.S. was only about 5.1%. With the speed-up of industrialization in the later decades of the nineteenth century, the urbanization process accelerated. The proportion of urban population increased to about 40% in 1900 and 45% in 1910. Around 1920, the urban population proportion reached 50%, completing what researchers describe as the “primary stage” of urban growth. Since the 1920s, the pace of urbanization has slowed. By 2002, the urban population had increased from 200 to 250 million, accounting for about 80% of the total U.S. population.

Urbanization has been a driving force in human-environment systems, and the pattern by which urbanization occurs has important implications for the capacity of nations and societies to sustain themselves over time. Urbanization and related problems of sustainable development have been a focus of research by among geographers and planners for more than a century. The S-curve is one characterization of the relationship between urbanization and sustainability. As cities mature through prolonged urbanization, urban and natural management systems are stressed, disamenities emerge and cities tend to become less sustainable (and livable). Along with urban maturity, a multitude of other factors that may also influence the process by which cities adapt to problems of sustainability, however, including local geography, land use planning, regional economic drivers, and macro-economic conditions.

Fig. 9.2 Illustration for geographic location of sample cities



In this chapter, we present case studies of four cities in China and the U.S. as a framework for comparing patterns of urban growth and sprawl across the two countries and different types of cities. Our case study cities are Chengdu (Sichuan Province) and Phoenix (State of Arizona), both of which were the historical centers of inland resource regions, and grew rapidly after World War II, as well as Shenzhen (Guangdong Province) and Las Vegas (State of Nevada), which have short histories of urbanization, with explosive growth rates after 1970 (Fig. 9.2).

This chapter is organized as follows. First, we provide background on each of the cities including their geographic location and historical development. Second,

we reconstruct the urbanization processes in the four cities, focusing on population and landscape change. Third, the key factors or characteristic drivers behind the growth of these cities are reviewed as a basis for conceptualizing differences of urban sprawl in China and the U.S. Finally, we discuss sustainability challenges in the four cities as a framework for exploring issues of changing human-environment relationships during the processes of rapid urban expansion.

9.2 Inland Centers: Chengdu and Phoenix

Chengdu and Phoenix are well-known cities, with strong cultural identities and relatively long histories. Chengdu was founded in 611 BC. During the mid-fifth century, B.C., the Liberal Kingdom named *Shu* shifted its capital city to Chengdu and built the city walls and moats. For 37 years during the late *Ming* and early *Qing* Dynasty Sichuan was in a state of almost constant war. Chengdu was largely destroyed. In the *Qing* Dynasty, Chengdu was rebuilt and immigration encouraged. Local officials opened up common lands to settlement and expanded opportunities for migration to Sichuan. Chengdu is now the capital city of Sichuan Province, an important central city in the central and western region of China, and a major megalopolis of China.

The Native American Hohokam Civilization emerged in the region where Phoenix is now located around 700 AD. The Hohokam people dug an irrigation canal 135 miles (217 km) long and developed an extensive system of agricultural cultivation in the area. During the period from 1300 to 1450 AD, possibly due to droughts and fierce floods, the Indian Hohokam civilization disappeared from the Phoenix region, leaving behind cultural relics as a foundation for further growth. In 1881, Phoenix became a city. In 1891, the railway was constructed. In 1912, Phoenix was designated the capital of Arizona. In 1911, Roosevelt Dam was built and irrigated agriculture emerged as an economic driver in the area. After the Second World War, the city developed rapidly, building on its agriculture and mining industries, but also emerging as a regional distribution and manufacturing and a center for retirement and recreation. At present, Phoenix is the capital and the largest city in the state of Arizona.

9.2.1 Urbanization Overview

9.2.1.1 Geography

The geographic location and climate characteristics of Chengdu and Phoenix are very different. Chengdu is situated between 102°54' and 104°53' E and between 30°05' and 31°26' N, in the western part of the Sichuan Basin and the eastern part of the Chengdu Plain in Southwest China, with an average altitude of about 500 m.

The Chengdu Plain is the biggest plain in the southwestern region of China, extending east to *Longquan* Mountain Range and west to *Longmen* Mountain Range, on the West Sichuan Fracture Zone. The plain region is high in the northwest and low in the southeast, with an average gradient of 0.3%. The city area of Chengdu is 192 km long from east to west and 166 km wide from south to north, with a total land area of 12,390 km², mostly on the plain, with *Jinjiang* River, *Fuhe* River and *Shahe* River running through the city area. Chengdu is a subtropical, humid monsoon region, with a mild climate, distinct seasons, a long frost-free period, abundant rainfall, and a limited number of sunny days. The average annual temperature is 16.2°C, the total annual rainfall is 918.2 mm and the average annual sunshine duration is 1,071 h.

Phoenix is situated in the central part of the Arizona State, between 33°31' N and 112°4' W. The region has become known as the Salt River Valley or Sun Valley. Phoenix is bounded by the McDowell Mountains in the north, the White Tank Mountains in the west, Superstition Mountains in the east and the Sierra Estrella Mountains in the south. Two mountains are located inside the city: Phoenix Mountain and South Mountain. Phoenix has an average altitude of 1,117 ft (340 m) and borders the Sonoran Desert. Phoenix has a dry and hot climate, ranking first among major U.S. cities in average annual temperature. During an average year, there are 89 days that the temperature of the city exceeds 100°F (38°C), typically during June to September. Phoenix is sunny for 85% of the daytime hours during an average year. The city's average rainfall is only 8.3 in (210 mm) at Phoenix Sky Harbor International Airport.

9.2.1.2 Patterns of Population Growth

Urbanization is a self-organized system with positive feedbacks, where urban functions attract population while urban population contributes to promote urban functions. Chengdu and Phoenix have a long history. The population size of Chengdu is greater than Phoenix. In the process of urban population growth, both of them experienced the assimilation of mainstream nation, as well as rapid population growth driven by industrial development.

Chengdu has experienced dramatic population shifts over its long history (Fig. 9.3). After destroying *Bashu*, *Qin* Kingdom “shifted ten thousand of its households into *Shu*” and established the *Shu* County at Chengdu, with the population of Chengdu increasing sharply. By the *Han* Dynasty, the economy of Chengdu was flourishing. During the *Western-Han* Dynasty, its population reached 76,000 households (about 400,000 people) and it became one of the six major cities (the other five of which were *Chang'an*, *Luoyang*, *Handan*, *Lintao* and *Wan*) in the *Han* Dynasty. During the *Western-Jin* Dynasty, the minorities re-occupied Chengdu and much of the *Han* population fled the city. During the periods of the *Sui* Dynasty, *Tang* Dynasty and *Song* Dynasty, the minorities were suppressed on the one hand and assimilated on the other hand, with more and more people migrating to Sichuan from Central China. During the period of *Sui* and *Tang*, the economy of Chengdu

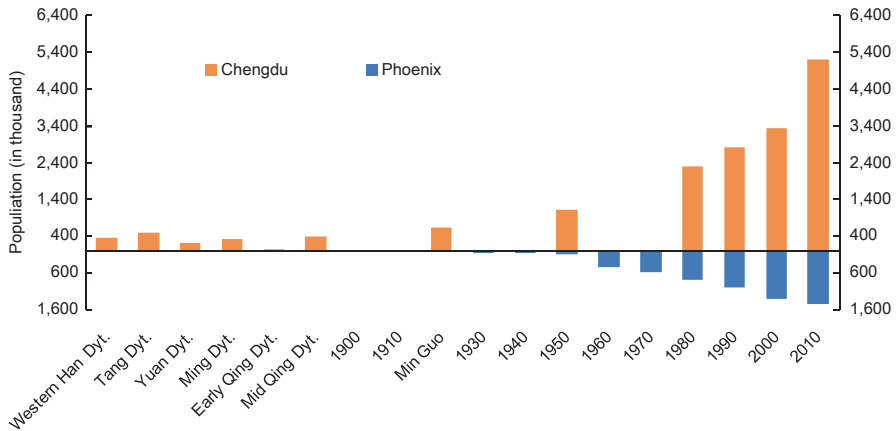


Fig. 9.3 Population change in Chengdu City and Phoenix City. (Note: the time scale is inconsistent and discontinued)

expanded rapidly, and the population grew to over 500,000 people, ranking second in population only to *Chang'an*. In this period Chengu was considered one of the four primary cities in China, alongside *Chang'an*, *Yangzhou* and *Dunhuang*. During the period of late *Song* Dynasty and early *Yuan* Dynasty, the population of Chengdu again decreased massively due to wars, diminishing to about 200,000 residents during the period of *Kublai Khan* (*Yuan* Dynasty). Additional wars during the period of late *Ming* Dynasty and early *Qing* Dynasty were responsible for extreme suffering in Chengdu. At the end of this period less than one hundred households remained in the city and its population dropped down below 10,000. In the 3rd year of *Qing's* *Shunzhi* Emperor (1646 AD), the entire city of Chengdu was destroyed in the war and nothing remained. The capital city of Sichuan was shifted to *Langzhong* in *Baoning* Prefecture. During the period of *Kangxi* Emperor, the government started to implement the great "Migration from *Hu* (Hubei Province) *Guang* (Guangdong Province) to Sichuan" which lasted nearly one hundred years. Nearly one million people migrated into Sichuan Province from other provinces. Because of the settlement of immigrants, Chengdu was gradually revitalized and its population increased gradually. During the period of *Qing's* Emperor *Jiaqing*, Chengdu's population grew rapidly to about 386,000. Afterwards, its population grew more slowly, reaching about 650,000 during the Republic Period. After the People's Republic of China was founded, as the capital city of Sichuan Province and the political, economic and cultural center of Southwest China, Chengdu experienced a sharp increase of population, growing from 1.13 million in 1949 to 5.10 million in 2008, an increase of 3.53 times at an annual growth of 7.56%. With the Chinese governmental reforms beginning in 1978, the proportion of population living in the Chengdu metropolitan area increased sharply, from 28.38% in 1978 to 45.35% 2008. The population in the central city area of Chengdu was 1.61 million in 1990, increasing to 2.05 million people in 2000 and over 3 million in 2006. In 2008, with



Fig. 9.4 Changes in the urban landscape of Chengdu. **a** Chengdu during Mingqing period (<http://www.lishi.net/html/laozhaopian/2011-12/2900.html>). **b** Chengdu at present (<http://www.lvxiabao.com/index.php?doc-view-1423.html>)

a permanent population of 4.41 million in the central city area, Chengdu could be considered a megacity.

Phoenix was formed on in February 25, 1881 through adoption of the “Phoenix Charter”, which established the foundations of a governmental system for the city. The city and region of Phoenix experienced rapid population growth after World War II. The population of the city of Phoenix was 106,818 in 1950, 789,704 in 1980, 1,321,045 in 2000, and 1,475,834 in 2005. The Phoenix region had a population of 4,281,899 in 2008, making it the 12th largest metropolitan area in the United States.

9.2.1.3 Patterns of Spatial Expansion

Agriculture laid the foundation for the development of both Chengdu and Phoenix. In both regions, the expansion of agriculture was associated with the development of a reliable supply of water and with the grading of agricultural sites which also served to prepare land for urban development. Moreover, agriculture created pastoral scenery which played a key role in attracting immigrants. The built-up area of the central city area of Chengdu was 60 km² in 1980, 74.4 km² in 1990, 129 km² in 1995, more than 200 km² in 1999, and up to 427 km² in 2008, 7.12 times of that in 1980 (Sichuan Statistical Bureau 2011). Chengdu’s urban landscape has changed dramatically, associated with fundamental shifts in architecture, infrastructure and all other dimensions of the built environment (Fig. 9.4). Figure 9.5 provides a vivid presentation of the city’s expansion, in which the built-up area of Chengdu gradually extends across nearby lands. Because Chengdu city is surrounded by a developed agricultural area, the expansion of the city has been associated with the conversion of a significant amount of land from agricultural to urban uses, which makes the city suffering from such conflicting uses of conversion (Peng et al. 2008).

In 1950, Phoenix extended over 17 square miles, ranking 99th in the United States in area (Table 9.1). By 1980, the area of the city had increased to 330.59 square

Fig. 9.5 Urban sprawl and land use change of Chengdu City from 1992 to 2006. (Peng et al. 2008)



Table 9.1 City area and rank in the U.S. cities of Phoenix

Year	City area (km ²)	Rank in the U.S. cities
1950	17	99
1980	331	9
1998	470	6
2008	839	3

miles, ranking 9th among U.S. cities in area. By 1998, with a land area of 470 square miles, it became the sixth largest city in the United States in terms of area.

Figure 9.6 illustrates land uses in the Phoenix region over five periods: 1912, 1934, 1955, 1975 and 1995. The light gray indicates desert, the green indicates agricultural areas and yellow indicates built-up areas. These maps vividly display urban expansion in the Phoenix region. In general, the growth of the metropolitan area occurs through the conversion of desert and agricultural land to urban uses. As we see, before 1955, the city of Phoenix was surrounded by a large agricultural region. Simultaneously, more and more farmland was reclaimed due to the contributions of the Salt River Project and Central Arizona Project, which brought water resources to the valley. Beginning in about 1955 or so, a significant change occurred in development pattern as the city extended into desert lands. From 1955 to 1995, the metropolitan region expanded significantly, mainly towards the north and west. Considerable amounts of farmland and desert were occupied and turned to urban land use.

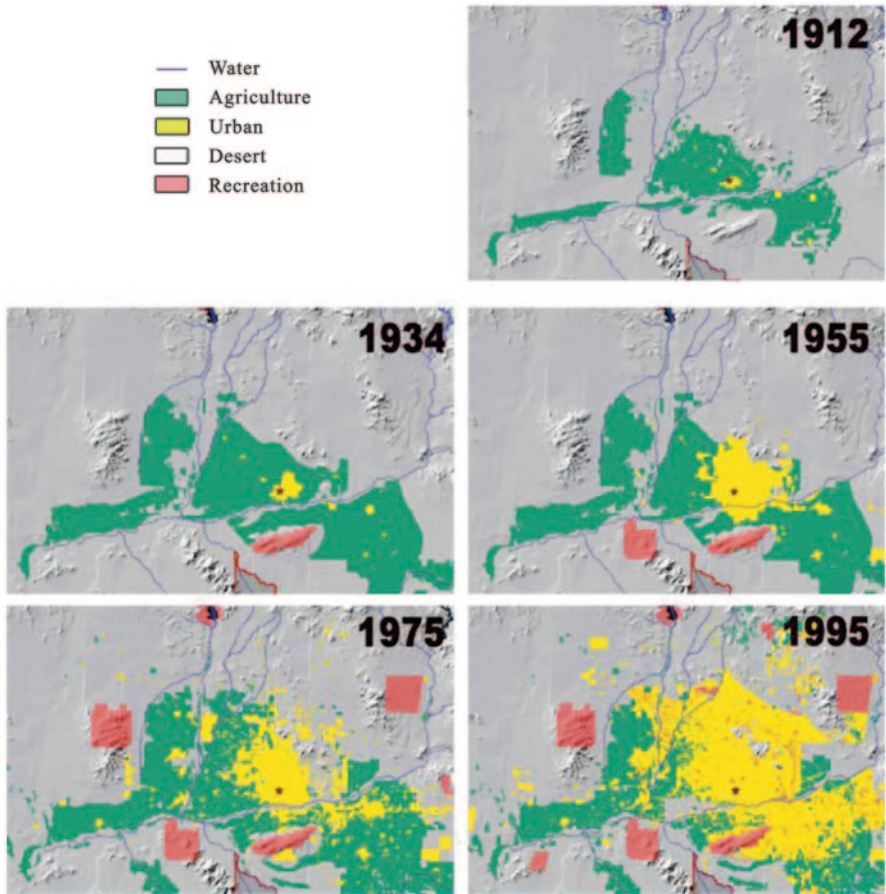


Fig. 9.6 Landscape urbanization of Phoenix. (Wu et al. 2011)

In addition to the continual expansion of city area, the urban landscape of Phoenix City also changed significantly, from interspersed urban and agricultural lands to a modern metropolis intensively developed with high-rise buildings (Fig. 9.7).

Agriculture laid the foundation for urban development in the region. It played a key role in securing water supply, preparing development sites, and creating pastoral landscapes that attracted immigrants from other parts of the country. Agriculture in central Arizona developed with water-intensive practices including flood irrigation of crops such as citrus. In many cases water rights were passed to the subdivision developments that succeeded them. In the post-World War II era, subdivisions were built in the citrus groves and marketed as garden suburbs. At least for a time, citrus trees and flood irrigation practices were maintained in the new suburbs. As across much of the Western U.S., urban growth in Phoenix has been heavily promoted

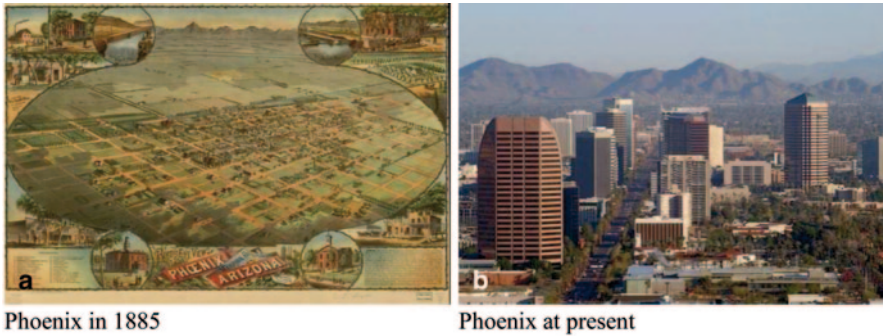


Fig. 9.7 Change in urban landscape of Phoenix. **a** Phoenix in 1885 (<http://www.worldmapsonline.com/historicalmaps/kr-1885-phoenix.htm>). **b** Phoenix at present (<http://www.mplife.com/us/inquire/120828/76833009901.shtml>)

through various forms of boosterism, including advertising campaigns by railroads, municipalities and developers themselves (Sokol 2005). In both Phoenix and Las Vegas, this boosterism featured images of well-watered oases and low-density residential development associated with amenities such as golf courses.

In the non-agricultural areas of both Phoenix and Las Vegas, subdivision development has typically followed a model of grading and landscape reconstruction, in which vegetation is stripped and the contours of the site are transformed to satisfy engineering guidelines. As with agricultural development, this process has modified the ecological character and processes of the region including wildlife habitat, species diversity, and hydrological processes including drainage patterns (Steiner et al. 1999). In general, urban development has also been associated with dramatic expansion of impervious surfaces, including both concrete and asphalt, which have further transformed hydrologic processes and reduced space available for landscaping. These development patterns are likely associated with urban heat island effects. Temperature in Phoenix has increased at a rate of about 1 °C a year. Indeed, both land use patterns and global warming may contribute to heat increases. More water efficient landscaping concepts such as xeriscaping have not taken hold until the last couple of decades, and water use in Phoenix is not sustainable over the longer term (Grimm et al. 2008)

9.2.2 Drivers of Urban Growth

Though Chengdu and Phoenix have considerable differences, there were two basic similarities in the process of urban expansion between the two cities. On the one hand, local geographical conditions supported high agricultural yields. Efficient productivity allowed a part of the population to leave the primary production and move to secondary and tertiary industries. This in turn created market and population agglomerations, and triggered the early stages of urban development. On the

other hand, the advantage of geographical location attracted heavy investment, and promotes the rapid development and promotion of the industry. The confluence of these two forces, generated a powerful urbanization dynamic that turned Chengdu and Phoenix into modern cities.

9.2.2.1 Water Supply and Flood Management

Both the Phoenix and Chengdu regions have struggled for centuries with management of water supply and flooding. Chengdu is situated near the mountain pass of the *Minjiang* River, a major branch of the Yangtze River, running out of the *Minshan* Mountain Range into the Chengdu Plain. From *Yulei* Mountain, the mountain pass of the *Minjiang* River, the Chengdu Plain inclines southeastward, with a sharp gradient. In ancient times, when there were major floods on the *Minjiang* River flooded the Chengdu Plain became an inland sea. When there was drought, the area became a barren landscape. Phoenix is also situated in relatively flat valley surrounded by mountain ranges. While the Phoenix valley itself is arid, the higher elevations accumulate moisture both in the form of snow and storm events. Both drought and flooding have been obstacles to the urban and agricultural development of Phoenix over much of its history. One of the primary hypotheses for the disappearance of the Hohohkham civilization is long-term drought. While the group constructed sophisticated irrigation works, these may not have been sufficient to sustain the society during periods of severe drought.

Both Phoenix and Chengdu have addressed both water supply and flood issues through a succession of public infrastructure projects. In 256 BC the procurator of *Qing* Kingdom's *Shu* Count, *Li Bin* organized the construction of the well-known *Dujiangyan* Weir project. This project split the water flow of the *Minjiang* River into two parts for the purpose both of reducing flood risk and extending irrigation into the Chengdu Plain. As a result of the *Dujiangyan* Project, the Chengdu Plain was an important economic center for more than 2000 years. The Chengdu Plain provided an economic foundation and material reserve for significant military investment and aggressive diplomacy. For instance, during the period of *Three-Kingdom*-dynasty, relying on *Dujiangyan* Irrigation Area, *Shu-Han* dynasty fought with the two other nations and sent its forces to Central China several times. *Zhuge Liang*, (181–234 AD, celebrated adviser to the empire, and the founder of the *Shu-Han* dynasty (221–263/264) “took the weir as the base of agriculture and resources for the kingdom”. He attached great importance to the management of the project and deployed 1,200 workers for its maintenance. During the *Tang* Dynasty, *Yizhou* (name of Chengdu in the ancient times) was flourishing and as famous as the economic capital of China, *Yangzhou*. At present, the *Dujiangyan* Irrigation Project with the *Dujiangyan* Weir as the canal pivot is responsible for irrigating more than 68.4 million hectares of farm land in seven cities (prefectures) and 37 counties (districts) in the central and west region of Sichuan Basin (Fig. 9.8). It supplies water for the enterprises and urban residential areas of Chengdu and offers various integrated services including flood control, power generation, agricultural and aquatic production, tourism, and

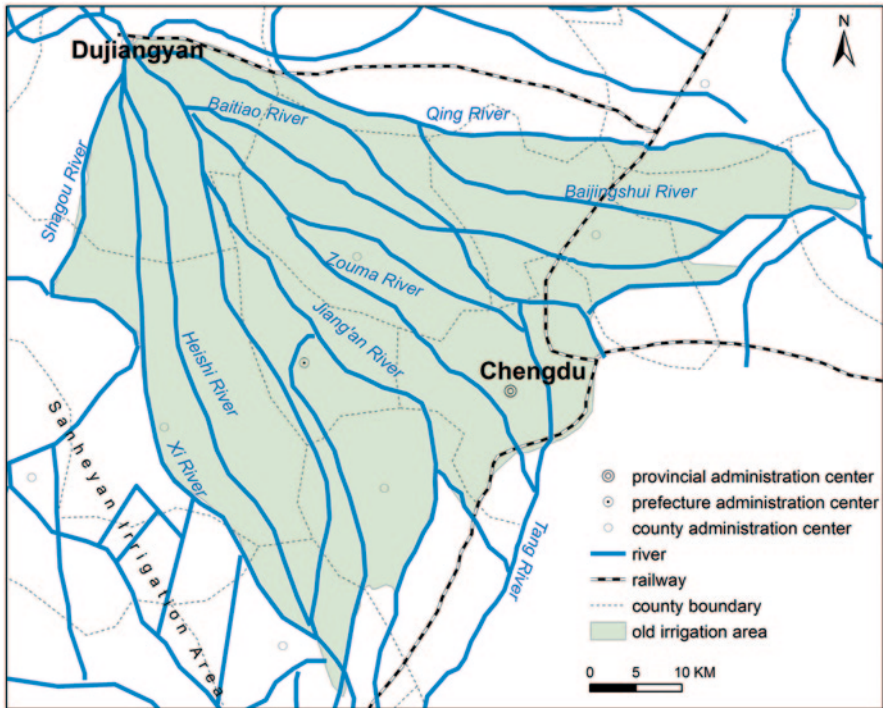


Fig. 9.8 Illustration of *Dujiangyan* irrigation area

environment protection. It is the largest irrigation project in China and necessary for continued support of the economic vitality of Sichuan Province.

The early development of Phoenix started with water diversion for irrigation. Beginning with Jack Swilling, who introduced farming and irrigation to the Salt River Valley after the American settlement, many of the early farmers built canals in the area. Later the Salt River Project was developed to support agriculture and urban development in the region. The demand for water exceeded the supply in the local rivers, however, and Phoenix turned its attention to the primary water source in the Intermountain West, the Colorado River (Fig. 9.9).

The development of water supply in Phoenix follows a pattern characteristic of many cities in the western United States. Construction of irrigation canals and ditches began in the 1880s. During the previous century civil engineers had acquired considerable experience in water transportation through development of canal projects such as the Baltimore and Ohio the Erie Canals, urban drinking water systems such as the Croton Aqueduct in New York City, and the engineering of flumes and other hydrologic systems for mining. In Arizona, the irrigation canals of the 1880s were constructed on the remnants of an historical canal system constructed by the Hohokam Native American group and abandoned in the sixteenth century. Use of historic canals was also a characteristic pattern in development of

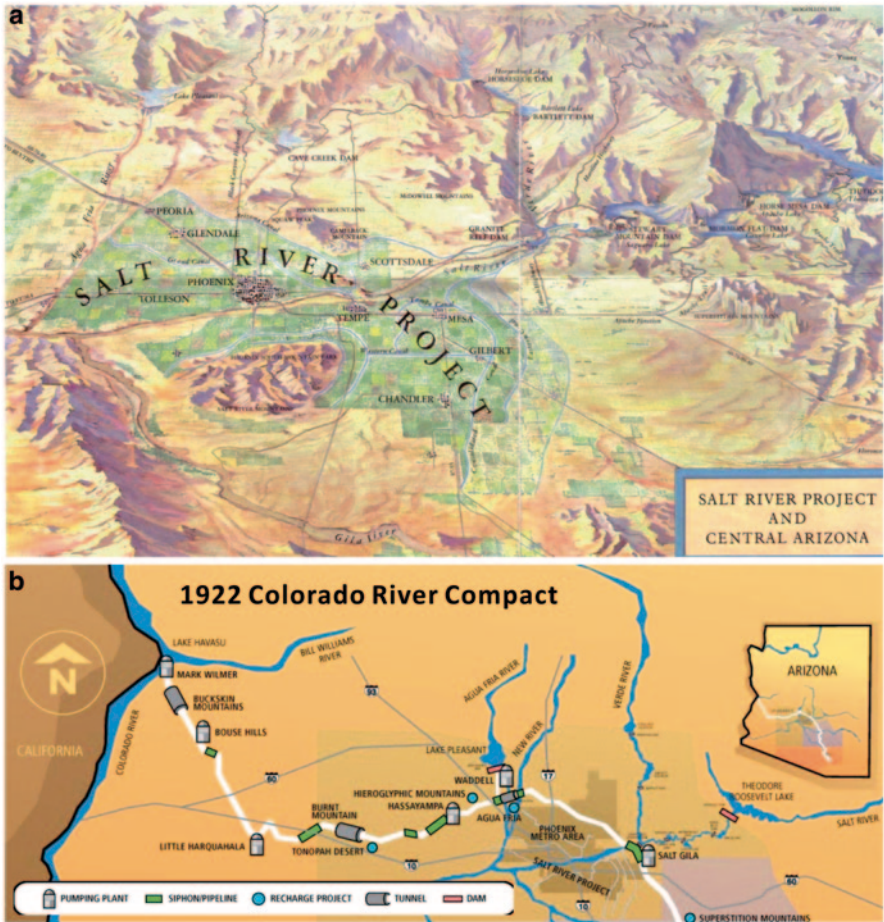


Fig. 9.9 a Water resources project for Phoenix (Source:<http://brazilbrazil.com/urban.html>), b a part of the central Arizona project system map, by Central Arizona project (Source: <http://www.cap-az.com/AboutUs/SystemMap.aspx>)

other areas of the U.S. West such as the Rio Grande Valley of New Mexico. This phase of water supply development was organized largely by local government jurisdictions and private entities including municipalities, ditch companies, cooperatives, and developers.

The federal Bureau of Reclamation, organized through the *National Reclamation Act* signed by President Theodore Roosevelt in 1903, strongly influenced urban development in Arizona. The Bureau of Reclamation grew in part out of Progressive Movement reforms calling for professionalization (and expansion) of the federal government. The Bureau of Reclamation focused initially on development of diversion dams; farmers were responsible for the construction and maintenance of ditches that transported water from the dams for the flood irrigation of crops such

as including citrus, melons and cotton. Dams were also constructed in the Phoenix area to manage intermittent floods resulting from storm water accumulation across the Salt and Verde River watersheds. This system of agricultural irrigation and flood management survived the great depression and became the foundation for urban development in the great development boom after World War II. In the mid-to-late 1950s, water planners argued for another phase of investment and system expansion. The seven dams and other system elements managed by the Bureau of Reclamation were consolidated into the Salt River project. This initiative was originally designed to support agriculture but its focus later shifted to urban uses. The Salt River project was designed as a comprehensive and integrated system for transportation and management of surface water in the Phoenix region.

During the 1990s, groundwater depletion became evident. Rates of withdrawal from groundwater sources continued to increase with the growth in irrigation and development. By the 1990s, groundwater depletion was recognized as a major water supply issue, and in 1977, the federal government required that Arizona address the problem or lose federal funding for water development. Arizona responded with state legislation that established a state regulatory presence over land and water development. This state activity has expanded over subsequent decades. State regulation may be constrained, however, by recent state ballot initiatives in Arizona designed to protect private property rights (Sparks 2009). These limit a regulatory 'taking' of land value without reimbursement to landowners and other affected parties.

Another phase of water supply development in the Phoenix area is the transfer of water from the Colorado River. When complete, this effort will divert up to 1.7 billion m³ of water from Lake Havasu and move it more than 450 km to the Phoenix region. The Colorado River is the primary drainage system in the intermountain region of the Western United States between the Rocky and Sierra Nevada mountain ranges. The diversion of water to Phoenix has implications for both upstream and downstream users of the system, and potential ecological effects throughout the region. Among these effects, the project may limit opportunities for modification of the dam and reservoir system along the Colorado River, which has been proposed both to address siltation of reservoirs and recreate historical bottom land ecologies along the river. Likewise, urban water demands both in Phoenix as well as other cities such as Las Vegas may influence opportunities for restoration of the historically important wetlands at the mouth of the Colorado River, located in Mexico. Over the past decade or so these wetlands have become an increasingly sensitive concern among environmental organizations and in U.S.-Mexico diplomacy. The recent legal settlement with the Gila Indians will also have an important effect on water supply for urbanization. It allocates about 800 million m³ for specific uses designated by the tribe, and is expected to support an expansion of the Phoenix metropolitan area in new directions. In this sense, decisions about water to support future growth in Phoenix have implications across a variety of boundaries: aquifers, watersheds, states, sovereign entities such as tribes, and nations.

City and state governments in Arizona have used a variety of regulatory tools and incentives to manage the allocation of water sources and rationalize water use.

Farming practices have been an important focus for water conservation efforts. Most farming around Phoenix is dependent on irrigation and historically the agricultural community has competed with urban users for access to water. Federal and state governments encouraged farmers to systematically evaluate water consumption and apply water-efficient farming methods. Another emphasis of government programs has been education of urban users to conserve water and invest in water-saving technologies. Although local governments in the Phoenix area have dedicated significant effort to water conservation, there are still significant barriers to reduction of water use to sustainable levels. (White et al. 2008; Larson et al. 2005).

9.2.2.2 Regional transport development

The development of both Chengdu and Phoenix is closely associated with the regions where they are located. Chengdu is situated in the central part of the Chengdu Plain and thus is in a favorable urban position with respect to Western Sichuan. However, as Chengdu Plain itself is located in the western part of Sichuan Basin and is in poor connection with other regions outside the basin, the development of the entire Chengdu region was constrained until fairly recently. Due to the rough roads and dangerous water crossings, external communication has been difficult and hazardous since ancient times. Historically, the *Yangtze* River was the primary transportation route out of the Sichuan Basin, but formed a series of deep valleys in eastern Sichuan (the Three Gorges in Mid-Yangtze River), where the river goes through rapids that are unfavorable for navigation.

The rapid development of Chengdu after the formation of the People's Republic of China is closely associated with improved regional transportation achieved by breaking through these natural obstacles. In the early 1980s, Chengdu was connected with areas outside Sichuan Province through three major railway lines: Cheng-Yu Railway, Cheng-Kun Railway and Bao-Cheng Railway. Cheng-Yu Railway built during 1950–1952 was the first major railway line in Southwest China. It crossed the Sichuan Basin, promoting the transportation of materials throughout the southwestern region and playing an important role in developing production and flourishing economic construction. The eastern terminal of the Cheng-Yu Railway is Chongqing City, which was connected to the line in 1965. In 1979 the line was connected to Guiyang of Guizhou Province and Xiangfan City of Hubei Province. The Bao-Cheng Railway began operation in 1958, extending north from Baoji in Shaanxi Province and south to Chengdu. The Cheng-Kun Railway opened in 1970 and extends across 130,000 km² including seven prefectures and cities of Sichuan and Yunnan. Thus, Chengdu is a pivot point for four railway lines (the above three lines and the railway from Chengdu to Dazhou) and a primary route for movement out of Sichuan.

Phoenix has a different, although also significant, transportation history. It sits astride one of the major routes between Southern California and Texas, and as such has become an important regional transportation center. The Southern Pacific railroad completed its line through Maricopa (near Phoenix) in 1883, and the Santa Fe

railroad entered the city in 1890. A number of other railroads were constructed in the state primarily for transportation of minerals. Interstate 50 was completed through the city in 1958 connecting Los Angeles and Texas. However, unlike Chengdu, Phoenix historically did not function as a major transfer point nor as a gateway to a major region. The Southwestern U.S. was sparsely populated until recently, and the major ports of Los Angeles, Houston and New Orleans focused on population centers in California, Texas and elsewhere. As the population of Arizona and surrounding states have grown over the past few decades, the role of Phoenix as a transfer point and logistics center has become more important. Moreover, Phoenix has become a primary gateway for immigration from Mexico to the United States, and along with this population shift, immigration has become a heated issue in Arizona politics over the past couple of decades. A limited tonnage of goods from Mexico is also shipped through Phoenix although this traffic is dwarfed by trade through Texas and California. In these respects transportation links to the south of Phoenix have become salient. However, Phoenix is competing in all these dimensions with other cities in the region including Salt Lake City, Las Vegas, Denver, El Paso, Laredo, San Diego and Los Angeles.

9.2.2.3 National Policy for Inland Cities

In late 1950s, due to fierce international conflicts and strategic considerations, China shifted its heavy industries from Northeast China and East China to the inland western region. This shift was known as the “third-line construction” period. During this period, Sichuan was one of the key receiving regions for the industrial migration. Chengdu was the command center of the southwestern third-line construction. From 1965 to 1976, a total of 33.5 billion Yuan (equal to 500 billion Yuan at present) was invested in construction activities in Sichuan, about 80% of the total national investment in Sichuan from 1949 to 1976.

During this period, important enterprises of the “first-line” region were shifted to Chengdu including the Sichuan Gear Factory. Additionally, the central government invested in the establishment, expansion and rehabilitation of large and medium military enterprises including Chengdu Aircraft Company and Chengdu Engine Company. The relocation, construction and operation of these enterprises strengthened the industrial base of Chengdu and massively enhanced its capacity to manufacture machinery, electronic elements and military equipment. Other types of manufacturing were also being promoted in the region, and by the 1970s Chengdu could produce more than 100 types of industrial products such as seamless steel pipes, automobiles, mechanical equipment, measuring and cutting tools, fertilizers, and basic chemical materials and antibiotics. Additionally, Chengdu became one of the four centers of the electronics industry in China and a base of fighter plane and radar production. By 1977, the city had more than 4,010 enterprises with an annual industrial output of RMB 3.65 billion Yuan.

The “Third-line Construction” policy played a strong role in promoting the urban growth of Chengdu. Before 1949, Chengdu’s total industrial output was only RMB

108 million Yuan, with 14,000 small businesses in the handicraft industry; factories and businesses of mechanical and semi-mechanical production including small-size textile mills and power plants, machinery plants and workshops providing repair services, processing factories for agricultural products and by-products; and brick and tile factories. As a result of public investment during the “1st five-year” period (1953–1957) and “2nd five-year” period (1958–1962), Chengdu’s industries were strengthened. The growth of industries such as electronics, machinery, metallurgy, chemical, textile, light industry, building materials and foodstuffs laid a foundation for the further growth of the Chengdu region. By 1965, the city had 2,270 industrial enterprises, with a total industrial output of RMB 1.05 billion Yuan.

The central government’s preferential investment in Chengdu during the “Third-line Construction” period was a primary driver for the transformation of the city’s economy. Chengdu changed from a city of consumption into a city of modern industry, represented by a significant presence in electronics and electromechanical industries rather than heavy manufacturing.

Economic growth policies in the Southwestern U.S. had their roots in post-civil war reconstruction and the shift of textiles and other industries to the Southeast. This industrial migration was accompanied by the emergence of a new economic development strategy. Cities across the U.S. South reorganized local and state tax policy and constructed public-private investment partnerships to enhance their competitive advantage in wage rates and land costs and more relaxed regulatory environments. This urban growth strategy—competition over wages, land development cost and regulatory liberalization—was transferred across the western United States after World War II. Moreover, federal and state governments made significant public investments in the Southwestern U.S. including construction of the interstate highway system and development of electrical power generation and distribution systems. Finally, military investment and retirement played a role in the growth of the Southwest (Abbott 1998). The army had a considerable presence in the Southwest during the Indian wars, which ended late in Arizona with the capture of Geronimo in 1883. During World War II, The U.S. military shifted the geography of defense industries and facilities to the southern and western parts of the United States, creating huge new regional centers of military training and supply. Both Phoenix and Las Vegas benefitted from this shift in military investment. Low population densities, land costs and sunshine made the Phoenix region particularly attractive to the air force. In the early years of World War II, the government established Lockland Air Force Base, the Thunderbird Training Grounds, the Garrett Research Center, three army camps and six air force bases in the Phoenix area. The presence of military facilities and defense contractors provided a primary stimulus to the emergence of technology industries, which have been a cornerstone in the growth of the Phoenix economy after the 1960s. State and federal government also emerged as an important employer in Phoenix as state government grew after the 1950s and federal agencies established regional and state offices in the city.

Finally, Phoenix became a magnet for retirement very early in the twentieth century, in part as a result of tourism and booster advertising campaigns mentioned earlier. For example, the Santa Fe railroad organized a well-known campaign featuring

native American art, Spanish cultural influence, cowboys, sunny days, warm winter climate and stark landscape. Later, Phoenix was marketed to retirees as a specialized and modern suburb, with age-appropriate housing convenient shopping, contemporary architecture, access to amenities such as golf courses, and availability of high-quality health care. The federal social security system and public and private retirement benefits provided the income to support this retirement migration. The military interacted with these other elements in the regional development process by creating a pool of retirees, at least some of who may have had second careers in defense industries.

9.3 Institutional Innovators: Shenzhen and Las Vegas

Our second set of cases is “young” cities that emerged not primarily as capitals of resource regions but out of a combination of institutional innovations and spill-over effect. We evaluate Shenzhen and Las Vegas as case studies of growth processes of this kind. These cities are the product of administrative innovations as national, state and local governments created regulatory experiments in what were then small, peripheral towns. Moreover, these cities developed as a result of spillover effects as mature cities spun off economic activities to low-cost, proximate areas. In both places, regulatory regimes that were dominant elsewhere in the country were relaxed. Regional economic development around both cities was stimulated by their regulatory uniqueness. Regulatory innovations were also accompanied by a specialized geographical advantage. Each city was located near an established metropolis, and derived further advantage from interacting with its mature sibling: Hong Kong for Shenzhen, and Los Angeles for Las Vegas. Finally, both cities developed strong investment and growth strategies to take advantage of their comparative strengths. The combination of these factors has created enormous economic momentum in both places (although the economy of Las Vegas has suffered over the past few years from the collapse of the housing boom).

Shenzhen became an administrative establishment first in the 8th year of *Qing's Kangxi* Emperor (1669 AD), when the *Qing* government set up *Xin'an* County for jurisdiction of the current Shenzhen and Hong Kong region, with an area of 3,076.00 km². After the Opium War, Hong Kong was functionally independent of Beijing. After P.R. China was founded in 1949, the Shenzhen region set up Baoan County, with the county center located at Shenzhen Town. In 1979, Baoan County was changed into Shenzhen City, with the municipal government located in Shenzhen. In November of the same year, Shenzhen was designated a city under the provincial administration. In 1980, the “Shenzhen Special Economic Zone” was established. In 1988, the State Council approved the designation of Shenzhen City in the state plan and granted economic management authority to the city. During this period of about three decades Shenzhen grew from a small fishing village to a global capital with GNP ranking fourth in China and a population of nearly 10 mil-

lion. Shenzhen has observed great changes during this period, and its urbanization rate is known as “Shenzhen Speed”.

At present, Shenzhen has one of the strongest export economies in mainland China with strengths in high technology, logistics and finance. In 2009, Shenzhen’s GDP reached RMB 820,123 billion Yuan, per capita GDP was RMB 92,771 Yuan, social fixed-asset investment amounted to RMB 170,915 million Yuan, and social consumable retail turnover amounted to RMB 259.868 billion Yuan. With the total export volume of USD 270,155 billion, Shenzhen has ranked the first among the large and medium cities in China for 20 consecutive years (by the end of year 2012).

Las Vegas was settled in 1854 by a small group of Mormon settlers, who located near a spring in an area inhabited historically by native-American populations. Soon after the Mormon settlement, the U.S. military established an army post in the area for the purpose of governing native American populations and managing border disputes with Mexico. The city of Las Vegas was created in 1905. Through the early 1930s Las Vegas flourished as a small mining and ranching service center, stimulated by the discovery of gold and silver deposits in the region and resulting population immigration. The Nevada legislature legalized gambling in 1931, apparently with little discussion of possible long-term effects. Las Vegas slowly diversified into a gambling capital during the 1900s and 1940s. With gambling as the initial economic driver, communications and other industries also emerged. Tourism continued as a pillar of the city’s economy, however, and by 2000 it annually attracted close to 40 million tourists and provided about 300,000 jobs. The city’s entertainment and consumer markets have attracted entrepreneurs and capital from other parts of the U.S. and the world. With rapid investment in casinos, hotels and other amenities, Las Vegas experienced rapid population growth—at times it was the fastest growing city in the United States—and its landscape underwent multiple transformations.

9.3.1 Patterns of Urban Expansion

9.3.1.1 Geography

Shenzhen City neighbors Hong Kong in the south, at 113°46′–114°37′E and 22°27′–22°52′ N. Its total area is 1,952.84 km² including an area of 391.71 km² for Special Economic Zone. Shenzhen has a tropical ocean monsoon climate, with the constant annual average temperature of 24.0 °C, extreme maximum temperature of 38.7 °C, minimum temperature of 0.2 °C, frost-free period of 355 days, average annual rainfall of 1933.3 mm, and sunshine of 2120.5 h. Topographically, Shenzhen is high in the southeast and low in the northwest, comprised of both mostly hilly land and gentle terraces. Its western coast is the beach plain. The main river is Shenzhen River with a total length of 35 km.

Las Vegas is located at 36°10′ N and 115°08′ W, with an area of 340.0 km², including a land area of 339.8 km² and the water area of 0.16 km². The metropolitan

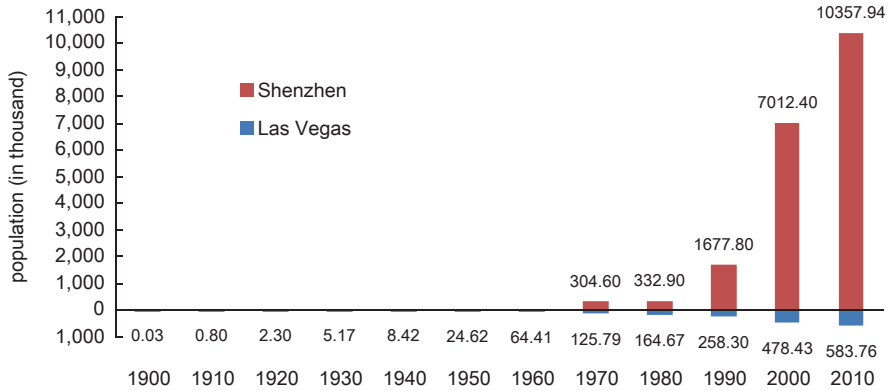


Fig. 9.10 Urbanization of population in Shenzhen and Las Vegas

area is 712 km². Its average altitude is 610 m. Las Vegas is of distinct seasons. In summer, it is of typical desert climate, with the temperature often up to about 38 °C at noon and a relatively cool temperature at night. In winter, the temperature is mild and comfortable as a whole, with an average temperature of about 15 °C at daytime. Las Vegas has the lowest relative humidity and perhaps the lowest annual rainfall of any major city in the United States (about 100 mm a year).

9.3.1.2 Patterns of Population Growth

Although both cities are young compared to Chengdu and Phoenix, Shenzhen is even younger than Las Vegas. As Fig. 9.10 shows, the population growth as a part of the urbanization process in Las Vegas began in 1900s with rapid increases since the 1980s. Shenzhen’s rapid population growth began as it was established as a Special Economic Zone in 1978. The urbanization process in the two cities is closely related to the influx of large populations.

Shenzhen was the original Baoan County of Guangdong Province. The population of Baoan County was 304,600 in 1970 and 312,600 in 1979, with an increase of only 8,000 over an entire decade. After 1979, Shenzhen City experienced a process of rapid population urbanization, with its population growing sharply (Fig. 9.11). From 1979 to the end of 1990, the permanent population grew at an average rate of 127,000 persons per annum. During the period from 1991 to 2000, the permanent population grew at an average rate of 533,000 persons per annum. From 2001 to the end of 2008, the permanent population grew at an average rate of 220,000 persons per annum. The average growth rate of permanent population was about 293,000 per annum in three decades, equal to population of a medium-size city. The pattern of its population growth was slow, fast and slow again. At present, Shenzhen’s population density is up to 24,564 persons per km², far higher than the provincial and national standard. Shenzhen is now the densest city in China.

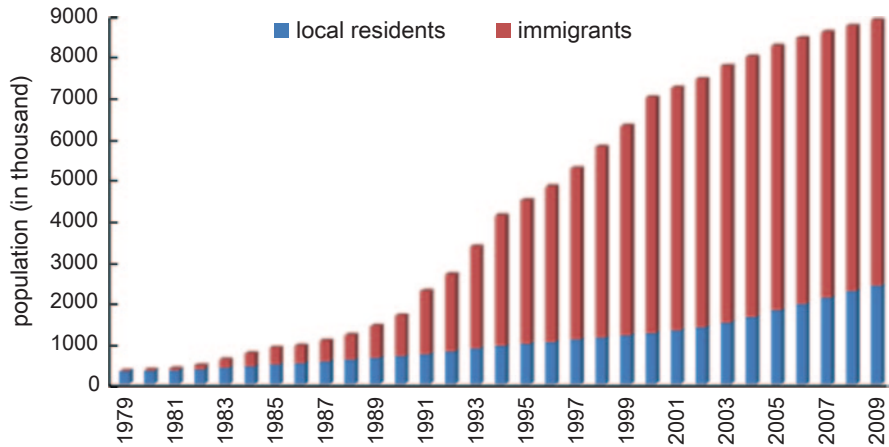


Fig. 9.11 Changes in number of Shenzhen’s permanent population and temporary population (1979–2009). (Shenzhen Manicipal Statistics Bureau 2010)

In 1900s, there was only 25 people in Las Vegas region (Fig. 9.11). Nevertheless, the number reached several thousand since 1920s, and became tens of thousands in 1950s. During much of the 1990s, Las Vegas is the city with fastest population growth rates in the U.S., with annual average growth rate of 85.2%.

9.3.1.3 Process of Landscape Transformation

Rapid urbanization of Shenzhen is not only represented in its social and economic development, but also in significant landscape change. Before 1979 Shenzhen was only a small frontier town (Fig. 9.12) with GDP of only 196 million Yuan in an area of only 3 km² Shenzhen has now become a modern international metropolis with high-rise buildings. Beginning largely as barren desert, Las Vegas evolved over just a few decades into a global leisure and entertainment capital.

The dynamic changes in Shenzhen land use can be observed by classifying and assessing the Shenzhen region using remote sensing imagery (Fig. 9.13). We see that the built up land uses in Shenzhen expanded from a scattered distribution in 1979 to a dense metropolis in 2010. In the early period of urbanization, development sprawled gradually outward around the already built-up area and traffic corridors. In recent years, the city’s spatial development pattern has been affected by topographic factors. The growth rate of the established area increased from 6.3% in 1980 to 33.5% in 2005. At the same time, the area of built up land in the Shenzhen region expanded from 2.9 km² in 1979 to 813 km² in 2009, with the proportion increasing from 0.15 to 41.63% in three decades, at an annual average growth of 20.67%.

Historical satellite imagery shows the rapid urban expansion in Las Vegas (Fig. 9.14). The extent of the build-up area in Las Vegas grew by three times during

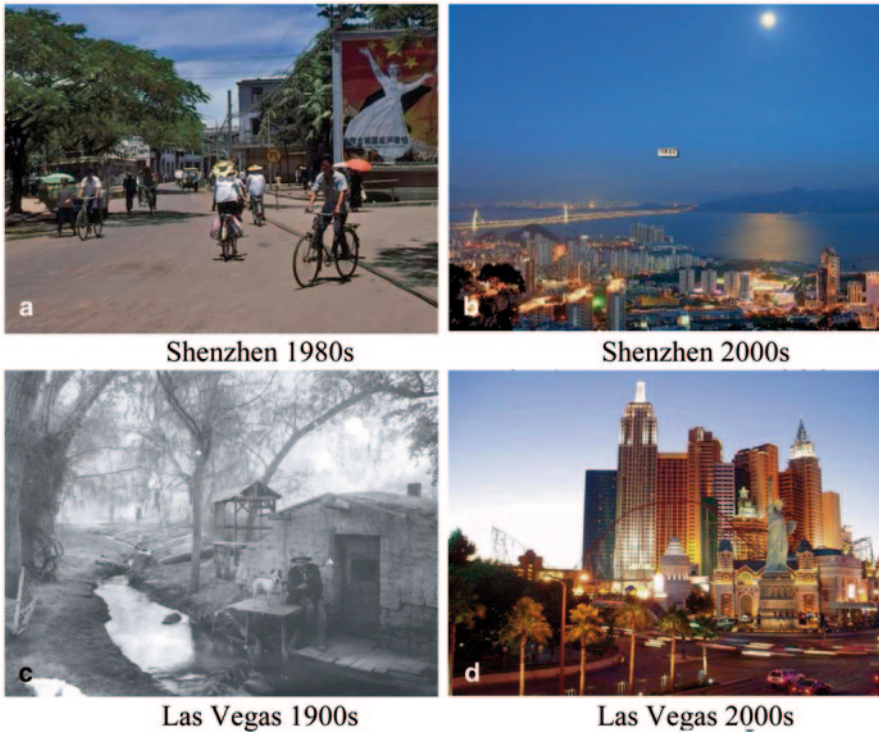


Fig. 9.12 Changes in urban landscape of Shenzhen and Las Vegas. **a** Shenzhen 1980s (<http://ly.sz.bendibao.com/tour/200986/ly119668.html>). **b** Shenzhen 2000s (<http://citylife.house.sina.com.cn/detail.php?gid=49738>). **c** Las Vegas 1900s (<http://www.gamblingweblog.com/tag/origins/>). **d** Las Vegas 2000s (<http://www.realbollywood.com/2012/09/spending-million-single-night-sin-city.html>)

this period (UNEP 2005; Wu et al. 2011). Visual browsing of the satellite imagery also suggests that the build-up area became denser during this period. Las Vegas developed in a desert without significant agricultural cultivation, which is one of the prominent ecological factors distinguishing Las Vegas from our other three case studies. In Las Vegas, the low level of land utilization around the city may have helped keep land costs low, in turn lowering overall development costs relative to competing regions such as southern California.

The expansion of Las Vegas has occurred largely in the western and southern directions. The old downtown, once close to the center of the metropolitan area, has been supplanted as the city's primary economic center by the Las Vegas 'Strip', which experienced an enormous influx of investment after 1990 by a new generation of casino corporations. The locations of the strip, airport, I-15 and other infrastructure have tended to pull new development investments toward the southern sector of the metropolis. Much of the new development has also occurred in independent jurisdictions such as Henderson, and the patterns of metropolitan expansion in Las

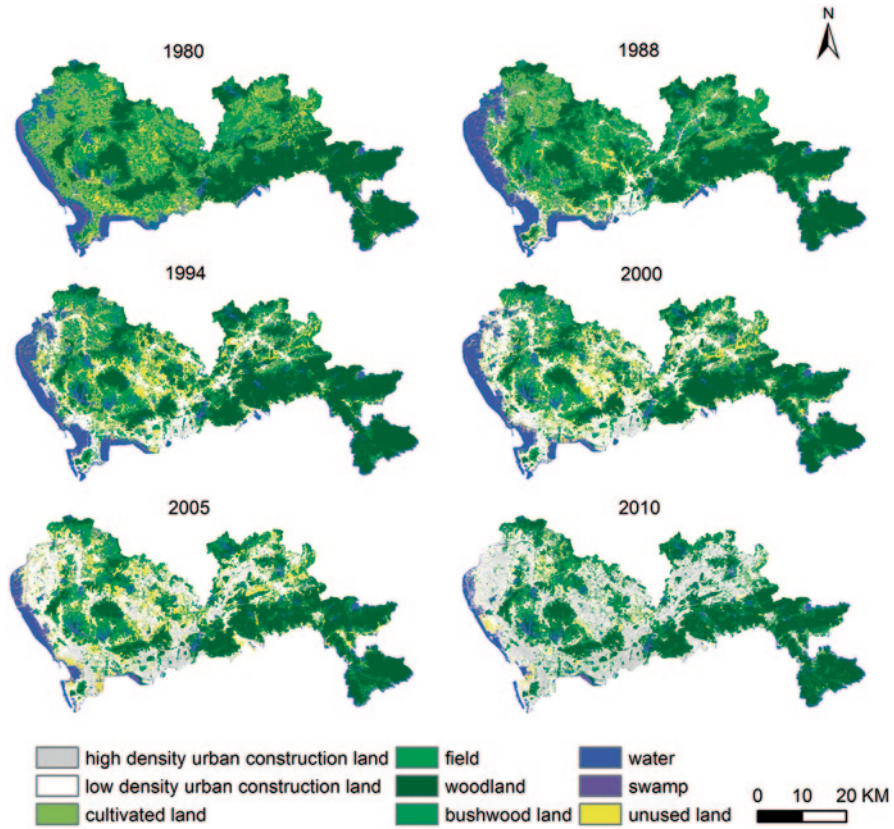


Fig. 9.13 Expansion of Shenzhen’s urban and built-up lands. (Yuan 2003; Zheng 2007; Xu 2004)

Vegas can be written in part as a story of competition among small and mid-sized jurisdictions. Amenities such as parks, golf courses and open spaces have also been concentrated in the south and west. Finally, development in the east has been limited in some areas by geographical factors including rough terrain.

9.3.2 Drivers of Urban Growth

The urbanization processes in our four case studies have important differences but also common elements. In the cases of Chengdu and Phoenix, cities emerged from advanced agriculture, post-World War II defense policy and as capitals of inland resource empires. Shenzhen and Las Vegas are a rather different type of case: they took off in a post 1980 growth boom as a result specialized interactions between economic dynamic and institutional innovations. We shall see in the following

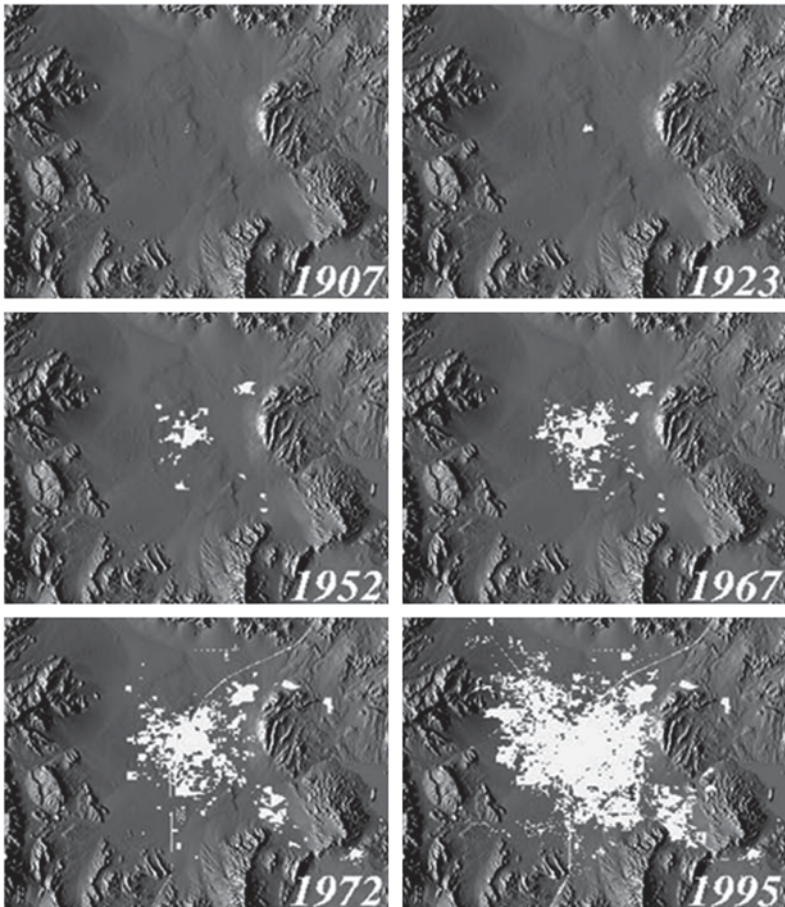


Fig. 9.14 Landscape urbanization of Las Vegas (1907–1995). (Wu et al. 2011)

sections the critical issues in the expansion of Shenzhen and Las Vegas and how policy design successfully create attractiveness to immigrants.

9.3.2.1 Regulatory Innovators

Without external incentives and economic reform, Shenzhen and Las Vegas probably would not have experienced rapid growth rates. In Shenzhen a special economic zone was established as an “experimental field” of the national economic reform and a “window” for the outside world. In conjunction with this zone the central government granted Shenzhen a series of preferential policies. With the support of such policies, Shenzhen became the pioneer in the reform of China, innovating

successively in various aspects such as land use system, taxation system, employment system and administrative system and laying a foundation for the rapid development of Shenzhen.

The most outstanding systemic innovation of Shenzhen was in the land use system. Before the reform the three fundamental problems with the policy of China for urban state-owned land were administrative allocation, charge-free and limitless use and prohibited transfer by users. In view of the above problems, Shenzhen Special Economic Zone carried out the reform of land policy mainly in two aspects: reform of land property system and land lease and pricing system. In November 1981, the standing committee of Guangdong's 5th Provincial People's Congress adopted the *Provisional Regulations for Land Administration of Shenzhen Special Economic Zone*, indicating that the land of Shenzhen entered the period of charged use. In 1987, Shenzhen Municipal Government promulgated the *Administrative Regulation for Land of Shenzhen Special Economic Zone*, indicating the official establishment of charged use and transfer system of state-owned land and the gradual formation of a land market in the special economic zone. On December 1, 1987, for the first time, Shenzhen auctioned the land, with a land lot of 8588.25 m² acquired by Shenzhen Special Economic Zone Real Estate Corporation at a cost of 5.25 million Yuan, with an average land price of 611.3 Yuan/m² and a use period 50 years. This auction was called "a milestone for the critical breakthrough in the land reform of China". On the premise of the experiment in Shenzhen Special Economic Zone, the Amendment to the Constitution of the People's Republic of China (1988) specified that "the land use right can be transferred according to law". In the same period, the Land Administration Law was promulgated, further specifying the charged use system of land. With such relaxation in land use system, land can be transferred (traded or leased) by its "use-right", which allows the emergence of a land market as well as the price system, leading to more efficient allocation of land resources. Availability of land is important to urban expansion of Shenzhen. In addition to the land use system, the Shenzhen Special Economic Zone also developed other economic innovations in areas such as taxation and finance. In general, the area became a pioneer of reform for the joint objectives of industrial promotion and urban development. In the special economic zone, preferential tax rates were implemented to attract domestic and foreign capital into the zone. During the early period, Shenzhen Special Economic Zone lowered the corporate income tax to 15%, which was the same as that in Hong Kong. In contrast the inland enterprises paid the tax at a progressive tax rate of 55%. In terms of finance, the first joint-stock commercial bank of China was established in Shenzhen in 1987, breaking through the conventional theory of state-owned banks. The first securities company also emerged in Shenzhen in the same year. Likewise, the Shenzhen Stock Exchange was founded in 1992 and became one of the two major stock exchanges in China. Under a regime of strict foreign exchange control, Shenzhen also took the lead in establishing the foreign exchange center in 1985. Other financial innovations such as mortgage and automobile loans and offshore financial services were all exported to the inland areas of China after being developed in Shenzhen.

With its policy advantages and bold innovations, Shenzhen provides a better investment environment than other regions and thus has created relatively strong attraction for foreign and domestic funds, technology, talents and other production factors. The area has organized itself as a conglomeration of modern production factors in a short period of time. Because of such open policies, in contrast to inland areas of China, Shenzhen became a national “policy control point”, forming agglomeration effects and becoming the source power for urban development.

The ban on gambling was repealed by the Nevada state legislature in 1931. At the same time, the Nevada legislature adopted liberal legislation governing marriage and divorce, which became another attractor for people fleeing the strict behavioral codes present across much of the United States. The first casino, the Pair-O-Dice Club, opened in 1931, with four more casinos opening up over the next 15 years. In 1946, the Flamingo Club opened its doors, establishing a new Las Vegas standard for clubs offering a ‘complete experience’, with luxurious hotel rooms, gardens, pools and entertainments. The industry has gone through another major upheaval over the past two decades or so, resulting in development of ever-larger resorts and themed experiences such as an emphasis on classical art and architecture at Bellagio. In alliance with the gaming industry, local and state governments have worked actively to stimulate further growth through marketing of the region; encouragement of public investment in water supply, electrical generation and defense industries; and regulation to strengthen the gaming industry and improve its image among policymakers and the public. Las Vegas has marketed itself through sophisticated cultivation of its image, beginning at least in 1945 when the city hired J. Walter Thompson to develop an advertising campaign promoting tourism. The city of Las Vegas has also been successful in securing infrastructure to support growth. Boulder dam, built with federal monies during the 1930s, has provided a relatively low-cost source of electricity and the first substantial growth spurt in the region. The city has also been successful in capturing water supply to support urban development, in part through the Southern Nevada Water Authority. Although Las Vegas has successfully implemented some conservation measures, its demand for water use is expected to stress regional water and other resources (Cooley et al. 2007). Finally, the city has benefitted from federal defense investments such as Nellis Airforce Base. With respect to regulation, Las Vegas developed an early reputation for lawlessness even during the 1930s when it provided entertainment to workers building Boulder Dam. By the mid-1940s, city leaders worked actively to discourage organized crime involvement in the casinos, and national policymakers put further pressure on the city and state through a Congressional investigation of organized crime in 1950. The state of Nevada adopted an important set of rules in the late 1950s designed to constrain the reach of organized crime in the gaming industry.

More recently, the gaming industry in Las Vegas has adapted to global competition by developing specialized marketing strategies and constructing more extensive infrastructure. Over the past 20 years, casinos have been designed with iconic architecture to attract visitors. They are open for business around the clock. Meals are ordered by a wave of the hand. The airport provides access to destinations worldwide and supports a variety of private craft. Other cities in Nevada and

elsewhere in the country have also emerged as gambling centers, but Las Vegas still represents the largest spatial concentration in the U.S. gaming industry because of its convenient transportation links and other historical advantages.

9.3.2.2 Advantageous Regional Conditions

In our two cases, the advantages of regulatory innovation are associated with two factors: proximity to a global city, and opportunity to exploit comparative advantage by attracting economic activity from places under a traditional regulatory regime. The rapid development of Shenzhen and Las Vegas are closely associated with these advantageous regional conditions.

The regional advantage of proximity to Hong Kong is a fundamental advantage that enabled Shenzhen to grow at a rate faster than that of other cities in China. The geography of Shenzhen is intertwined with that of Hong Kong. They have a common boundary of 27.5 km. Shenzhen is astride the only land route by which the inland can communicate with Hong Kong, and by which Hong Kong can enter the *Pearl River Delta* and interact with the inland. Due to the long-term operation of global regional political and economic pattern, Hong Kong became a central node of the world economy. The economic and social differences between Hong Kong and Shenzhen acted as a mutual attractor. Hong Kong was a “free port” with a highly-developed economy, differing from its neighboring Shenzhen in social system, institutions, economic strength, urban position and social form. The development of Shenzhen, especially its initial stages, is “Hong Kong-oriented”, and its urban form had its start by sprawling outward from *Luohu*, *Shatoujiao* and *Shekou*, all of which lie in close contact with Hong Kong.

Hong Kong has influenced the urban economic development of Shenzhen in several dimensions. First, the large-scale industrial shift from Hong Kong was the fundamental driver for the takeoff of industry outside the special economic zone in Shenzhen. After the late 1970s, the tertiary industries of Hong Kong had developed rapidly, but its export labor-intensive industries were constrained by the increasing land price and high labor cost. Thus, Hong Kong needed access to a development region with lower total costs. When China broke through the political boundaries separating Shenzhen and Hong Kong with the unique policy of the special economic zone, Hong Kong moved quickly to take advantage of the availability of land and low labor costs in Shenzhen. Second, Hong Kong moved capital as well as industry to Shenzhen. The large-scale investment from Hong Kong stimulated the process of urban construction in Shenzhen, and the rapid development of the built-up area. Hong Kong capital has continued as the major source of foreign investment in Shenzhen. Third, the regional advantage of neighboring with Hong Kong has inspired Hong Kong people to consume in Shenzhen, driving the rapid development of tourism, commerce, housing and other material forms in Shenzhen.

The competitive advantage of Las Vegas derives substantially from its location near the population centers of southern California, which provided investment capital, industry expertise, a customer base and access to the entertainment industry that

were a critical ingredient in the expansion and marketing of Las Vegas. In 1938, California began an aggressive campaign against gambling, which created a sharply different regulatory environment between the two states. Parts of the gaming and entertainment industries moved to Nevada as the regulatory environment for gambling in California became less permissive. For many years, southern California remained an important market for the Las Vegas gaming and entertainment industries. Beginning in the 1940s, Las Vegas developed a glamorous cachet based on Hollywood connections, particularly association with stars such as Liberace, Frank Sinatra and Sammy Davis Jr. This relationship was a competitive advantage of Las Vegas during this period, differentiating it from other historical centers of gambling and entertainment in the country such as Galveston Island, Texas and New Orleans, Louisiana. The growth spurt of Las Vegas after 1980 is in large part a product of its low taxes, housing and living costs relative to California. As California's urban population growth took off in the post-World War II period, costs of land, construction, retail products, public services, labor and other factors escalated, and home ownership was no longer feasible to many residents of the state. Las Vegas emerged as a primary low-cost alternative, and attracted migration both by individual households as well as employers.

Las Vegas has also grown as a result of multi-modal transportation links that provided convenient access to first domestic and now international markets. McCarran International Airport has become a significant hub for air traffic. The Union Pacific Railroad extends through Las Vegas and at least earlier in the century was an important mode for passenger traffic in the region. Interstate I-15 is an increasingly important north-south route through the Intermountain West.

9.3.2.3 Industrial strategy and competitive advantage

In the early period of establishing the special economic zone, Shenzhen developed the economic model of "processing with supplied materials, processing as per sample, processing with samples supplied, assembling parts supplied and compensated trade" which largely simulated the growth of secondary industry. After the 1990s, seizing the opportunity afforded by the rise of global information and distribution systems; Shenzhen diversified its industrial structure. Tertiary industries starting to develop and the proportion of the high-tech sector in the secondary industries gradually increased. More recently, the modern tertiary industry with finance and logistics as the core developed rapidly. Business, trade, tourism and real estate also have emerged with a major share in the economic activities. At present, Shenzhen has established a new industrial system of "adapting to the functions of modern central city with the high-tech industry and advanced manufacturing as the base and with the modern tertiary industry as the support".

Gambling is the best-known industry in Las Vegas but the city's economy is not limited to it. The rapid development of gambling industry in Las Vegas stimulated the rise of general tourism and other industries. After the 1980s, Las Vegas built a broader range of service and manufacturing industries and developed an increasing-

ly diverse employment base, with an important concentration in housing and land development. Because of the city's rapid population growth since the early 1980s, it was deeply exposed to the national recession and decline in housing markets after about 2007. The city proved to be particularly vulnerable to weakness in the construction industry and highly-leveraged housing credit markets. The contraction and troubles in these industries have led to high unemployment rates and thrown into question the recent Las Vegas model of economic development.

9.4 Conclusions

Urbanization and urban sprawl are the produce of human society and economy developing to a certain extent, but still a kind of result and representation of the interactions of man-land system on the earth surface. These four cities have different origins and influences, but many areas of commonality. From the perspective of urban geography, the development of a city is constrained or stimulated by three factors: natural conditions; regional and national economic context; and growth strategy. In this chapter we compare four Chinese and U.S. case study cities across these three dimensions, contrasting two U.S. and Chinese cities with a relatively long urban history and two U.S. and Chinese cities with a relatively short history.

Topographically, the four cities are all situated in a relatively flat region, notably the Chengdu Plain where Chengdu is located. They are all located in the northern temperate zone. Water supply is a critical natural resource for all four cities. Chengdu, Phoenix and Las Vegas have secured water resources necessary to support urban growth through large-scale water supply and conservation projects. Shenzhen mainly depends on large reservoirs in the city to assure the supply of fresh water.

In terms of regional geography and investment strategy, all four cities had considerable intrinsic advantage which they were able to build through policy and investment. The young cities of Shenzhen and Las Vegas had the advantage of location at the periphery of a global megalopolis, which they exploited through regulatory and administrative innovations. Chengdu and Phoenix had the advantage of location in the center of inland resource regions, which they cultivated through military and infrastructure investment. Chengdu, for example, is well-situated within Sichuan Province, but the establishment of its economic position with respect to Southwest China is closely associated with development of several important railways. All four cities used their geographical and policy advantages and early-stage investments as a foundation for development of industry specializations including technology industries, construction and services in Phoenix; gaming, tourism and construction in Las Vegas; and technology, logistics and finance in Shenzhen.

Growth processes in all four cities are associated with patterns of spatial dispersion and fragmentation typically characterized as sprawl. In both our U.S. and Chinese case studies, regional and global immigration was a primary driver of urbanization process, and the process of immigration in itself may have led to dispersed and fragmented development. For example, in our U.S. cases, cultural images including

the oasis, the retirement suburb and Los Angeles-style modernism attracted immigrants to new, low-density subdivisions. The suburban morphologies characteristic of postwar residential development in the U.S. have more recently been adopted in China. Immigration has also stimulated development of specialized districts such as low-cost housing areas and ignited political and social tensions that may have tended to fragment overall urban patterns. In all of our case studies secondary industries emerged including public employment, distribution and logistics, and service industries such as health care. These generated additional growth dynamics around development of dispersed sub-centers. Military and government facilities and technology industries have also, at least until recently, tended to choose low-cost locations on the urban periphery. Demands for semi-natural amenities such as golf courses have also stimulated development at the urban periphery. In general, these pressures over time have led to development of a dispersed metropolitan geography, conspicuous in our U.S. cases and emerging in the two Chinese cities.

This chapter also suggests that even with urban applications of advanced science and technology, the viability and further growth of cities remains sharply constrained by natural conditions and availability of resources. Current development patterns in all four cities tend to be associated with high rates of energy, land and water consumption and depletion of ecological services such as habitat and hydrological function. All four cities have to a greater or lesser extent modified their environmental conditions through infrastructure development and adoption of conserving behaviors, but they still appear vulnerable to long-term problems of resource depletion, ecological disruption or natural disaster. The urban sustainability movement, focusing on compact cities alternative travel systems and resource-efficient building systems, offers one strategy to reduce resource consumption in both U.S. and Chinese cities. It is unclear whether the ideals of this movement can be engineered and implemented. The history of the *Dujiangyan* Water Irrigation Project near Chengdu is uplifting, however: it suggests that long-term environmental adaptation—sensitive to or even in harmony with local conditions—is achievable.

In discussions of global climate change, capacity for adaptation has become an important measure of the success of human systems at a global, national or urban scale. Cities are able to adapt if they have the institutions and abilities in place to manage complex and changing relationships between human and natural factors such as water use, hydrologic and ecological process, heat, landscaping, agriculture and economic development strategy. Building the knowledge, technology and institutions to manage these relationships is the fundamental challenge for the next generation of cities. Over their recent histories, Phoenix, Las Vegas, Shenzhen and Chengdu have been successful in building urban development systems that emphasize promotion of economic growth while also managing environmental resources. In the past decade or so, these cities have begun to bump up against less tractable resource constraints and environmental risks. Their challenge for the next decade is to rethink urban form around new relationships between growth strategy and resources, and rebuild the adaptive systems to manage it.

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