Viewpoint

The urban system in West China: A case study along the mid-section of the ancient Silk Road – He-Xi Corridor

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The evolution of the urban system in the semi-arid and arid West China has a close relationship to the origin, prosperity, and decline of the ancient Silk Road. This urban system bears noticeable inscriptions of the fragile physical environment, complex ethnic mix, and changing political systems and policies. This paper uses the mid-section of the ancient Silk Road – He-Xi Corridor as a case study to examine the challenges of urban development in West China and to propose suggestions for future development from the perspective of comprehensive planning. The research focuses on a series of seven cities and numerous towns which primarily serve the local population by providing different functions, beyond their value to travelers and historians. These cities are rapidly gaining importance to provincial and national authorities. Although current political, social, and economic influences are significant, a considerable part of their evolution can be explained by the natural environment, primary resources, ethnic differences, and their geographical distributions. The investigation examines the relationship between the evolution of these urban centers and internal and external conditions and provides a base for planning policy to enhance their viability as significant nodes for future development.

Keywords: Challenges of urban development, arid/semi-arid environment, Urban system, He-Xi corridor, West China

Introduction

The 2000 Census in China clearly identifies a pattern of accelerated urbanization. The urban population rose from 20% of the nation’s population in 1982 to 36% in the year 2000, a net gain...
of 16% in less than two decades. Much of China’s accelerated urbanization has taken place in economically advanced regions of the East Coast, particularly where the influence of market reforms and globalization have been most strongly felt. However, less is known of the urban development in West China, part of the nation’s vast hinterland. Due to the limited data and inconspicuous economic achievement, little literature has been found on how the urban system evolves in this region.

West China is a geographic term which is used by ordinary Chinese to indicate remote parts of China where ethnic minorities are concentrated. These areas usually include Yunnan, Guizhou, Sichuan, Qinghai, Tibet, Inner Mongolia, Xinjiang, Gansu, and Ningxia. The first five provinces and autonomous regions consist of three topographic units. Yunnan-Guizhou Plateau is located in southwest China with a subtropical climate and changing landscape. Sichuan is a large basin with several huge river systems flowing through, such as the Yangtze River. Qinghai-Tibet Plateau is the largest and highest plateau in China, with an average elevation above 4000 m. The last five provinces and autonomous regions are located in the semi-arid and arid areas in China, called the Great Northwest, which is often taken as West China.

Cities in arid/semi-arid West China are largely located in the oases dotted on the diluvial fans and alluvial plains along the feet of mountains and the rivers. They rely heavily on melt glacier water and face severe shortages of water resource. They are situated in minority concentrated areas. The city system there originated with the thriving silk trade and military installations to protect trade and consolidate the Han People’s (Mandarin) controls. The urban growth was challenged by a fragile physical environment, long-standing ethnic conflicts, and changing politics. The urban growth has taken a unique path deviating from what is commonly seen in coastal China. In general, the urbanization level was low and the living standard was poor. The gaps between cities in West and East China have widened, which has been causing political instability and a resurgence of nationalism, and led to a new campaign for exploiting West China by the Chinese central government.

In this paper, we plan to examine the challenges West China is facing to modernize its economy, and to propose future development strategies from the viewpoint of comprehensive planning. Since West China covers a vast region, this paper analyzes the main characteristics of urban development along the middle section of the ancient Silk Road of China as a window to examine urban systems in West China (Figure 1). The rationale for us to choose this area as the case study includes the following points. The study area is located west of the Yellow River, called He-Xi (River-West) Corridor. The cities in He-Xi Corridor have similar physical environments to those cities in West China. In addition, He-Xi is located at the transitional zone between West and Central/East China. Through its long history, this area has been a frontier buffering the Mandarin Chinese and ethnic minorities. Urban growth in this region reflected complex interactions between harsh environments, recurring ethnic conflicts, and human struggles for survival. Another point worth noting is that many cities in this region were promoted as important inland industrial bases after the establishment of the People’s Republic of China and before China’s economic reforms, and have been reenergized as important bridges to relay economic miracles from the east to the west in recent years. Therefore, an understanding and exploration of urban development in this area will serve as a good pilot for learning lessons to provide guidance to the overall development of West China.

An introduction of the urban system in He-Xi Corridor will be presented in this section. The challenges of urban growth will be examined in a coherent manner from the region’s physical environments, ethnic compositions, historical heritages, political forces, and urban system characteristics in the second section. The future planning strategy will be proposed in the discussion and conclusion section.

Figure 1 The route of ancient Silk Road.
Cities in China are official establishments that require administrative designation and receive fiscal resources from the Central State Government (Xie and Costa, 1991; Yeh and Wu, 1999; Lin, 2002); The officially designated cities in China consist of three ranks: (1) national municipalities directly under the administration of the Central State Government, such as Beijing, Shanghai, Tianjin, and Chongqing, whose governments enjoy administrative power equivalent to the provincial governments; (2) provincial cities (often called district-level cities) under the administration of provincial governments, and (3) county-level cities under the administration of provincial city governments (Xie and Costa, 1993). A national municipality or provincial city is also an administrative entity. In addition to its host urban district (often called the city proper by Chinese planners), it usually administers a number of suburban districts, adjacent counties, and county-level cities. The city proper (urban district) is the popular definition of the geographic area of a municipality or provincial city. The city proper is often named after the city. However there are exceptions (see the next paragraph). Moreover, in the Chinese definitions of administrative and statistical geography, a municipality or provincial city includes a much large area, the city proper and its administered suburban districts, counties, and county-level cities.

The study area (He-Xi Corridor) consists of the western half of Gansu Province, including five provincial cities (Table 1 – left-adjusted and in bold fonts; Figure 2). Jiyuguan is a provincial city, but does not contain any counties or county-level cities (Table 1). Jinchang, Wuwei, Zhangye and Jiuquan all contain one urban district (city proper) and one (Jinchang) to five counties (Zhangye). Jiuquan also includes two county-level cities (Yumen City and Dunhuang City). Interestingly, all host urban districts (cities proper) are named differently from these provincial cities (Table 1), which is seldom seen in East China. This may reflect the fact that these cities’ urban districts do not have dominant populations and economies compared with the counties or county-level cities (see “The challenges of urban growth” section).

Table 1 The urban systems in the He-Xi Corridor in 2000

<table>
<thead>
<tr>
<th>Region</th>
<th>Total population (year-end) (10,000 persons)</th>
<th>Non-agricultural population (10,000 persons)</th>
<th>Percent of non-agricultural over total population (%)</th>
<th>Total land area (km²)</th>
<th>Developed areas (km²)</th>
<th>GDP (10,000 yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiayugan City</td>
<td>15.96</td>
<td>13.55</td>
<td>84.90</td>
<td>2935</td>
<td>34.00</td>
<td>179,307</td>
</tr>
<tr>
<td>Jinchang City</td>
<td>45.25</td>
<td>20.99</td>
<td>46.39</td>
<td>8966</td>
<td>41.00</td>
<td>350,746</td>
</tr>
<tr>
<td>Jinchang Proper</td>
<td>20.49</td>
<td>15.46</td>
<td>75.45</td>
<td>3019</td>
<td>34.90</td>
<td>228,459</td>
</tr>
<tr>
<td>Yongchang</td>
<td>24.70</td>
<td>5.93</td>
<td>24.01</td>
<td>8777</td>
<td>6.10</td>
<td>122,287</td>
</tr>
<tr>
<td>Wuwei City</td>
<td>191.10</td>
<td>28.22</td>
<td>14.77</td>
<td>32,517</td>
<td>24.66</td>
<td>636,269</td>
</tr>
<tr>
<td>Liangzhou Proper</td>
<td>99.20</td>
<td>19.64</td>
<td>19.80</td>
<td>4874</td>
<td>15.71</td>
<td>427,607</td>
</tr>
<tr>
<td>Minqin</td>
<td>32.27</td>
<td>3.31</td>
<td>10.93</td>
<td>15,871</td>
<td>4.05</td>
<td>87,600</td>
</tr>
<tr>
<td>Gulang</td>
<td>38.95</td>
<td>2.08</td>
<td>5.34</td>
<td>4975</td>
<td>2.00</td>
<td>64,010</td>
</tr>
<tr>
<td>Tianzhu</td>
<td>22.67</td>
<td>3.12</td>
<td>13.76</td>
<td>6797</td>
<td>2.90</td>
<td>41,613</td>
</tr>
<tr>
<td>Zhangye City</td>
<td>125.76</td>
<td>21.44</td>
<td>17.05</td>
<td>41,924</td>
<td>41.20</td>
<td>640,889</td>
</tr>
<tr>
<td>Ganzhou Proper</td>
<td>48.14</td>
<td>12.24</td>
<td>25.43</td>
<td>4240</td>
<td>20.00</td>
<td>262,000</td>
</tr>
<tr>
<td>Sunan</td>
<td>3.54</td>
<td>0.95</td>
<td>26.84</td>
<td>20,456</td>
<td>1.70</td>
<td>22,450</td>
</tr>
<tr>
<td>Minle</td>
<td>23.86</td>
<td>1.60</td>
<td>6.71</td>
<td>3678</td>
<td>4.30</td>
<td>91,100</td>
</tr>
<tr>
<td>Linze</td>
<td>14.62</td>
<td>1.94</td>
<td>13.27</td>
<td>2727</td>
<td>3.40</td>
<td>77,087</td>
</tr>
<tr>
<td>Gaotai</td>
<td>15.85</td>
<td>1.86</td>
<td>11.74</td>
<td>5421</td>
<td>5.00</td>
<td>75,898</td>
</tr>
<tr>
<td>Shandan</td>
<td>19.75</td>
<td>2.83</td>
<td>14.33</td>
<td>5402</td>
<td>6.80</td>
<td>105,234</td>
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<tr>
<td>Jiuquan City</td>
<td>95.11</td>
<td>33.56</td>
<td>35.29</td>
<td>194,000</td>
<td>67.15</td>
<td>728,737</td>
</tr>
<tr>
<td>Suozhou Proper</td>
<td>33.66</td>
<td>11.04</td>
<td>32.80</td>
<td>3386</td>
<td>25.00</td>
<td>184,205</td>
</tr>
<tr>
<td>Jinta</td>
<td>13.85</td>
<td>2.54</td>
<td>18.34</td>
<td>18,800</td>
<td>4.50</td>
<td>83,067</td>
</tr>
<tr>
<td>Anxi</td>
<td>9.16</td>
<td>9.16</td>
<td>100.00</td>
<td>24,100</td>
<td>4.10</td>
<td>55,429</td>
</tr>
<tr>
<td>Subei</td>
<td>6.68</td>
<td>0.53</td>
<td>45.69</td>
<td>66,700</td>
<td>2.50</td>
<td>11,972</td>
</tr>
<tr>
<td>Akesai</td>
<td>0.77</td>
<td>0.77</td>
<td>100.00</td>
<td>31,400</td>
<td>0.75</td>
<td>11,757</td>
</tr>
<tr>
<td>Yumen City</td>
<td>19.40</td>
<td>11.49</td>
<td>32.80</td>
<td>13,500</td>
<td>16.00</td>
<td>253,981</td>
</tr>
<tr>
<td>Dunhuang City</td>
<td>17.10</td>
<td>4.55</td>
<td>25.43</td>
<td>31,200</td>
<td>14.30</td>
<td>89,414</td>
</tr>
</tbody>
</table>

Note: The bold and left-aligned city is a provincial city that is directly under the jurisdiction of the Provincial Government of Gansu. A provincial city often administers a host urban district called city proper (see the next footnote) and several counties or county-level cities (for instance, Jiuquan City). The right-aligned counties are under the jurisdiction of this left-aligned provincial city.

b The italicized names have two instances. The term ending with Proper only indicates the primary city area (host urban district) that excludes suburban towns and countryside communities. The term ending with City means a county-level city that is under the jurisdiction of a provincial city government.

c The location name without a city or proper suffix is a county name. A county often indicates an administrative unit with a primary function of agriculture and rural economy. A county may contain several towns, but usually does not have a large concentrated urban center that could be designated as a city.
brief, He-Xi has 5 provincial cities (Jiayuguan, Jinchang, Wuwei, Zhangye and Jiuquan), 2 county-level cities (Yumen and Dunhuang), and 13 counties.

The challenges of urban growth

The challenges of urban growth in this region can be summarized in a few sentences. This region is located in a remote area where the physical environment is harsh in terms of climate and water supply, which leads to sparse population and slow economic development. Moreover, this region has been a primary buffer belt between the predominant Han population (Mandarin) and its culture, and other ethnic groups and their cultures. Recurring ethnic struggles and wars over territorial controls impeded economic development (Wei, 2001). Environmental severity and political instability have been main factors that determined the socioeconomic features in this region.

Arid/semi-arid climate

Urbanization in this region bears noticeable marks of its physical environments (location, climate, landscape, hydrology, and natural resources). He-Xi is located in semi-arid and arid areas. The annual rainfall decreases from 158 mm at the east to 35 mm at the west (Gansu Statistic Bureau, 2002). The importance of geologic events is attributed to the tectonic activity during the Silurian period of the Paleozoic era (444–416 million years ago) which molded the Qilian Mountains (Zhao, 1997). Millions of years of glacial activities on the Qilian Mountains created a huge solid reservoir of gravels and sands. The result is a 1120 km level area referred to as the present day He-Xi Corridor. Melt water from the mountain glaciers are the primary source of water in addition to the limited rainfall.

Being confined by the physical conditions of geology, physiognomy and water resources, cities and towns were developed at the base of the mountain on the diluvial fans and alluvial plains, and along the rivers supplied with the glacier melt water. For instance, the Shiyanghe River flows through Wuwei City, and the Heihe River flows through Zhangye City. Jiuquan City and Jiayuguan City are adjacent to the Beidahe River. Yumen City is near the Changmahe River, while Dunhuang City is located near to the Danghe River. So, the spatial distribution of the cities is determined by the spatial pattern of river systems. Therefore, the fortunes of many these cities are affected by the hydrologic changes discussed in following sections.

A remote region with multiple ethnic minorities

The He-Xi Corridor has been a concentrated area for many ethnic minorities in its centuries-old history. More than a dozen ethnic groups and dozens of their tribes were reported to live in this region in the Qin dynasty (about

Figure 2 The cities in the He-Xi Corridor, Gansu Province of China.
the 2nd century B.C.). There are more than 24 ethnic minorities living in He-Xi in modern times (Jiuquan Yearbook Editing Committee, 2003). Administratively, there are four ethnic autonomous counties, Tianzhu Tibetan, Sunan Yugur, Subei Mongolian and Akesai Kazak (Table 2). From Table 2, we know that the population densities in these minority counties are far lower than the average level of the He-Xi Corridor, but the GDP per capita, the financial revenue per capita and the annual rural net income per capita are higher than the average levels of He-Xi Corridor, except for Tianzhu County. Obviously, these less-populated autonomous counties have comparative advantages to develop animal husbandry due to vast grasslands and small populations. However, the long-term nomadic life has hindered the speed and depth of technical, cultural, education and social development. Consequently, the people’s living standard is very low. The life style is relatively isolated and there is little exchange beyond local villages or tribes. Ethnic minority groups do not have the cultural resources to cooperate with people of other ethnic origins. They are reluctant to accept new ideas of market economics and new thoughts of coordinated development. Distrust and conflicts often exist between various minorities. In very recent years, some level of sympathy toward nationalism, separatism and terrorism has been developed here, which seriously distracts the attention of both individuals and governments from economic development (Zhang et al., 2004). The general directive from the Central Government of China is that the political stability in the minority areas takes priority over economic and social development (Zhou, 2002).

Ethnic conflicts have been an important part of the history of this region. He-Xi was a frontier in ancient China since the first Chinese dynasty of Qin. Over more than 2000 years, battles for controlling this vast territory were recurrent. He-Xi was actually controlled and administered by more than a dozen minority groups, including the Wusun, Yueshi, Xiongnu, Xianbei, Turki, Tubo, Huihe, Qidan, and Mongoils. Fighting for control or expelling the influences or intrusions of minority groups into the Mandarin hinterland was often important to the Chinese emperors and dynasties (Fan, 1994), although Mandarin control over this region was periodic and short-lived. The most significant control by Mandarins was from 133 to around 50 BC under the Han Dynasty (Li, 2000).

He-Xi developed under the unique interactions of its physical environments and social conditions, flourishing and declining with Silk Road trade, suffering from accelerated environmental deterioration and desertification, while severe water shortages hindered economic development. Industrial development was heavily dependent on natural resources. Its political significance was overemphasized, and urbanization levels remained low. These characteristics of He-Xi Corridor deeply reflect the challenges from both physical and anthropologic factors, which will be presented below.

Flourishing and declining with the Silk Road trade

Due to its unique location as a corridor between Central and West China, and between East and Central Asia and the Middle East, trade and related services were critical to the original development of He-Xi. Many early adventurers made forays into unknown lands to seek the wonders and riches of those who had interesting material goods to offer. Thus was the beginning of the trade routes between China, the Middle East, India, and as far away as Italy, which had their origins during the period of the Han Dynasty (206 BC–8 AD). The beginning of the journey was Chang’an, currently known as Xi’an, and then the caravan route divided into the North Road and South Road as it crossed the West New Territory (called Xinjiang Autonomous Region in Mandarin Chinese: Figure 1). For approximately 1700 years it often flourished as the most important overland trade route in history. Although ancient, this route was proclaimed the ‘road of silk’ (Silk Road) by the Germanic geographer, Ferdin von Richthofen, in his 19th century book ‘China’ (Dickinson, 1969). According to Dregge and Buhler (1896), the initial route was blocked by the Xiongnu who were antagonistic nomadic people occupying the arid parts of present day Western China and what is now part of the Islamic world that borders China. Trails varied in an east–west direction to avoid warring people and to take advantage of water resources. Along these trails moved agricultural products, other material goods, and technology as urban clusters sprouted around oases to serve as focal points for tribal people and traveling caravans.

The ancient Silk Road passes through most cities and towns in He-Xi Corridor which includes Tianzhu, Gulang, Wuwei, Yongchang, Shandan, and...
Minle, Zhangye, Linze, Jiuquan, Jiayuguan, Anxi, Dunhuang, and a handful of others (Figure 3). The early urban clusters passed through cycles of relative prosperity and decline. Originally these cities developed as long distance posthouses and teahouse market sites. As they emerged, their functions evolved into military and economic centers as the Han Dynasty encouraged western expansion. During a period of turbulence, when fighting occurred for control of these sites, the Hanwu Emperor Liu Che (141–87 BC) reoccupied the present day He-Xi Corridor and created four counties: Wuwei, Zhangye, Jiuquan, and Dunhuang which remain as part of the current administrative structure. Concurrently, he created ten towns in Wuwei, ten more in Zhangye, nine in Jiuquan, and an additional six in Dunhuang (Ban, 1962). These towns have been restructured as historical Silk Road urban sites based on the county-town system in the Han Dynasty (Fang, 1991). Today these cities and towns function as commercial locations, yet in the broader context, some of them are now emerging as tourist attractions along the Silk Road. These are exemplified by the world-renowned Mogao Grotto at Dunhuang, which is drawing international attention.

Prosperity and stagnation characterized the development of these cities during the Tang, Song, and Yuan Dynasties. As China’s maritime trade expanded, the Silk Road routes decreased in significance. During the Ming and Qing Dynasties the government adopted a closed-door policy. This resulted in the existence of isolated urban clusters and minimal interaction with the world outside of Western China. Peace was interrupted during the Mingguo (the Republic of China and Nationalist Government) era and periodically local warlords fought for control. Buddhist enclaves continued their timeless ways while China and the steppe land region paid little heed to activities along the Silk Road.

Accelerated environmental deterioration and desertification

It has been a constant struggle to build suitable human residences and economic activities in this region due to the harsh environment. This is especially evident in the case of water resources which are dependent on glacial melt and limited rainfall. The desired harmony by the inhabitants has long been fragile since they have been faced with a challenging natural environment. In many ways the people have been their own worst enemy. Many physical events are attributed to excessive human activities. These include natural disasters, river flooding and siltation, fluctuations in the quantity and quality of water resources, soil and groundwater salinization, and desertification. These catastrophic events had direct negative impacts on peoples’ economic activities and survival and would often force them to migrate.

Frequent extreme natural disasters caused the prosperity of some urban
places to decline and disappear. As the environment changed, people moved to adjust new conditions. Zhangye City is a good example to show locational changes of an urban area. Zhangye was established in 111 BC and was called Yande City at that time (Ban, 1962). This urban area lies on the western edge of an alluvial fan along the middle reaches of Heihe River. The terrain was level and the water resource was sufficient in the historical past for urban development. The evolution of Zhangye City extended through the later Han (25–220 AD), the Three Kingdoms (220–280 AD), and the Jin Dynasty (265–420 AD). However residents from the ancient city of Yande moved to Yongping, now known as Zhangye City, and Yande ceased to exist. The change of this city’s site was attributed to natural causes and mismanagement. The vegetation cover was modified, which contributed to the invasion of the Badajilin Desert. This led to torrential flows of water and debris from the mountain channels, and ultimately the migration of the Heihe River.

During the early Ming Dynasty (1368–1644 AD), there was a halcyon period of national economic prosperity (Yang, 1995). Population dramatically expanded and concentrated in many urban areas and over their surrounding irrigated fields along the Silk Road. As growth occurred, the need for forest material for construction and fuel led directly to deforestation and increased water consumption in the upper rivers. A temporary imbalance of population and resources produced a disharmony. Soon there was an inadequate amount of usable water for irrigation and many areas lost agricultural productivity. Wind erosion followed, and the desert expanded. Several cities, including Guanzung City, Suoyang City, and Bulongji City, fell into disuse as the rivers changed directions and the people moved away to search for better residential and agricultural sites. The historical city of Dunhuang is another illustration of natural events influencing the evolution of an urban area (Ma and Li, 1992). Dunhuang City was located to the west of the Danghe River. It was moved to the east bank because floods occurred during the early years of Qing Dynasty (the late 17th century), Over time the development of the urban system in He-Xi Corridor experienced an arduous and fluctuating path, yet its heritage remains attached to the world renowned Magao Grotte.

Desertification has accelerated in recent decades in He-Xi Corridor. The active frontier of the deserts in He-Xi reaches 1600 km, and nearly 30% of villages and farm households are distributed in the affected zones. Although a forest protection belt longer than 1000 km has been built to prevent sands from moving, the frontiers of the deserts are still moving at a speed of 3–5 m per year. The desertification area increased 156,000 ha annually in 1970s, 210,000 ha in 1980s, and 240,000 ha in 1990s (Dai and Fang, 2002). The average reduction was about 100 million m³ per decade. In addition, the water resource per capita was reduced at a speed of 0.0026 m³ every year. Subsequently, the cropland and irrigated area decreased quickly (Figure 4).

Severe water shortage hindering urban development

Water is the crucial to the development of oases in arid and semi-arid areas. A finite quantity of water can only irrigate a limited area of cropland and support a certain level of population and economic activities. Because the cropland area in He-Xi expanded year by year since the Han Dynasty, the water supplies cannot meet the increasing demands of irrigation. Subsequently, a large amount of farmland was nibbled by desertification. Moreover, the tail lakes of Shule River, Shiyang River and Heihe River, which used to be very large, dried up in the Ming Dynasty (about 1620s), the Qing Dynasty (about 1940s), and 1970s, respectively (Wu, 2000). These areas are now occupied by Kumdager Desert, Tengri Desert and Badain Jaran Desert, respectively. A large number of ancient cities and towns were abandoned and their populations migrated because of the desertification (Ma and Li, 1992).

The water shortage has been worsened in modern times because of the intensified and unplanned utilization. At present, the annual average precipitation in He-Xi is about 60–120 mm, which is 1/6 of the average level of China. The water resource per capita in He-Xi is 0.197 m³ per person, which accounts for 1/9000 of the average level of China. The cropland and irrigated land per capita in He-Xi are 0.126 and 0.104 ha, respectively. However, the corresponding figures in China are 0.100 and 0.049 ha. Therefore, it is the irrational utilization which makes the water shortage become the biggest challenge to sustainable development in He-Xi. Take Minqin County as an example, which lies in the low reaches of Shiyang River. The water volume coming from the upper reaches was 546 million m³ in 1950s, but was reduced to 322.6 million m³ in 1960s, 221.7 million m³ in 1980s, 148.3 million m³ in 1990s, and 84 million m³ in 2000 (Dai and Fang, 2002). The average reduction was about 100 million m³ per decade. In addition, the water resource per capita was reduced at a speed of 0.0026 m³ every year. Subsequently, the cropland and irrigated area decreased quickly (Figure 4).

Another point we want to address is that the people living in the downstream areas of the three big rivers (Shule, Shiyang and Heihe Rivers) have been overexploiting the groundwater due to the dramatic reduction of surface water. The groundwater table in these areas drops successively and sharply. Take Shiyang River as an example, where the water table of Minqin County is dropping at the speed of 0.5–1.0 m per year at present. The wells have been dug deeper and deeper. Many wells, which are used for irrigation, are more than 100 m deep and some of them even reach 300 m. Because of the constant decline of groundwater table in He-Xi, this led to dramatic environmental changes. A large area of narrow-leaved oleaster and desert date trees died. Ejina Oasis withered sharply. Hongyashan Reservoir in Minqin County dried up in 2004. Many warning signals of environmental deterioration have been seen by local residents at an accelerated rate (Qiao and Fang, 2005).

Industrial development dependent heavily on natural resources

Industrial development in He-Xi is primarily raw material based, which...
A third city, Jiayuguan, which is under the jurisdiction of the Gansu provincial government, was established as a military camp in the Han Dynasty (140–187 AD) and was designated as a city in recent years based on its industrial development due to the nearby iron deposits. Jiayuguan is located on the northwest edge of an alluvial fan and has evolved into a regional industrial site. Proximate to Jiayuguan are three primary ingredients necessary for steel manufacturing – Jingtieshan iron ore, nearby Xigou limestone, and coking coal in neighboring Ningxia province which has excellent railroad connections to the Jiuquan Steel Company. Although the iron ore has only a 37% iron content, the reserves are very large (Mao and Zhang, 1999). This has led to consideration of developing a smelting plant at the site of the ore to lower the transportation costs by reducing the volume of the raw iron. Among Jiayuguan’s local advantages is the Shule River which flows through the Binggoukou region of the Qilian Mountains. Many of the employees, who were formerly petroleum workers at Yumen, migrated to Jiayuguan.

**Over-emphasized political significance**

Strong political impacts on urban development in the He-Xi Corridor can be analyzed from three angles – administrative structure and governmental function, socialist ideology of equal and balanced social development, and national interest of defense. Chinese cities are administrative entities and officially designated according to political status, economic development level and total population (Fan, 1999). The five provincial cities have been regional political centers since the People’s Republic of China was established. Since the late 1970s, Chinese cities have exercised more significant economic functions through assuming more administrative power for leading economic development around their hinterlands (Song and Zhang, 2002). A city often administers its host urban district, suburban districts, and surrounding counties or county-level cities. This top-down administrative structure has a profound impact on urban expansion of the Silk Road urban centers. As we will see later, obtaining the status as a city in He-Xi is largely attributed to its administrative function rather than its sheer population size or economic strength. However, Chinese cities of different categories enjoy dissimilar scales of governmental resources and state investments for infrastructure construction and economic development. Therefore cities in He-Xi have received tremendous advantages from this political system.

For instance, in order to implement the city led economy policy, four counties, Wuwei, Zhangye, Jiuquan, and Dunhuang, each with less than 100,000 non-agricultural populations, have been promoted to county-level
cities by administrative decree. This political incentive, as well as economic benefits, accelerated urban growth from villages, to towns and eventually to cities. When growth is deemed desirable, planners determined the urban design, the scale of growth, and the function of each community. In addition to these responsibilities, administrators plan sites of various land uses, the amount of investment, and the rate of economic expansion. Every city assumes some degree of administrative function in addition to political, economic, scientific and technological activities. Moreover, in recent years of economic reforms, market economy and industrial development became an important impetus to urban growth. Household industries, township enterprises, and country trade markets are active and impetuous agents stimulating rural urbanization in He-Xi Corridor just as they are over the entire nation (Xie et al., 2005).

The goal of balanced regional development has long attracted the socialist government in China partially because of a real need (Xie and Dutt, 1991). A spatial imbalance exists in the People's Republic of China as measured by urban development, monetary investment, job creation, housing, educational opportunities and other indicators of prosperity. During the post-revolutionary period, Chairman Mao was confronted with widespread poverty and a need to address a nation in desperate need for reconstruction. He recognized the disparity between the coastal area and the central and western interior and strongly encouraged coordinated and balanced development (Xie and Dutt, 1990).

National defense is another important factor stimulating urban development in this region. Socialist China used the isolation of the western area as a positive locational factor. Government ownership of the land allowed it to build a center for nuclear development deep in the interior at Lop Nor and industrial bases for national defense as well as trying to balance social development (Xie and Dutt, 1991; Yu and Wei, 2003). More recently, this interior was selected as the home for China's space exploration research.

By the early 1980s, when the market economy and economic profi-
ciency were emphasized and economic reforms were launched, the national leadership enacted a dual policy to equalize national development yet the emphasis was on high speed economic growth in the eastern region. As a matter of fact, this region got a low priority for the development by comparison with the east. As a result, the economic and social gaps between this region and East China dramatically widened, which led a re-declaration of “Great Exploration of West” in 2000 (Cai, 2000). Beijing was refocusing on the pockets of development (the existing cities) in Gansu Province and the Xinjiang Autonomous Region. The motive is largely driven by political forces and the desire to develop natural resources. Moreover, the ethnic composition has been a factor of attention in recent years. The majority of the population are other than Han (Mandarin) Chinese. People and enterprises as well as investment in the coastal areas are encouraged to go west and establish collaborative ventures in this area to reduce regional disparity and alleviate the vulnerability to territorial insurgency. Much of this investment and resources end up at the former post-towns which have evolved into centers for administration, economics and production, military camps, marketing and tourism. Today, these multifunctional urban sites form the largest and most interactive urban system in He-Xi.

Nevertheless, an inequity remains through the beginning of the 21st century which is measured by statistical analyses using the Moran I test (Yu and Wei, 2003). Yu and Wei concluded that eastern regional growth is continuing to occur but at a decreasing rate. Currently, there is rising concern about the future of the impoverished western provinces and the aggressive behavior of radical Islamic elements who aspire to create a new political unit called East Turkestan. This has precipitated a renewed interest in balancing regional development and reducing regional disparity.

Low urbanization level

The cities in the He-Xi Corridor are small, their urbanization levels are low, and there are no primate cities on the basis of urban non-agriculture population. We are going to examine these urban demographic characteristics from the city's administrative and statistical definition first and from the urban proper (district) norm next. Using the total population over the administrative boundary of a city, the provincial city, Wuwei, has the largest population, close to 2 million. However, if we only look at the urban non-agriculture population as the functional index, only 15% of Wuwei City's population comprises the non-agricultural population. Though the absolute figure of 282,200 non-agriculture population is the largest among the Corridor's cities, its urbanization level is the lowest (Table 1). Continuing to use the non-agricultural population over the urbanized area (a city's host urban district, or city proper) as the function index, Liangzhou Proper (Urban District) of Wuwei City has the largest non-agricultural population, 196,400 (Table 1). However, Liangzhou Proper still has a large percentage of agricultural population, i.e., 80% of its total population (Table 1). Following the same calculations in Table 1, it is observed that all urbanization rates are low except for Jiayuguan and Yumen. Therefore, the identification of primacy is not obvious. None of the He-Xi Corridor's seven cities' non-agricultural population in the urbanized area (the city proper) exceeds 200,000 (Table 1). All these seven cities are considered by the Chinese standards as small cities, no matter what administrative role they are acting.

The longitudinal data since the People's Republic of China (1949) confirmed this finding. Except for Jiayuguan and Yumen, the other five cities witnessed slow increasing urbanization rates (Figure 5). Jiayuguan was designed as a city in the mid 1960s due to its rich resources of iron ore and its steel industry. The prospering and change of Yumen was fully driven by the petroleum industry. The He-Xi Corridor has an overall low urbanization level, but its changes reflect the national political and economic transformations. The urbanization level was very low.
The cities' and towns' scales in He-Xi are so small that their urban radiation and attraction ranges are small and consequently these cities are unable to attract adequate resources and interests for healthy urban development. This delays the rural urbanization process of He-Xi Corridor, and may even lead to decline of existing towns and cities.

**Lessons, discussions, and conclusions**

We have learned a few lessons and identified several findings through this research. First, geographic location and natural environment are critical physical factors that have prevailing impacts on growth directions of a region. Situated at the transitional zone between the Mandarin Chinese and ethnic minorities and between Central and West China, the growth path in He-Xi has been leveraged by its significance as an important transportation link. The development of the Silk Road has facilitated exchanges of both materials and cultures between Mandarin Chinese and other ethnic groups and other nationalities further west. However, on the other hand, the ethnic differences and conflicts have been a challenge to economic development and a priority for political stability in this region in history and in modern times as well.

Second, the environment in He-Xi is easily prone to excessive human activities and desertification due to the limited water sources, the plentiful supply of gravels and sands, irrational exploitation, and political instability. The ecological productivity and sustainability has been disturbed at an accelerated rate from the history to the present. The surface water supply has been diminishing, the groundwater table dropping, the soil nutrient depleting, the siltation and salinization intensifying, and the frontier of the desert intruding.

Third, the urban system in the mid-section of the Silk Road (the He-Xi Corridor) originated with the thriving of silk trade and the military installations for protecting the trade. These cities and towns (the ancient way-stations) are dotted on the diluvial fans and alluvial plains irrigated by the melting mountain glaciers. Major urban centers are located at the conjunctions of this east–west transportation artery and the south-north river systems. Small cities and towns have been developed along these transportation routes and rivers. The spatial pattern of these urban centers comprises a shape of “w”, a Chinese character meaning “the water streams,” which actually tells the critical environmental component on which these cities in He-Xi rely (Figure 6). Moreover, though many of these cities in recent decades were often favorably supported by the rich raw mining resources and the socialist policies of balanced regional development, ethnic unity, and national defense, they are in general left behind compared with their counterparts in East China due to their remote location, shortage of water, and harsh environment. The industrialization focuses on mining and crude processing, but agriculture is still dominant, and the urbanization level is low. Urban development is facing many challenges. Therefore, we strongly claim that the future of urban development in He-Xi relies heavily on comprehensive planning and strategic consideration of ecological and economic sustainability.

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**Figure 5** The half-century urbanization in He-Xi Corridor.
We propose that the strategic goals of this comprehensive planning comprise, “One Center and Four Poles”, “One Axis and Three Zones”, and “Coordinated Development of Urban Centers and Towns”. This comprehensive planning takes consideration of the development history, physical environment, ethnic composition, local advantages and resources, and sustainable development. This framework of urban development resembles to the Chinese font character, “w” (Figure 6), which impacts the future spatial pattern of urban growth.

“One center” would be a newly combined urban cluster consisting of Jiayuguan City, and Yumen City, which we name “Jiu-Jia-Yu.” The government should consider combining Jiayuguan City, Jiayuguan City, and Yumen City into a single city to create a new urban growth center. This would result in a primary (or top-level) urban center in He-Xi that would have a non-agricultural population exceeding 500,000 in the combined urbanized areas (including, Suzhou Proper, the host urban district of Jiuquan City, Jiayuguan City, and Yumen City combined). The city should be regarded as the strategic hub in the eco-economic corridor of western China and the third tier city on the Second Euro-Asian Continental Bridge between Lanzhou and Urumqi.

Figure 6  The spatial structure of urban system in He-Xi Corridor (“w”).

2 The Second Euro-Asian Continental Bridge connects many national capital cities, provincial capital cities, and primary regional cities. We categorize the national capital cities as the first tier, the provincial capital cities as the second tier and the primary regional cities as the third tier when we study the urban systems along the Continental Bridge.

3 We treated provincial capital cities as the first tier, primary regional cities as the second tier, and local urban centers (county level cities) as the third tier when we describe the urban systems for West China.
and therefore closer integration would have a positive impact. Although Jiayuguan is single purposed and the hinterland is small, its infrastructure is better than Jiuquan. Conversely, the general service function of Jiuquan is well developed but the urban infrastructure is poor. Administrative restrictions have caused the service areas to spread in different directions (Center of Soft Science Research, Northwest Normal University, 2001). Whereas Jiuquan has a spatial expansion east and south, Jiayuguan has grown west and south. Recently, the population has begun to move west of Jiayuguan.

Further cohesion of the three cities should strengthen the social and economic base, which would create the largest urban center and a prosperous growth pole of the He-Xi Corridor. Without a comprehensive plan it is unlikely that any of the cities will achieve significance as urban centers. This is predicated on numerous factors that contribute to this urban goal. Besides the transportation ties, natural gas and electrical lines and optical facilities exist to support population growth and regional economic development. These would contribute to further development of tourism and the petroleum industries at Yumen and farther away in Qinghai.

The “Four Poles” are Zhangye City, Wuwei City, Jinchang City and Dunhuang City. Zhangye is one of the national famous historical and cultural cities in China. Throughout a long history, it was the administrative capital and the commercial center in the He-Xi Corridor during the past dynasties. Because of its strategic location and high agricultural production, Zhangye has been known to the locals as the “Golden Zhangye”.

In the future, Zhangye should utilize its advantages in water resource, electricity resource, and tungsten resource and develop energy industry, tungsten exploiting and processing industry, water-saving apparatus industry, agricultural machinery industry, and food industry. The future objective is to build Zhangye City into a national water-saving demonstration city, the second national agricultural hi-tech industrial base, a new “tungsten capital” of China (Zhangye City Government, 2002), and the cultural and education centre in the He-Xi Corridor, becoming a central city in the mid-section of the He-Xi Corridor (Zhangye Construction Committee, 2001).

Wuwei is also one of the national famous historical and cultural cities in China and a regional central city in the He-Xi Corridor. Wuwei City, in the future, should mainly develop its brewing industry (grape wine), the agricultural processing and food industry (cornstarch) and tourism. The future objective is to construct Wuwei City into the green food processing base, and the commercial and trade city along the Silk Road (Wuwei Construction Committee, 2002).

Jinchang is the largest nickel and cobalt production base and the platinum metal refine center in China. It is the “nickel capital” of China. The future objective of Jinchang City is to build into a modern industrial city with specialties in heavy chemical industry and building materials industry (Jinchang Construction Committee, 2001). Dunhuang is a world-famous tourist city. In the future, Dunhuang city should give priority to the development of eco-tourism, desert, cultural and ethnic tourism. The future objective of Dunhuang City is to build an international eco-tourist and cultural city.

“One Axis” refers to the second Euro-Asia Continent Bridge in the section of He-Xi Corridor. It is composed of the railway from Lanzhou to Xinjiang (called Lan-Xin Railway) and the “312” National Road. At the beginning of the 1990s, the construction of the Euro-Asia land bridge created excellent opportunities for urban redevelopment in this region. The extension of the Lan-Xin trunk rail-
change. The goal is to plan and build each city based on its relationship to other towns and urban centers so that a comprehensive and coordinated urban system could be built as determined by the regional plan (Yang and Zhao, 2001).

This region is in severe shortage of water resources, but has extensively open land resource and low urban levels and population density. Overheating growth or excessive development could be easily generated under current opening-up and stimulation of market economy and “Great Exploitation of the West”. This could repeat the mistakes made in history because of the fragile environment. Therefore it is critical to educate local government officers, planners and developer and remind them of the challenges this region is facing in socioeconomic development. A thorough study and research of the constraints, as well as the advantages, should be a top priority. We should attempt to explore what is the optimal urbanization level in the He-Xi Corridor under the challenges of limited water resources and diversified ethnic compositions from the perspective of sustainable ecological economics and equitable social development.

Moreover, there are many challenges in research itself. The data availability, comparability, and completeness are serious concerns. Its lack or a lack of enforcement in standards of collecting the data was common among the local statistical offices. Many data items were missing from the reports due to the lack of trained personnel, the negligence of the significance of information in socioeconomic decision making, and the distrust that resulted from deficient economic laws and ethnic differences. Field surveys and social investigations were the primary methods we deployed in this research, which were prone to many uncertainties. We have been continuously working in this region and getting more complete and reliable data. We are conducting research as a follow-up to this paper, analyzing optimal urban development and corresponding thresholds of urbanization level while ensuring certain speeds of growth and sustainable environmental carrying capacity.

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**References**


