



WORKING PAPER #36 / JUNE 14, 2016

# An Exploratory Study of Urban Expansion Dynamics in China:

## *Overlooked Third Tier Cities*

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### ABSTRACT

This study focuses on understanding the ongoing and future (to 2050) expansion characteristics and dynamics of Third Tier cities in China. Third Tier cities, with city proper populations of 0.5 to 1 million, have received little attention, yet face unique issues related to their size and role, e.g., auto dependency, volatility in growth rates. The study, based on four case study cities, outlines priority challenges facing Third Tier cities related to urban expansion; and indicates action areas, and a proposed on-the-ground program, to make future urban expansion of Third Tier Cities in China more land efficient, productive, inclusive, and sustainable.

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Funding for this research from the Marron Institute of Urban Management at NYU is gratefully acknowledged



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June 14 2016

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## ACKNOWLEDGEMENTS

The authors gratefully acknowledge the co-operation, dialogue, and assistance of key agencies that made this research and Monograph possible.

In China, assistance was forthcoming, despite the busy schedules of staff in Third Tier Cities. In particular, we wish to thank the Directors and their staff of Comprehensive Department of the Development Reform Commission and Administrative Office of Urban Planning Bureau in Baohsan. In Sanya, we are grateful for the assistance of the Chief Engineer and staff of the Urban Planning Bureau, the Director and staff of the Comprehensive Department of the Development Reform Commission, and the Director and staff of the Tourism Bureau. In Xuancheng, we thank the Director of Planning and staff of the Department of Planning, Development Reform Commission. In Yuncheng we are acknowledge the extensive assistance provided by the Director and staff of the Regional Cooperation Department of the Development Research Commission of Shanxi Province and the Yuncheng Director of Planning and staff of the Development Research Center, Shanxi Province.

The NYU Urban Expansion Program at the Marron Institute of Urban Mangement and the Stern School of Business of New York University provided extremely useful feedback as our work progressed, including two sessions in New York with the Urban Expansion Program's team there. We are especially thankful for the guidance and direction provided by Professor Shlomo Angel, the Director of the Program, and the data and feedback provided by the Program staff, including Alejandro M. Blei, Nicolas Galarza Sanchez and Patrick Lamson-Hall. We also wish to thank Professor Paul Romer, the Director of the Marron Institute, for his insights and for the Institute's financial support provided for this study.

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# THE MACRO CONTEXT

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## 1.1 BACKGROUND

China has undergone rapid and large-scale urbanization since the market economy reforms started about 1980, its urbanization level increasing from 19% in 1978 to 26% in 1990 and 56% by the end of 2015. Much has been written about this process, but the literature - academic, professional, and mass media, focuses on the first tier cities (primarily Beijing and Shanghai), and to a lesser extent, secondary cities (e.g., Wuhan, Chengdu, Chongqing). Third tier cities, with a *city proper*<sup>2</sup> population of approximately 0.5 to 1 million population, have received little attention, yet often are the locus of significant, often unique issues, related to their size and role, as will be argued.

Increasingly urban population expansion in China occurs through horizontal expansion rather than densification of existing areas, a process accelerated by increasing difficulties in acquiring property in existing neighborhoods for redevelopment. The process of urban expansion is very complex in China, as elsewhere; but the prime drivers and outcomes in China can more clearly be seen in the case of the Third Tier cities, a second reason for focusing on this tier of cities in this Study.

## 1.2 OBJECTIVES

The key objective of this study is to understand the ongoing and expected (to 2030 and 2050) expansion characteristics and dynamics of four case study Chinese cities with City Proper populations between 0.5 - 1 million in terms of (i) Key Drivers: Both socio-economic (market) and policy, (ii) Expansion Metrics: Land Use Change in terms of magnitude of buildup, land uses, and patterns (urban form), and (iii) Issues related to roads and transit grids, open space, protected farmland, etc.

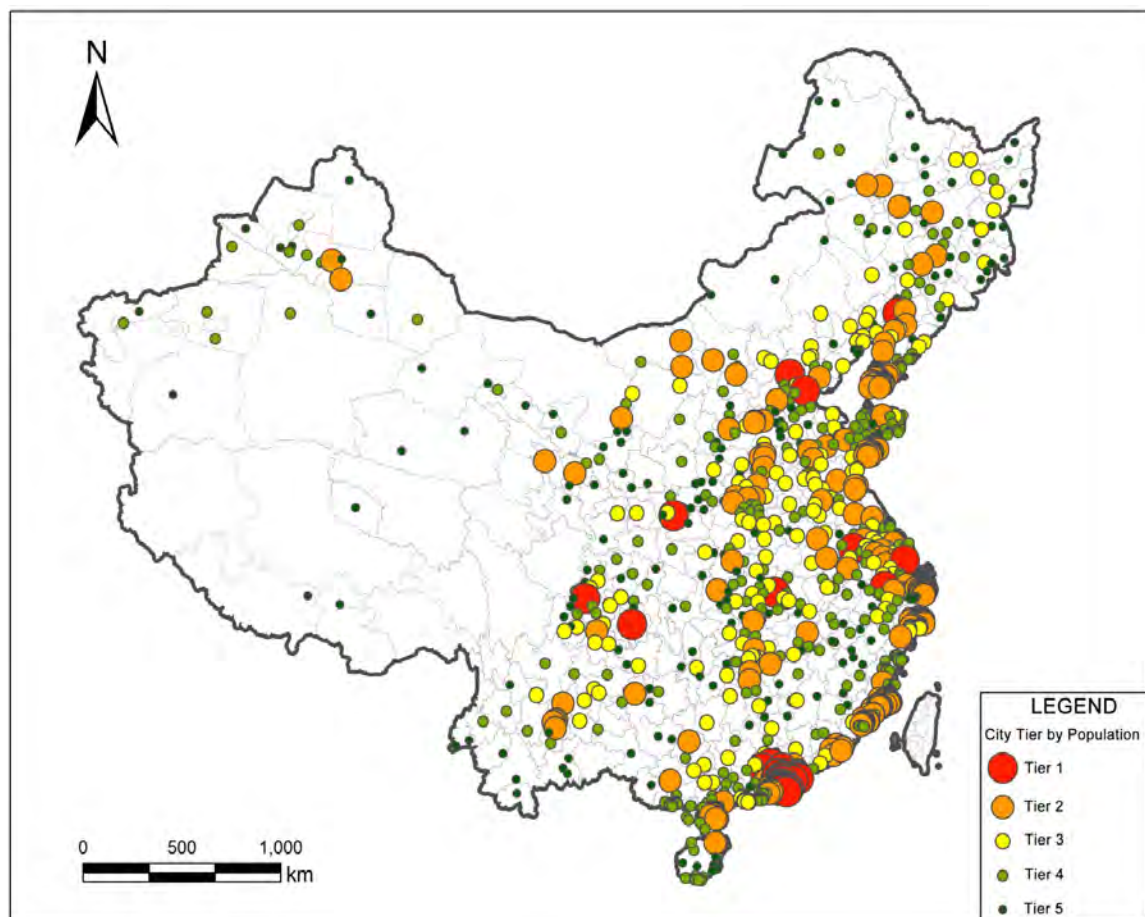
A secondary objective of the study was to establish relationships and trust with relevant local officials in the case study cities, focusing on the Municipal Urban Planning Bureaus; and to determine their willingness and enthusiasm to be involved in a much larger scale follow-up action-oriented initiative (Phase 2).

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<sup>2</sup> The *City Proper* in a Chinese city is the sum of all the *urban districts* (usually contiguous), and does not include counties, even if contiguous and partly urbanized.

### 1.3 THE NATIONAL SPATIAL CONTEXT

Map 1 describes the location of cities in China by tier size. As can be seen from Map 1, in Western China and the North-east frontier, Third and Fourth tier cities are mostly free-standing and constitute the backbone of the urban system. They are, generally, the primate cities in these regions. On the other hand, in Coastal and Central China, the third and fourth tier cities are generally found along corridors between the major megapolitan areas, and / or are satellite (peri-urban) cities of major metropolitan areas. In addition, there are free-standing Third and Fourth Tier cities in these regions, such as Yuncheng and Xuancheng, case study cities for this research, but they do not play a primate role in the urban system.



**Map 1: Spatial Distribution of Cities by Tier Status: China**

Source: Research Team

Tables 1 and 2, based on census data from the 1990, 2000, and 2010 censuses indicates that Tier 3 and 4 cities are losing population share as the differential between their growth rates and those of the Tier 1 and 2 cities has increased. Nevertheless, according to the 2010 census, Tier 3 and 4 cities (*city propers*) accounted for 173,034,785 inhabitants, a gain of 41,685,539 people from 2000, more than the entire population of Canada. If a wider *municipal* spatial definition is



used, the corresponding metric indicates that Tier Three and Four cities were home to 319,314,999 people in 2010.

**Table 1: Population and Growth Rates of Chinese Cities by Inter-Census Period and Tier Status: 1990-2010**

	Population						Population Compound Annual Growth Rate (CAGR)			
	1990		2000		2010		1990-2000		2000-2010	
City Category	Total	Urban	Total	Urban	Total	Urban	Total	Urban	Total	Urban
<b>Tier 1</b>	82,694,845	56,823,944	113,098,621	88,009,352	148,139,767	126,882,202	3.2%	4.5%	2.7%	3.7%
<b>Tier 2</b>	128,420,445	83,896,241	160,297,265	109,974,780	197,876,289	152,602,231	2.2%	2.7%	2.1%	3.3%
<b>Tier 3</b>	123,245,827	62,744,190	140,696,957	71,944,925	155,724,534	94,630,554	1.3%	1.4%	1.0%	2.8%
<b>Tier 4</b>	144,843,800	32,231,898	155,863,581	59,404,321	163,590,465	78,404,231	0.7%	6.3%	0.5%	2.8%
<b>Tier 5</b>	71,970,388	15,687,399	75,841,592	28,316,551	76,914,223	33,252,069	0.5%	6.1%	0.1%	1.6%
<b>Total</b>	551,175,305	251,383,672	645,798,016	357,649,929	742,245,278	485,771,287	1.6%	3.6%	1.4%	3.1%

Source: Chinese census data compiled by Research Team

**Table 2: Change in Population Share of Tier 3 and 4 Cities in China: 1990-2000-2010**

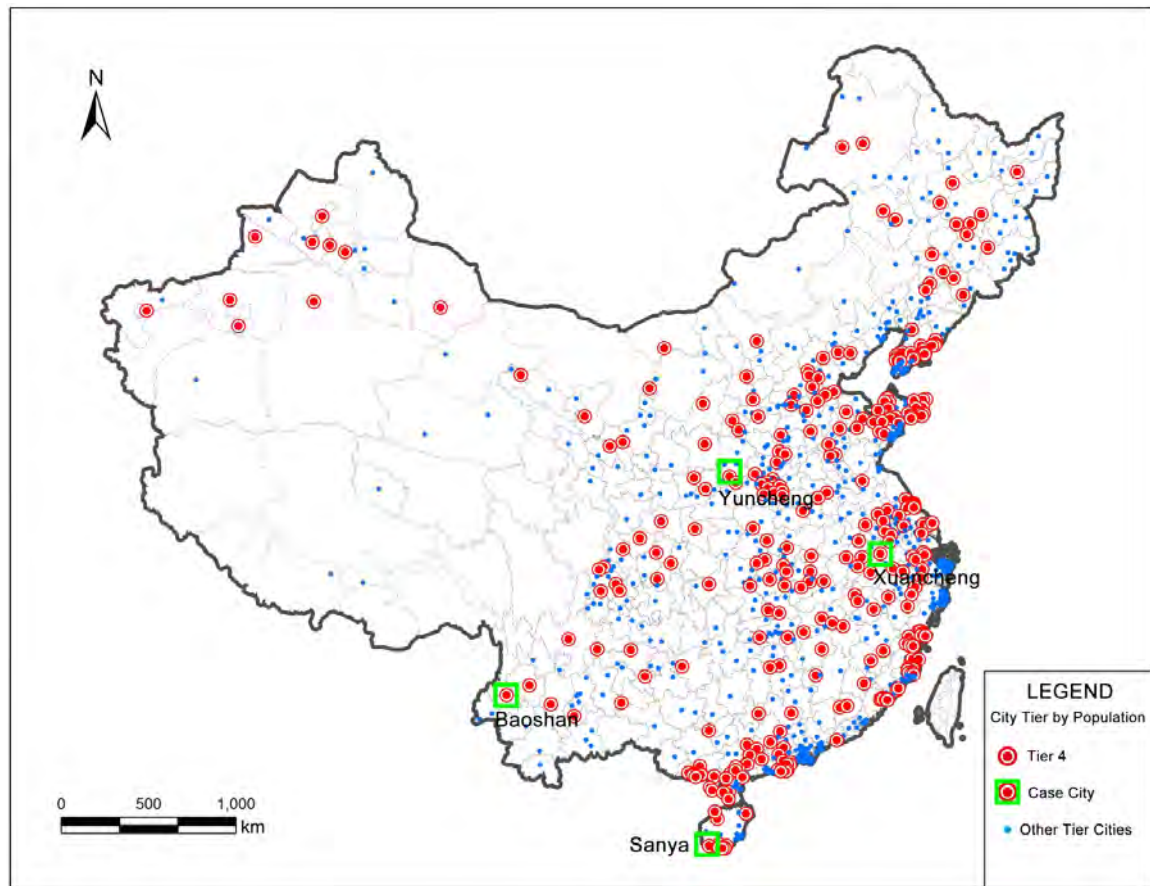
Tier	1990	2000	2010
<b>3</b>	25%	20%	19%
<b>4</b>	13%	17%	16%
<b>3+4</b>	38%	37%	35%

Source: Chinese census data compiled by Research Team

## 1.4 CASE STUDY CITIES

Map 2 describes the location of the four case study cities chosen for this research, namely Baohsan, Sanya, Xuancheng, and Yuncheng. These four case study cities were chosen to create a stratified diverse sample, based on the following criteria: (i) Different Functional Roles, (ii) Diverse Geographic Location, (iii) City Proper Population between 500,000 – 1 million, and (iv) Rapid Population Growth: >3% CAGR of the City Proper 1990-2010.

**Map 2: Location of Case Study Cities**



Source: Research Team

Table 3 describes the key population and built up urban land metrics associated with each of the four case study cities. Baoshan, Sanya, and Yuncheng are discussed in greater detail in the following sections.

**Table 3: Case Study Cities: Key Parameters**

Case Cities	Study Area Population				Built-Up Land		
	2000	2010	2000-2010 Growth Rate	2000-2010 CAGR	2001 (sq.km)	2013 (sq.km)	2001-2013 Growth Rate
Baoshan	432,511	504,101	17%	1.5%	39.08	71.11	82%
Sanya	328,859	527,098	60%	4.8%	52.97	110.53	109%
Yuncheng	513,371	639,835	25%	2.2%	79.39	143.63	81%
Xuancheng	323,709	421,857	30%	2.7%	23.07	106.07	360%

Source: Research Team

## 1.5 POLICY FRAMEWORK: LAND USE IN 3<sup>rd</sup> and 4<sup>th</sup> TIER CITIES

Third and Fourth tier cities have been significantly affected by several major policy initiatives, including:

(1) The *National Urban Planning Law of 1989*, which encouraged small city development. However, by 2010, the policy objective had changed to encouragement of balanced urban growth, i.e., a “mature”, traditional urban hierarchy was encouraged, with all tiers expected to grow at roughly the same percentage change pace.

(2) The *New Urbanization Policy (2014-2020)*, still in effect, placed heavy emphasis on the development and urbanization of under-urbanized regions. Because under-urbanized regions tend to have smaller cities, as indicated in Section 1.3 (above), with urban hierarchies usually dominated by Third and Fourth tier cities, this policy implicitly supports the development of Third and Fourth tier cities. The Baoshan case study (below) is a typical example of the impacts of this policy.

(3) The *Rise of Central China Policy (from 2010)* policy, which is still in effect, was driven by the need for Chinese low to middle manufacturing enterprises to stay globally competitive in the face of rising Chinese labor costs, aggressive international competitors, particularly in Southeast and South Asia, and pressures from Chinese residents in the richer (generally coastal) regions for higher quality environments and improved public health outcomes. Residents in these wealthier regions often targeted polluting manufacturing firms as the cause of their woes. This policy is primarily benefiting peri-urban areas of Megapolitan regions in the interior of China such as Chengdu, Wuhan, and Chongqing (which contain third and fourth tier satellite manufacturing cities), but also some Third Tier free-standing cities in the interior, which are developing appropriate infrastructure to host new manufacturing investment, including firms relocating from the coast. Xuancheng and Yuncheng in this study (see below) are prime examples of Third tier interior cities hosting significant inbound investment related to China’s policy of moving manufacturing to the interior. In the case of Xuancheng, it is a pilot city for relocated industry, with direct financial and technical support from China’s national development agency, the National Development and Reform Commission (NDRC) and the World Bank to facilitate this process.

(4) The *Develop the West Policy (1999)*, still in effect, was oriented to the larger metropolitan cities of the West (a daring regional development policy relative to international experience to date which tended to focus on smaller settlements or rural areas), typically Tier 2 cities such as Chongqing. However, as noted above, the Tier 2 cities in the West typically contain Tier 3 and 4 peri-urban satellite cities. As the *One Belt, One Road* policy, introduced in 2013, has come into effect, designed to increase connectivity between China and Southeast, South, Central Asia, and the Middle-East, the Develop the West Policy has become increasingly subsumed under the One Belt, One Road policy, which incorporates both Chinese domestic and international spatial development policies. As indicated below, case study city, Baoshan, has been directly and significantly impacted by this initiative.

Another regional development strategy, the Revitalizing the Northeast Strategy, introduced in 2003, affected Third and Fourth Tier cities in that Region (of which there are many as indicated by Map 1), primarily natural resource and challenged “rust belt” industrial cities.

(5) National Construction Standards play an important role in internally shaping urban form and land use in Tier 3 and 4 cities. These national construction standards are promulgated by the Ministry of Housing, Urban & Rural Development (formerly the Ministry of Construction), and have evolved over several decades, many introduced or redefined in the City Planning Act of 1990, updated in the Urban and Rural Planning Law of the PRC in 2008.<sup>3</sup> Examples of key urban construction codes are listed in Appendix 1.

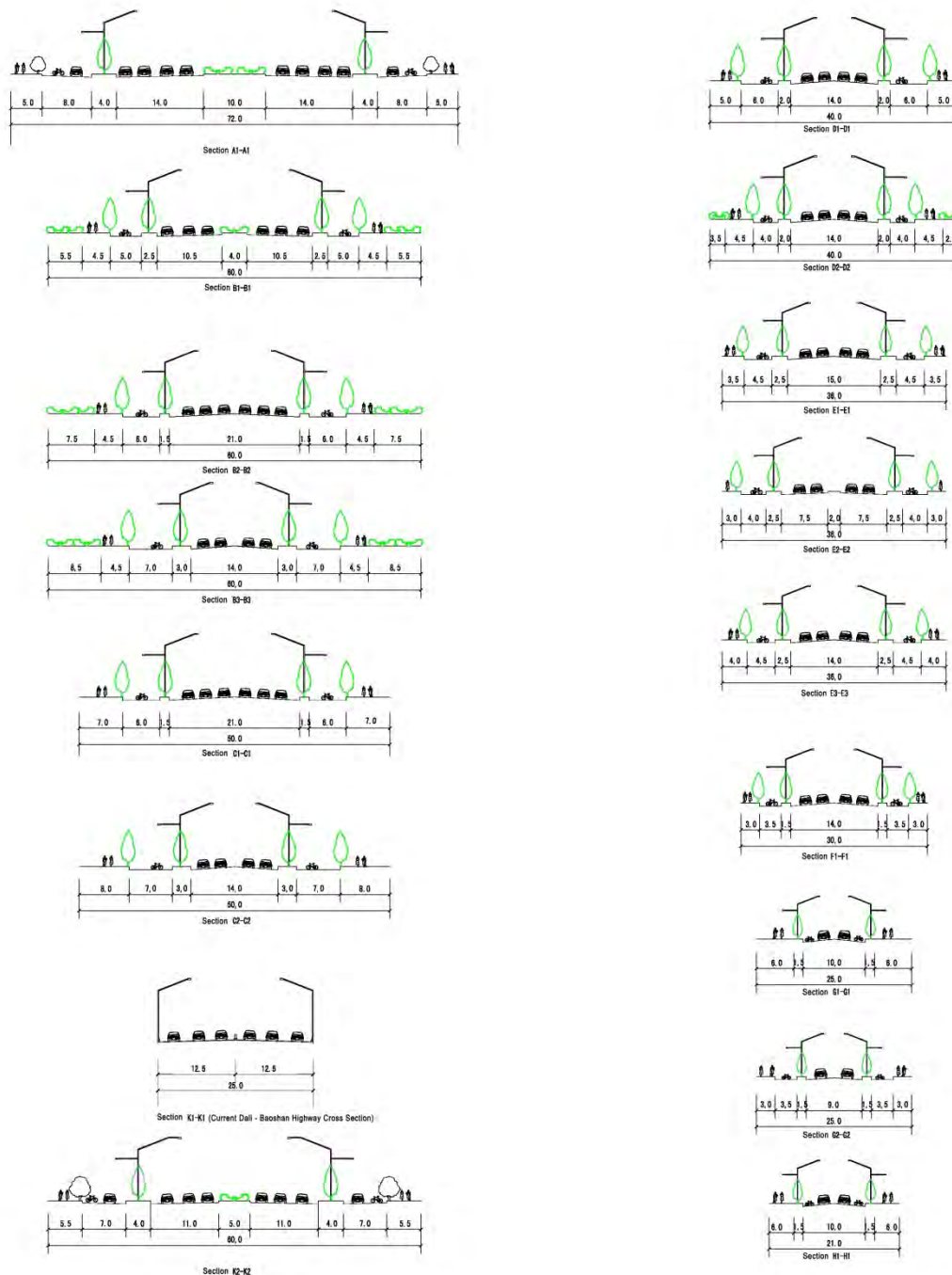
The conventional wisdom is that the myriad of detailed national urban construction standards may reduce local flexibility and induce over-construction, especially in smaller cities. However, we question this view; it appears local authorities may use higher standards (designed for larger cities) to justify overbuilding of infrastructure, e.g., overly wide roads and monumental civic plazas, but in fact, the national standards offer a wide range of alternatives to local governments, many corresponding to international best practice. Figure 1 makes this point in terms of the broad range of road cross sections prototypes identified by the Ministry.

(6) Protecting basic farmland is a key policy of China, given its high population (1.38 billion, 2015) and relatively low cultivable area 11.3% of the national area according to the World Bank.<sup>4</sup> Prior to 1979 the prime objective was to increase farmland, e.g., opening up farmland in the far north-east Province of Heilongjiang; however, since then the policy objective has shifted to protecting farmland, especially from urbanization pressures. The *Basic Farmland Protection Law* came into effect in 1994, which was updated by the Land Management Law of 2004. The goal is to protect at least 120 million hectares for farm use. Of late, there is further focus on farmland protection around urban areas (especially those over 5 million in population), through the Permanent Basic *Farmland Protection Law* of 2013. The Basic Farmland Protection policy has had very significant, and increasing, impacts on urban expansion in China, as indicated, in particular, by the Baoshan and Sanya case studies.

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<sup>3</sup> For more information see: *Proceedings of the Greater Mekong Subregion Urban Development and Planning Training Program*, Tengchong, China 11-15 May 2015, Beijing and Manila: Asian Development Bank, 2015. Of particular relevance to construction standards are papers: Zhang, Bing, *Urban and Rural Development and Planning System in China*, and Dong, Ke, *Implementation of City Planning and Management Systems*

<sup>4</sup> World Bank Arable Land Data Base: <http://data.worldbank.org/indicator/AG.LND.ARBL.HA.PC>



**Figure 1: Chinese National Road Cross-Section Standards**

Source: Baoshan Urban Planning Bureau

(7) Recently (February 2016), the national government announced a No Gating / Compact Cities *Policy* in support of Transit-Oriented Development (TOD) and Compact non-sprawling cities.<sup>5</sup> (This policy was announced and is strongly supported by President Xi.) The objective is to

<sup>5</sup> For details, see: “*Cities: Xi’s Latest Target: The Great Sprawl of China*”, Bloomberg Business Week, April 25, pp 18-19

change China's Soviet-inspired urban planning system, with multilane boulevards lined with gated compound after compound, extending deep into the suburbs, often with few public and private amenities; the latter are generally centralized in the core city. The result is gated blocks blocked to through traffic, forcing traffic onto a handful of main roads. These main arterials are then so wide and such strong barriers that different urban built form ecologies develop on either side of these arterials. According to a recent World Bank study,<sup>6</sup> Beijing has an average of 14 street intersections per square kilometer, compared with 211 in Tokyo's Ginza District and 133 in Paris.

If this policy is implemented, it will affect Third and Fourth Tier cities substantially, although probably less than First and Second Tier Cities. However, the policy is running into heavy resistance from the Chinese public, expressed primarily through social media, who argue that gating is important for privacy, security, and quiet, and so the policy may not be implementable.

## 1.6 CHALLENGES FACING THIRD AND FOURTH TIER CITIES

Tier Three and Four Cities experience a set of problems unique to them, or more accentuated at these tier levels, associated with their size and roles. Key challenges facing Third and Fourth Tier Cities are:

(1) Third and Fourth Tier cities often lack diversified economies, associated with their size, which makes them more vulnerable. These cities can be classified into four main economic types: (i) Administrative / Trading (Regional) Centers, (ii) Manufacturing Centers; (iii) Amenity/Tourism Cities; and (iv) Natural Resource Extraction Centers.

Usually the *Administrative / Trading Centers, Regional Service Centers* in the lexicon of economic geographers, are economically and demographically stable, given the stabilizing effect of significant government employment, and their service role (public and private) to significant rural hinterlands. Yuncheng, discussed below, is a typical city that falls into this category. However, even the regional service center function can be vulnerable. For example, the advent of High-Speed Rail (HSR) system has made larger metropolitan centers, with their greater range of services more accessible. For example, it is now only one hour and four minute's travel time by HSR to Xi'an metropolis from Yuncheng; by road it is 243 kilometers, a 2 hour and 45 minutes' drive.

Generally speaking, Third and Fourth Tier cities are benefiting from second stage manufacturing from the coast to interior cities which is significantly underway.<sup>7</sup> However, the negative side of this dynamic is that Third and Four Tier cities are often receiving less sophisticated, lower value-added manufacturing, and higher polluting industries (although lower polluting than when the relocated firms were located on the coast because new facilities incorporate cleaner technologies and benefit from windfall profits from the differential in land price between the coast the interior, which can be invested in new process technologies). Smaller cities often cannot be too choosy in terms of the firms that locate in their jurisdictions, given the pressures

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<sup>6</sup> Part II, Supporting Reports, Box 2.4, in: World Bank and Development Research Center of the State Council, PRC, *Urban China, Toward Efficient, Inclusive, and Sustainable Urbanization*, Washington and Beijing: World Bank and DRC PRC, 2013

<sup>7</sup> First stage decentralization of Manufacturing was from central cities to peri-urban areas and is now virtually complete in China.

that they face for fiscal revenues, plus local economic and employment growth. The Xuancheng case study is typical of a manufacturing dominated smaller city.

*Tourist / Amenity* Third and Fourth Tier Cities are often booming, given the rapid expansion and growth in affluence of China's middle class;<sup>8</sup> China has the second largest tourist industry in the world by value, (after the United States), most of it is domestic (90.3% of spending), which in 2014 contributed 943.1 billion USD to the Chinese economy and created 66,086,000 jobs.<sup>9</sup> To a significant extent, Third and Fourth Tier cities anchor China's major domestic (and international) tourist destinations. The Sanya study (discussed below) is typical of a city in this size category that is booming through tourism. However, these cities, perhaps most vividly expressed in Sanya,<sup>10</sup> experience significant problems from their rapid economic development, particularly related to seasonal peaking based on public holiday, weather, second home, etc., drivers) which can overwhelm public and private services, e.g., hospitals, and hotel room supply.

*Natural Resource* Third and Fourth Tier Cities are generally the most vulnerable, significantly impacted by wild swings in commodity prices, depletion of natural resources, etc.

(2) Third and Fourth Tier Cities are more likely to suffer from inefficient land use, compared with larger First and Second Tier Cities, exhibiting lower population densities (especially on their peripheries), leap-frogging development, etc. Often metropolitan urban form concepts such as new towns, multiple urban sub-centers, and satellite towns are applied prematurely resulting in leap-frogging and underperforming urban subcenters. Another problem is that industrial land, in particular, is provided virtually free and over-sized parcels are often given to firms, a product of the lack of bargaining power of smaller cities in regard to attracting manufacturing, discussed above. These phenomena / issues will be discussed in more detail in the case studies below.

One significant problem is that Third and Fourth Tier Cities are generally too small to support rail mass transit, although some are considering rail transit (or have implemented it in the case of Sanya). Most are considering alternative more cost-effective systems more appropriate to their size, e.g., Bus Rapid Transit (BRT). The result, ironically, is that Third and Fourth Tier Cities tend to be more auto dependent than larger cities. Appropriate cost-effective road infrastructure is often lacking, e.g., development of major arterials (super arterials) connected to blocks characterized by grid-pattern connector and feeder roads, construction of road overpasses at bottleneck intersections, building of pedestrian overpasses to make these cities more walkable.

(3) Third and Fourth Tier Cities tend to not be in the spotlight, both nationally and internationally, i.e., they receive a relative lack of attention from key actors who could improve their urban planning and management practices, particularly the national government (with whom they often lack bargaining power), large corporations (both domestic and global), international development agencies developing, disseminating, and facilitating best city building practice, and the media. The result is that Third and Fourth Tier Cities often lack access to best

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<sup>8</sup> For a discussion of emerging amenity urban development trends in China, see: Webster, D, Cai, J., Muller, L., Ting, W., "Early Stage Amenity Dynamics in China: The Yunnan Amenity Corridor, in Moss, L. (Editor), *Amenity Migration: A Global Perspective*, New Ecology Press, 2014

<sup>9</sup> World Travel and Tourism Council (WTTTC), *Travel and Tourism: Economic Impact 2015: China*, London: WTTTC, 2015

<sup>10</sup> "Sanya - People Used to Retire Where They Lived and Worked. That Is Beginning to Change", *The Economist*, May 28, 2016, pp. 36-37

practice expertise in city building. (This situation is one of the main reasons why the NYU Urban Expansion Initiative is focusing on Third and Fourth Tier cities in China.)

## **1.7 CASE STUDY APPROACH**

Below, three of the four case study cities are assessed in some detail. In the interests of brevity, because Xuancheng and Yuncheng are similar in many respects, we do not discuss the Xuancheng case in detail; however, our data base on Xuancheng is available from the lead author.



## BAOSHAN CASE STUDY

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### 2.1 BAOSHAN OVERVIEW

Baoshan is a Third Tier city constrained by its rugged physical geography setting; as a frontier border city (near Myanmar), it is buffeted by global forces. Image 1 pictures the city's core.



**Image 1: Baoshan's City Core: Looking South**

Source: Research team

Baoshan's geostrategic role stems from the fact that it is where the oil and gas pipelines from Myanmar's Kyaukpyu port (invested by China) enter China. It is on the road (yet to be upgraded) to India through Myanmar (the "Burma Road"), and a rail link is planned to connect Baoshan to the Myanmar rail system, including Kyaukpyu Port. All of the foregoing infrastructure initiatives are part of China's One Belt, One Road flagship strategy; a national flagship strategy designed to better connect China with Southeast, South, and Central Asia. Officially in the Chinese

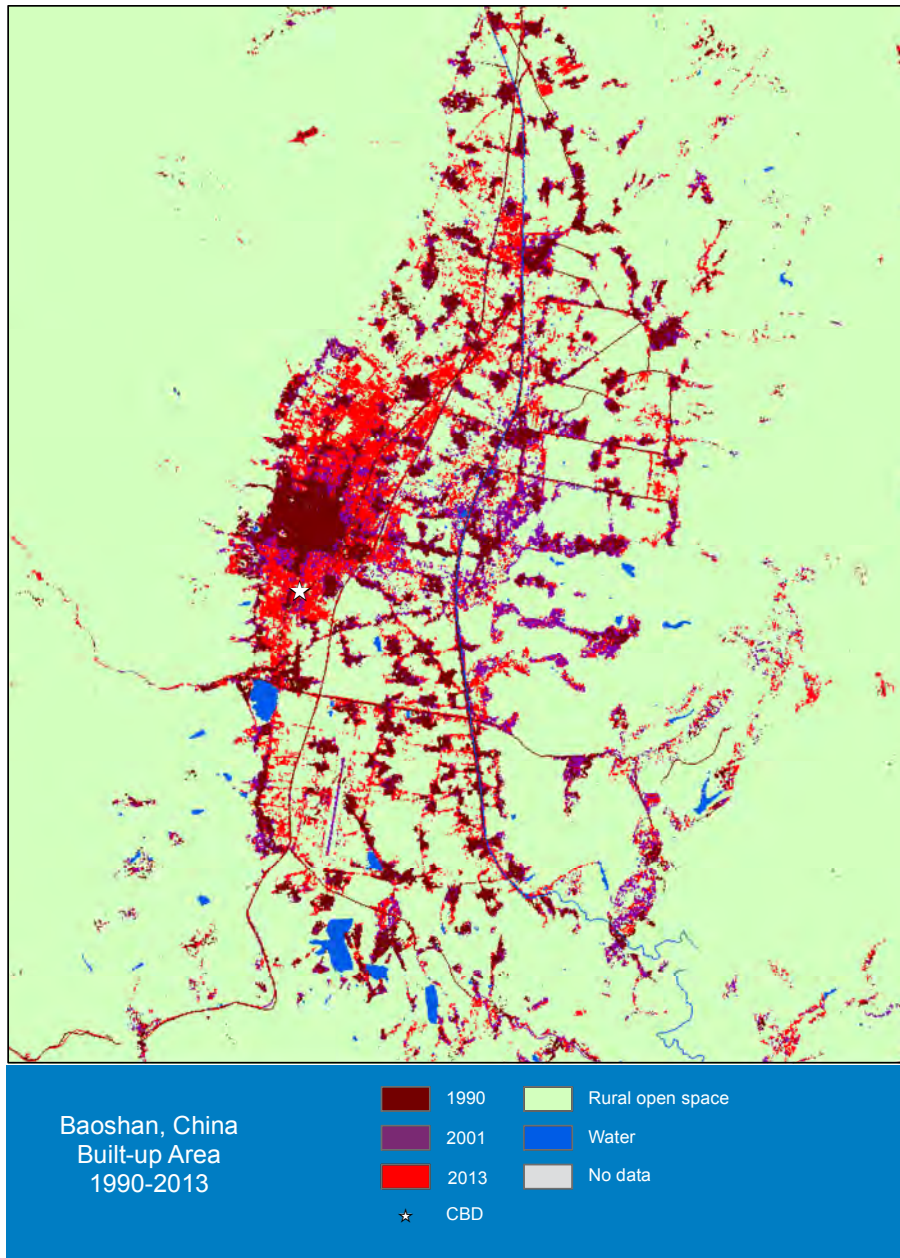
planning system, Baoshan is positioned as a Sub-Level Metropolitan Area and Border City in western Yunnan Province.

Anticipation of a key cross-border role has driven Baoshan's economic and demographic growth, physical planning, and project investment (both public and private), e.g., development of a large market area (Yiwu International Trade Town) around the rail station (discussed below), which is yet to be operational. With a negative impact on Baoshan, the new Myanmar Government, under the recently elected government of Aung San Suu Kyi, has cancelled or delayed much of the planned cross-border infrastructure, including the major Myitsone Dam on the Irrawaddy

River, which would provide electricity to Southwest China and Myanmar. The city's location in a mountain valley plays a key role in shaping the physical form of the city (see Images 3 and 4).

Aside from the cross-border role, which is partially on hold, Baoshan's economy is based on regional services, e.g., government (it is the Municipal capital), education, trade (wholesale and retail, cross-border), and natural resources processing.

## 2.2 LAND USE / DENSITY CHANGE: BAOSHAN



	1991	2001	2013
Urban Built-up (sq km)	2.7	2.8	18.9
Suburban Built-up (sq. km)	25.3	36.3	52.2
Total Urban + Suburban Built-up (sq km)	28.0	39.2	71.1
Density (pax/sq.km)		11,067	7,309

**Figure 2: Baoshan Land Use Change: 1990-2001-2013**

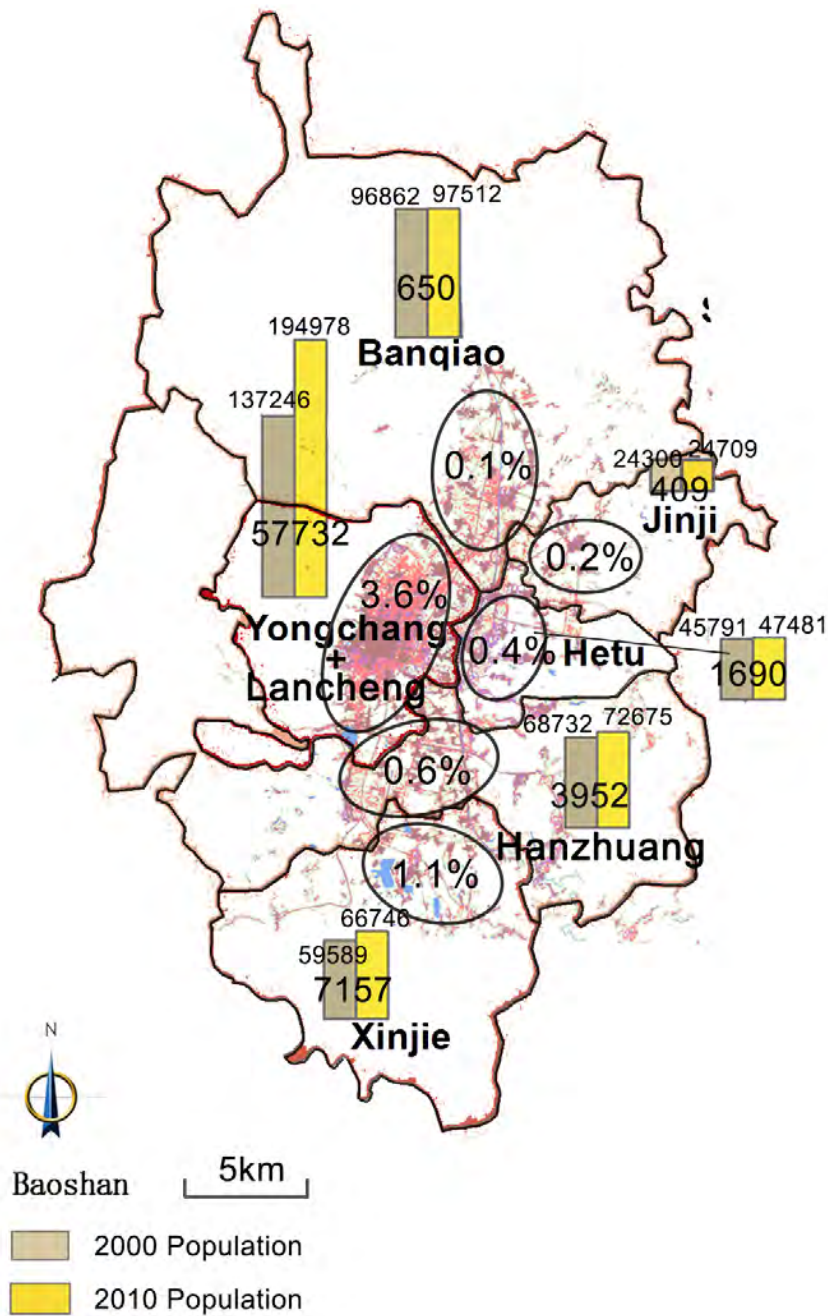
*Note: "Urban" refers to the Longyang and Lancheng "Street Level" Data Areas (somewhat equivalent to US Census Districts). The rest of the study area is deemed "Suburban".*

Source: Research Team and NYU Urban Expansion Project Team

Using NYU's Urban Expansion Initiative's land use change detection methodology and official government demographic information, Figure 2 describes spatially, and in tabular form, changes in built up area from 1991 to 2013. As is indicated by Figure 2, there has been a 2.5X increase in the built up area from 1991 to 2013, with most of the increase occurring between 2001 and 2013. The result has been a dramatic drop in urban density from 11,067 persons per square kilometer in 2001 to 7,309 in 2013. Our most recent data indicates that this trend is continuing, in fact, accelerating, with the 2015 built up area totaling 80 kilometers, according to the city government. Based on local planning policy, the land use objective is for 90 square kilometers to be built up by 2020. This especially rapid buildup since 2014 is largely the product of the New Urbanization Policy described in Section 1.5. As an under-urbanized region, Baoshan is designated for rapid urban growth, which in Chinese fashion, is significantly based on supply side initiatives, i.e., developing more land, and anticipating that more people and activities will come.<sup>11</sup>

Map 3 describes population change by area in Baohsan over the 2000-2010 inter-census period. (Jurisdictions included in the population analysis for the three case study cities in this study, are described in Appendix 2.) As indicated, the fastest population growth in both absolute and relative terms is on the periphery of the core city. Currently, the population of the city proper is approximately 300,000, but it is planned to reach 500,000 by 2020 based on 60,000 annual population increments during the 12<sup>th</sup> national five year development plan (which ends in 2016) and 80,000 annual population increments during the 13<sup>th</sup> national five year development plan (2016 – 2021). However, we consider the 2020 500,000 objective highly optimistic and unlikely to be reached, especially given the changed geopolitical situation which was expected to provide the economic impetus for this growth.

<sup>11</sup> Chinese urbanization is often described as land (and property) driven rather than being economically and demographically driven. The national government accepts this critique and is attempting to realign policies accordingly.



**Map 3: Baoshan Population Change by Area: 2000-2010**

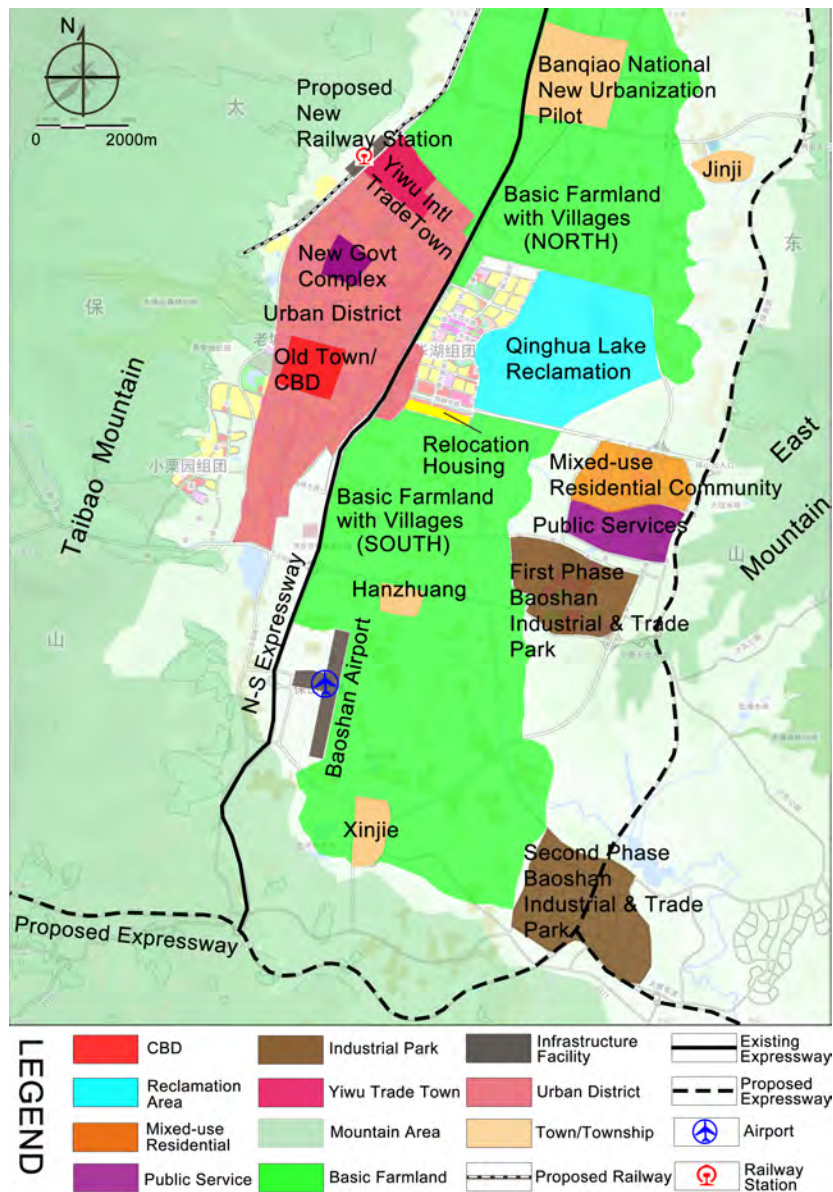
*Note 1: Bar charts and absolute population data (including change) are based on local jurisdictions (or groups of jurisdictions), as named. Percentage change data (in circles) is based on the foregoing data; circles indicate the prime spatial areas of demographic growth within each jurisdiction (or group of jurisdictions).*

*Note 2: Small numbers above bars indicate absolute population for the year in question; Bold numbers indicate change in population.*

Source: Research Team based on census data



## 2.3 BAOSHAN: SPATIAL ELEMENTS/ECONOMIC BASE



**Figure 3: Baoshan: Key Spatial Elements**

Source: Research Team

Figure 3 describes the main spatial elements constituting the Baoshan urban area (urban, suburban, immediate peri-urban). The future economic base of the city is planned around the Baoshan Industrial and Trade Park (south-east of the core city), with two planned phases (Phase 1 is currently under construction) and the Yiwu International Trade Town, adjacent to the New Railway Station.

Much of the visioned future *economic base* of Baoshan is based on the assumption that there will be seamless access to Myanmar and (eventually) India. Thus products such as small goods (largely extruded plastics products) and textiles are being promoted for manufacture in the Baoshan Industrial and Trade Park. In our judgement, these low

value added activities are problematic given China's middle income country level of development, and the uncertainty of links and access to Southeast and South Asian markets. Ongoing development of Cloud IT services (for both the private and public sectors at a national scale) in Baoshan show much greater potential, given this activity's rapid growth, and need for large amounts of electricity (available locally) and a benign climate. Other activities based on reliable, low-cost electricity are, and should be promoted. As noted above, the Yiwu

International Trade Town is designated to be a major economic hub in Baoshan based on international trade to Myanmar, and beyond.

Another economic area being promoted, with high potential promise is tourism and amenity. Although Tengchong Town, also in Baoshan Municipality (143.2 kilometers – two hours drive - from Baoshan city) currently is the dominant tourist destination in the Municipality and has a national tourism profile, Baoshan intends to capture more tourist and amenity activity, including second home residents, etc. (Appendix 3 describes a typical second home development in China, in this case the International Tourist City in Tengchong, Baoshan Municipality.) The local environment in and around Baoshan is very scenic: mountains, hot springs, etc. In addition, there is ongoing large-scale investment in high-quality restoration of the historical center of Banqiao (the new urbanization pilot town discussed below) and in rehabilitation of Qinghai Lake (discussed below).

Of note, is the large amount of land protected as *Basic Farmland*; an increasingly enforced policy, as described in Section 1.5. However, as indicated by Images 3 and 4, a large number of existing vital villages exist within the large Basic Farmland area.

Other important form / land use elements in Baoshan include:

- (1) The Banqiao National New Urbanization Pilot project (to the north), which involves taking an existing key peri-urban town and turning it in a major urban sub-center, as a pilot mechanism under the New Urbanization Policy described in Section 1.5. As noted, this major investment includes restoring the historic core of the city as a tourist attraction.
- (2) The New Government Complex (to the north of the existing CBD), which is driving development, through induced private sector investment, of a new urban sub-center.
- (3) The Qinghua Lake Rehabilitation project (a famous lotus lake, which was being encroached and degraded), which is driving middle income urban residential development to the west of the Lake. This partially accounts for the high population growth on the periphery of the Core city noted above.
- (4) The Mixed Use and Public Services Complex (schools, government offices, etc.) immediately to the north of the first phase of the Baoshan Industrial and Trade Park.

Images 2 describe typical urban landscapes related to the discussion above.



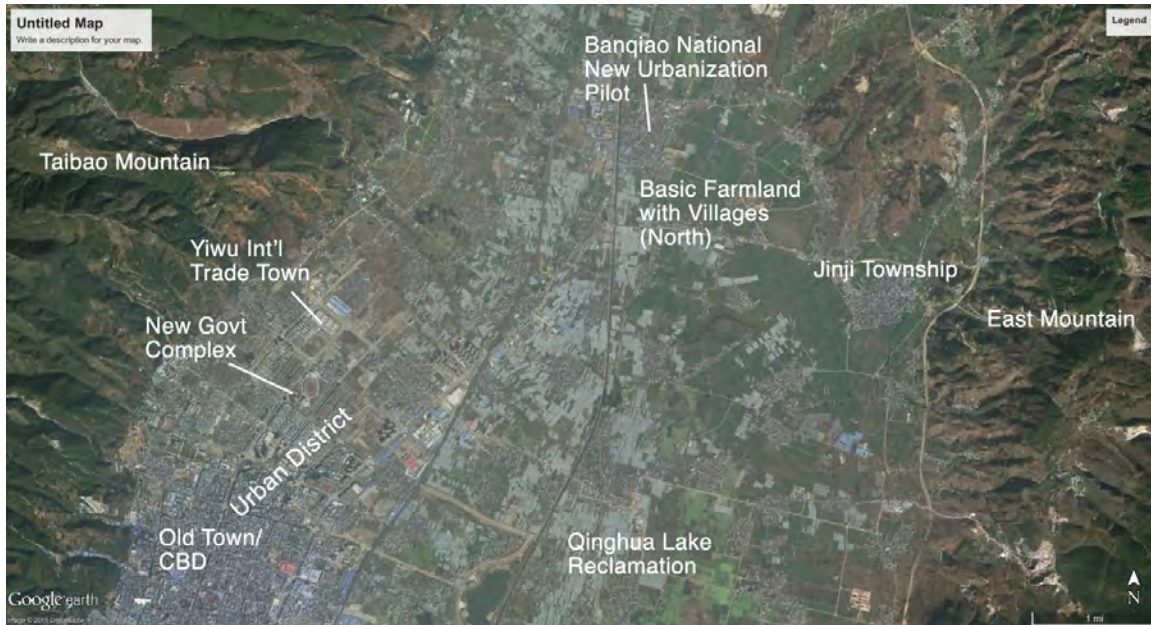
**Image 2: Typical Urban Landscapes: Boashan Urban Area**

*Images clockwise from top left: Yiwu International Trade Town, Reconstruction of historic center in Banqiao; Hot spring hotel in Jinji, Typical periurban village; Industrial area residential community; Decentralized public facilities: school; Qinghua lake restoration; Relocation housing on periphery, New shopping complex: government subcenter; Rehabilitation of Lotus Lake.*

Source: Research Team

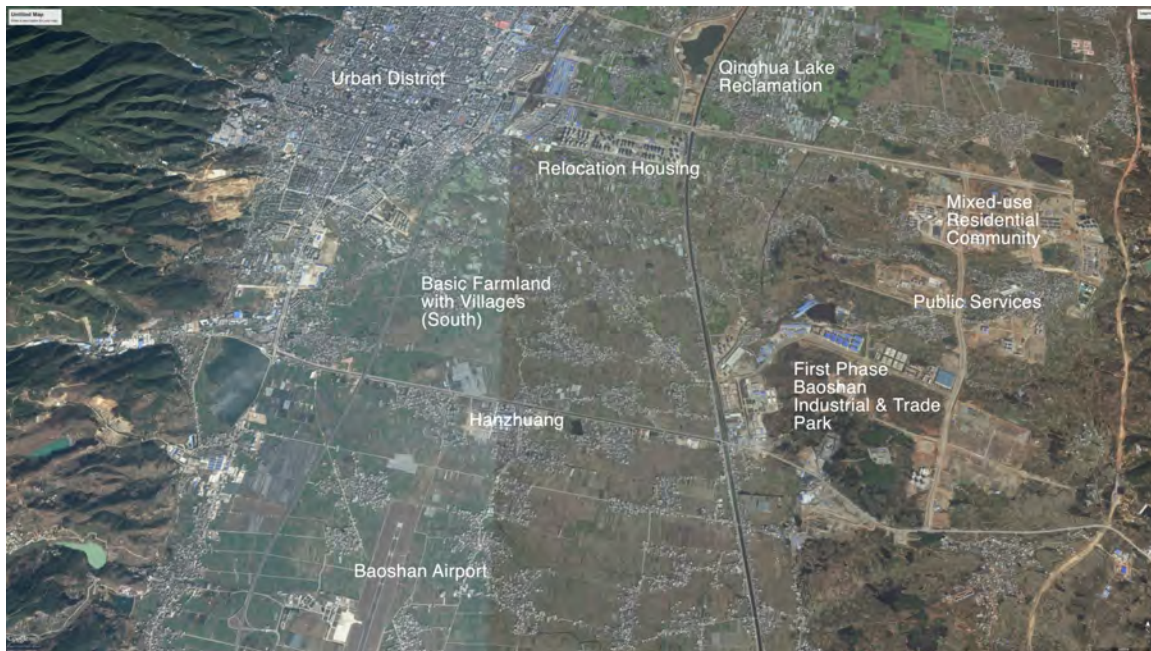
The remote sensed images (Images 3 and 4) provide a different perspective on the above phenomena and dynamics. Of particular interest and importance is the extent of existing village development in the *Basic Farmland* areas, and the strong role that the valley setting (with mountain barriers on the east and west) play in driving the north-south linear urban form of the Baoshan urban area.





**Image 3: Remote Sensed Image: Baoshan Urban Area North (2016)**

Source: Google Earth; Downloaded on February 5, 2016

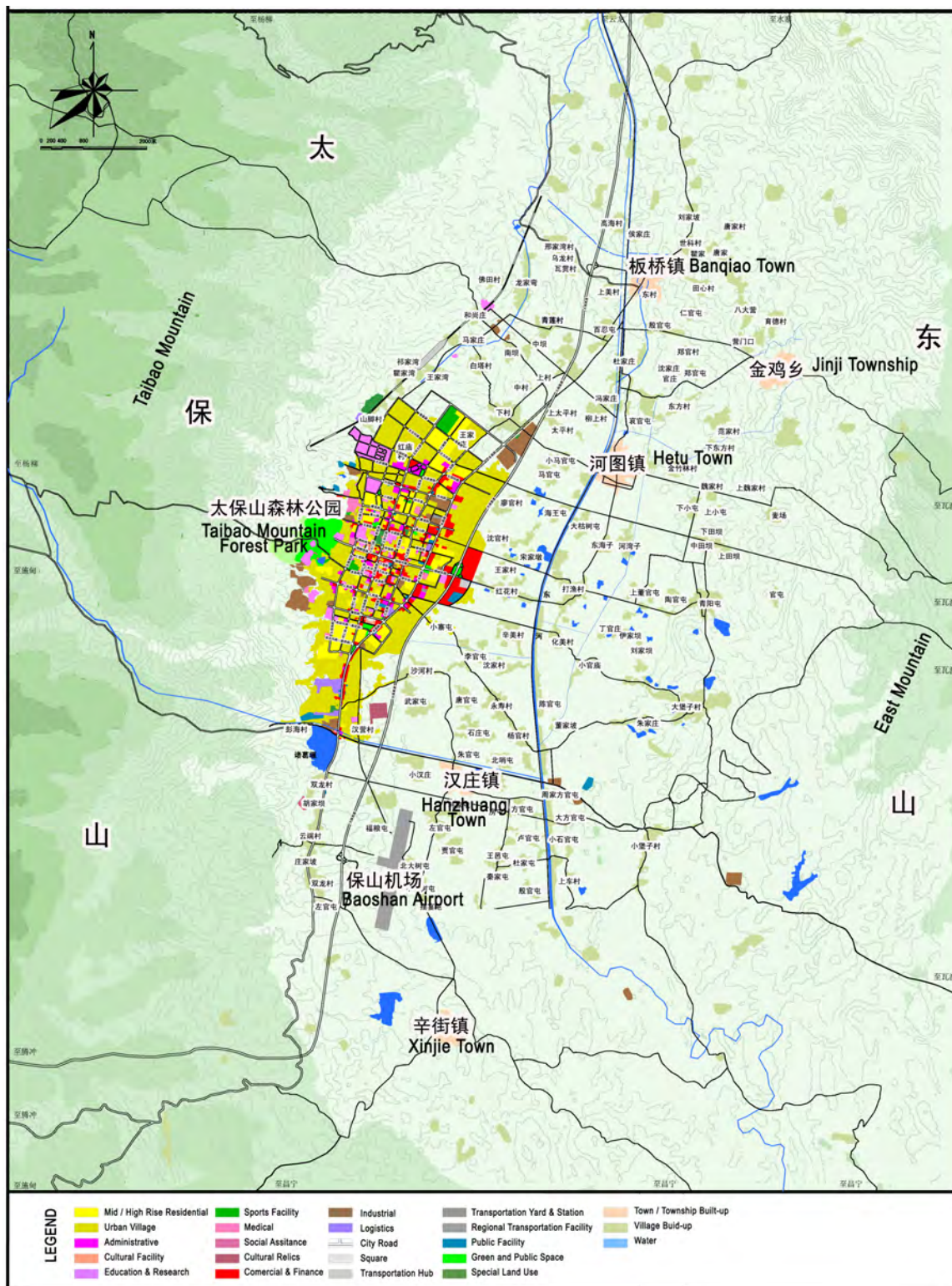


**Image 4: Remote Sensed Image: Baoshan Urban Area South (2016)**

Source: Google Earth; Downloaded on February 5, 2016

As indicated by Maps 5 and 6 Baoshan has developed detailed land use plans for the city, which extend beyond 2030. The existing (see Map 5) emerging urban form largely reflects the 2030 plan; unlike the lack of congruency between urban land use plans and actual development in some Chinese cities. The relatively small size of Baoshan may make its land use more controllable and thus contributes to greater congruency between land use plans and actual physical development.

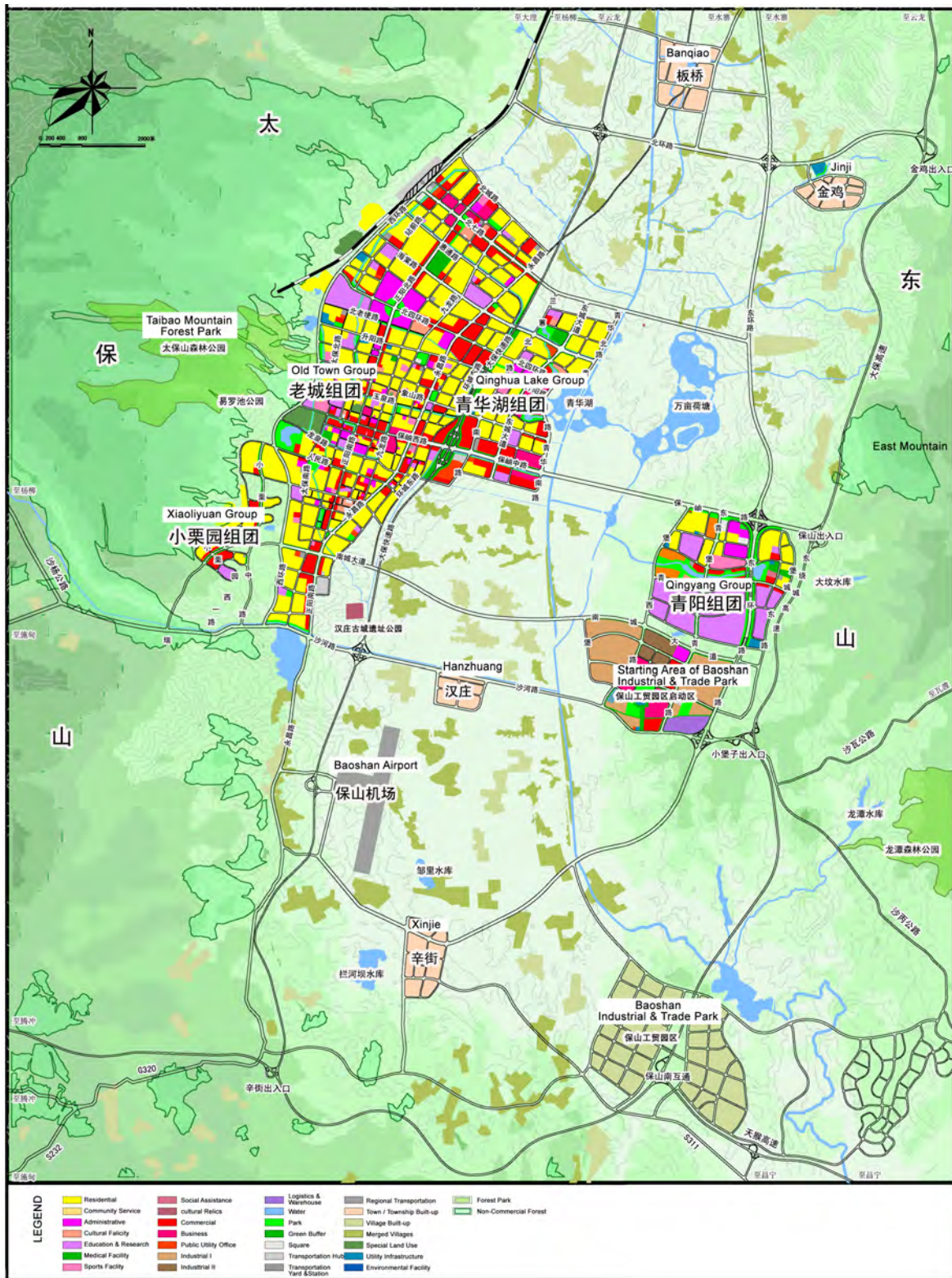




**Map 4: Baoshan Current Land Use, July 2013**

Source: Baoshan Urban Planning Bureau

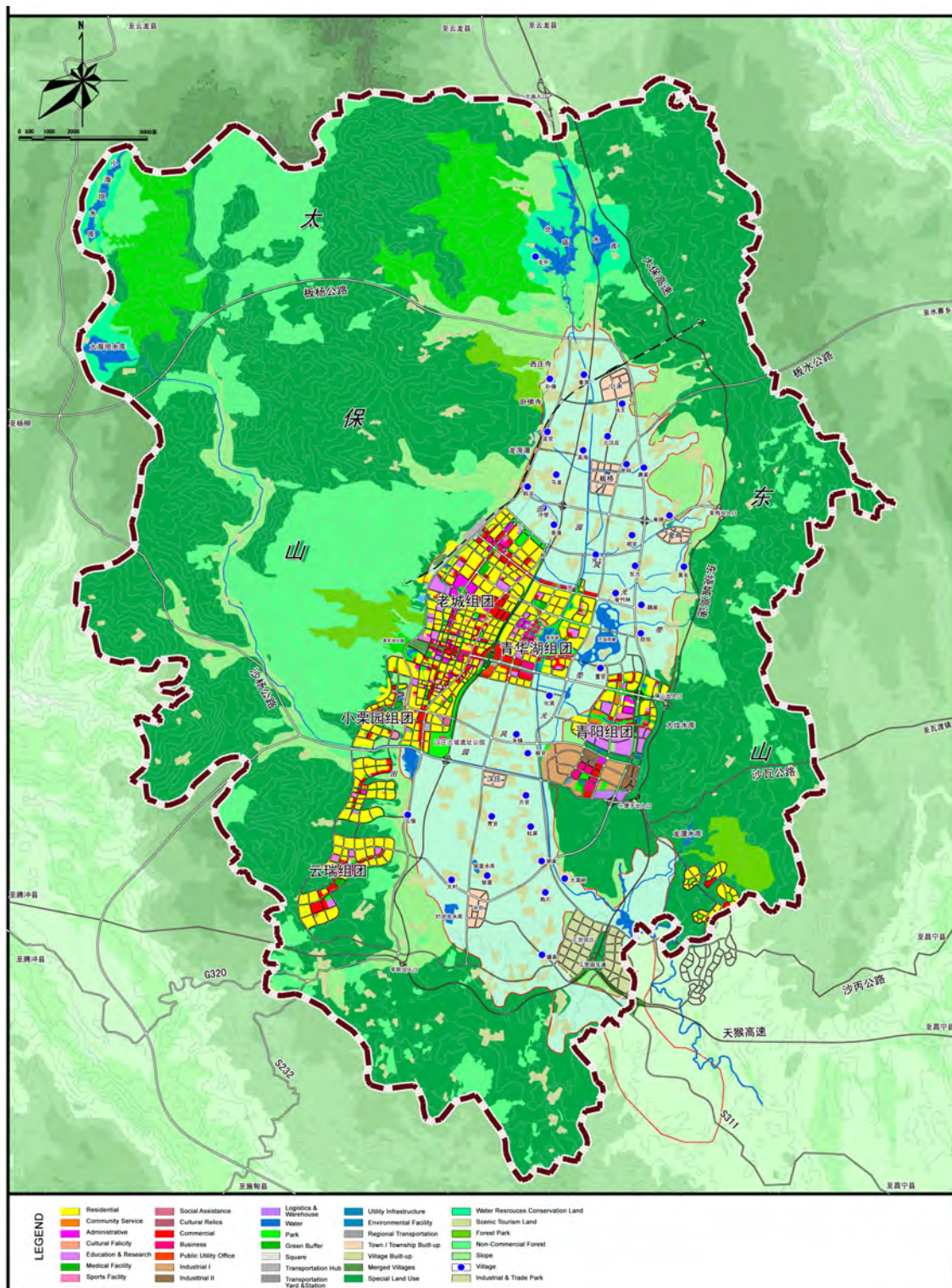




**Map 5: Baoshan Official Land Use Plan: 2030**

Source: Baoshan Urban Planning Bureau



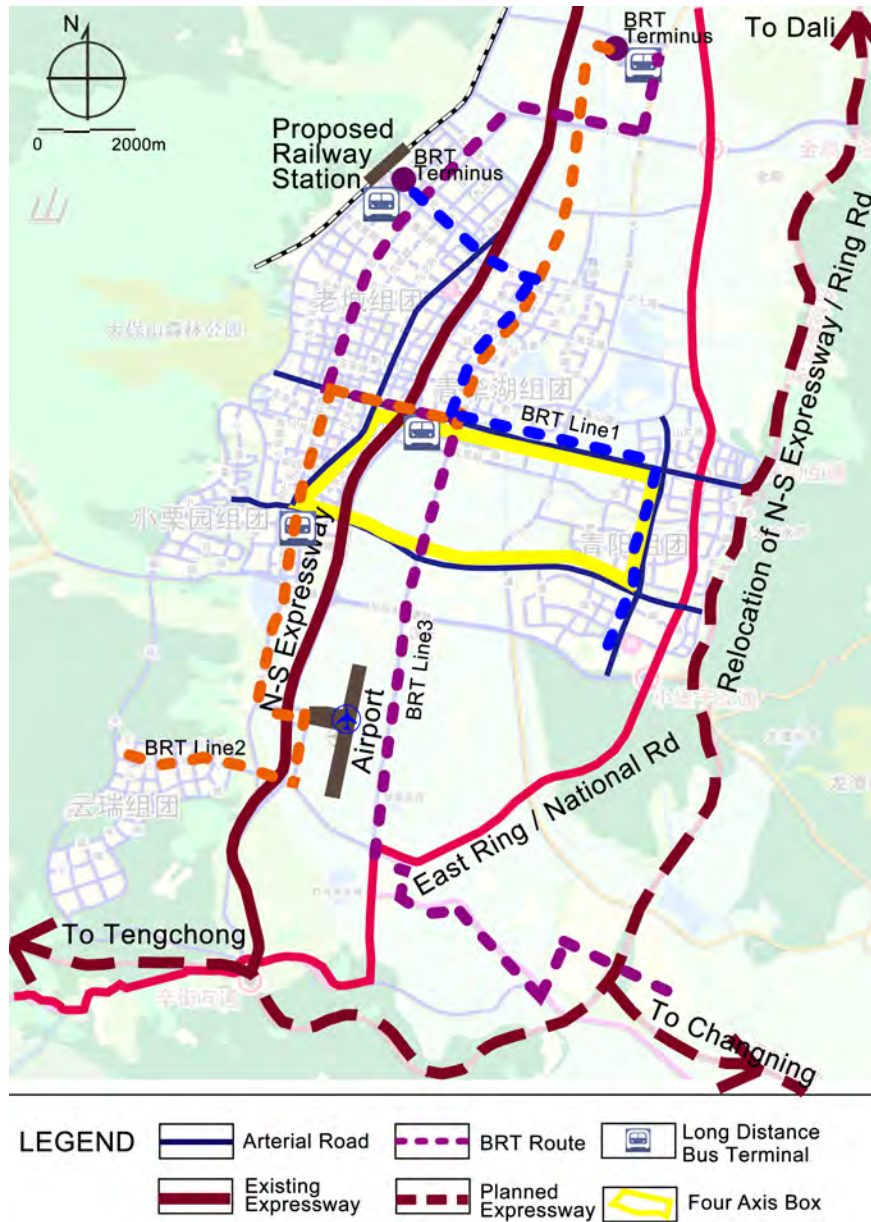


**Map 6: Baoshan Long Term Land Use Plan**

Source: Baoshan Urban Planning Bureau

## 2.4 BAOSHAN'S URBAN TRANSPORT SYSTEM

Baoshan's road grid is based on a four axis box, as indicated by Map 7. The planned first BRT line is designed to join the two new catalytic economic nodes: The Yiwu International Trade Town and the Baoshan Industrial and Trade Park, indicating an alignment between economic and transport planning. The prime transport development corridors emanating from the CBD are to the north and to the east, indicating congruency with existing development patterns and the official land use plans. Development to the west is obviously blocked by mountainous terrain, whereas the south is relatively dormant, despite the existence of the airport to the south.



**Map 7: Baoshan's Existing and Planned Transport Grid**

Source: Research team



Map 8 indicates that there is a wide variation in road widths in Baoshan, encompassing 20, 40, and 50 meter road widths. These road cross-sections correspond to the national road cross-section standards indicated in Figure 1. As indicated by Map 8, the roads become much wider in the expansion areas, making these areas less walkable and human friendly; see Image 5, which describes the main arterial road running south to serve the Baoshan Industrial and Trade Park. This type of overly wide “boulevard” road dramatically contrasts with the narrow roads within the villages, which are being enveloped by the city’s expansion. Image 6 shows typical narrow roads within these enveloped urban villages and the adaptive public transport response, three wheeled motorized vehicles (tuk tuks). Also of importance, is the significant degree to which the Basic Farmland designation disrupts the road pattern both in the central-south and central-north areas of the Baoshan urban region.



**Map 8: Baoshan’s Road Grid: Variations in Road Width**

Source: Baoshan Urban Planning Bureau



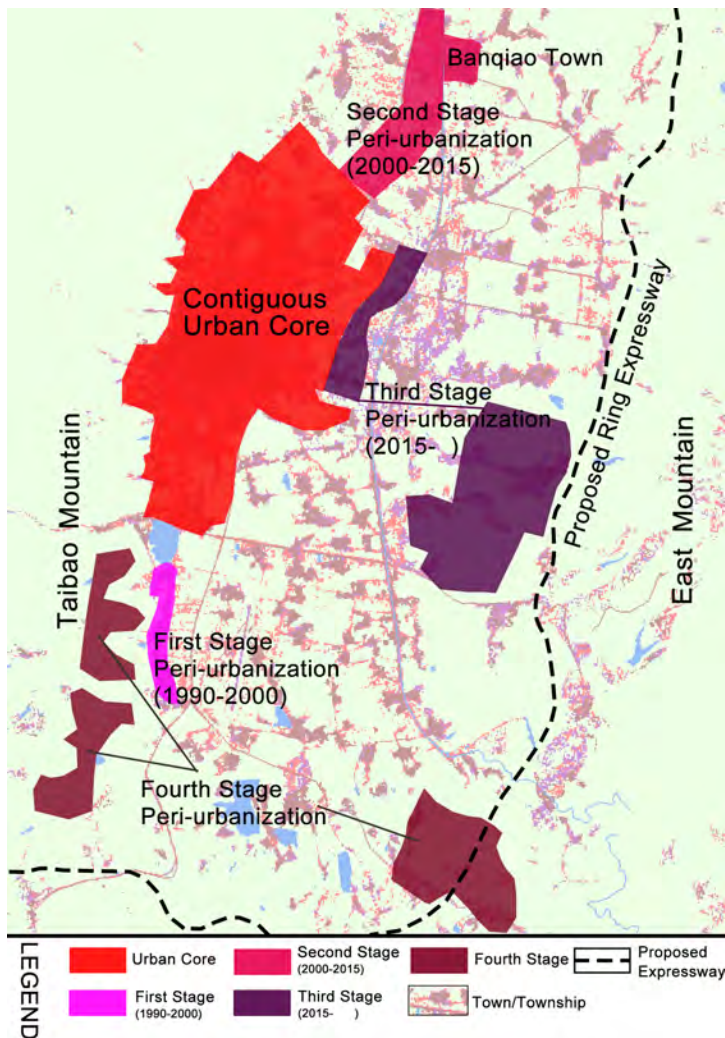
**Image 6: Arterial Road Serving the Baoshan Industrial and Trade Park**

Source: Research Team



**Image 5: Village Roads served by 3 Wheeled Motorized Vehicles**

Source: Research Team



**Figure 4: Baoshan: Peri-Urbanization Dynamics**

Source: Research team

Figure 4 describes Baoshan's peri-urban dynamics. As can be seen from Figure 4, of particular note in shaping the expansion of Baoshan, is the planned development of a new expressway along the East Mountain on the east side of the urban region (also see Map 5). This new expressway is intended to act as a ring road, a development driver of the east side of the urban region, pulling traffic away from the city center – the current north-south expressway (see Map 7) passes through the traditional center of the city.

## 2.5 BAOSHAN: POPULATION AND LAND PROJECTIONS

Table 4 describes projected population and urban land states for 2030 and 2050 based on low and high projections. Although Baoshan’s density goal, based on the national standard, is 10,000 persons per square kilometer, we have used the more realistic actual 2013 density of 7,309 in our projections – a metric that may be on the high side.

**Table 4: Baoshan: Population and Land Projections**

	Population		Land Requirements (sq.km) <sup>1</sup>	
Forecasts	2030	2050	2030	2050
Low Growth Assumption <sup>2</sup>	684,792	798,139	94	109
High Growth Assumption <sup>3</sup>	1,017,395	1,445,358	139	198
Notes:				
1. Land Requirements based on 2013 population density (pax/sq.km)			7,309	
2. Low growth forecasts based on constant 2000-2010 CAGR for Study Area			1.5%	
3. High growth forecasts based on constant 2000-2010 CAGR for Core City			3.6%	

Source: Research Team

## 2.6 FINDINGS AND CHALLENGES: BAOSHAN

What can be learned from Baoshan?

(1) Smaller cities are more vulnerable to shocks, especially cities highly exposed to geopolitical shocks, thus in projecting population (and associated, land demand), multiple exploratory scenario approaches are likely to be useful, especially in identifying coefficients to be plugged into mechanistic demographic forecasting equations, or as part of a mixed methods projection approach.

(2) In the case of Baoshan, and as frequently seen in China, the official demographic forecasts seem unrealistically optimistic; this, in turn results in over-estimates of urban land needs, which are reflected in the land use plan, and even on the ground, given China’s supply-led urbanization model. This can lead to vacant housing, “diluted” urban sub-centers, etc.

(3) In Baoshan’s case, the new urbanization policy results in even more high-side demographic and urban land use projection bias than would normally be the case, creating high risk of land use inefficiencies, and hyper-urbanization (not enough employment relative to migrant flows encouraged through supply side driven, rural-urban migration inducement based on new urbanization policy frameworks).

(4) Given the optimistic economic future portrayed, and the fact that industrial land is priced far below market rates (as in most of China), in Baoshan, there appears to be an over allocation of land to industrial uses. This contributes to land use inefficiency, e.g., leap-frogging, extensive

low density urbanization in the south-east of the urban area, all of which contributes to auto dependency and reduced access to public and private services.

(5) Protected basic agricultural land plays major role distorting urban expansion patterns and transport grids.

(6) The Baoshan case illustrates that the situation is ripe for cost-effective transport investments, e.g., BRT routes, fly-overs over bottleneck intersections (designed as aesthetically pleasing as possible).

(7) Driven by the foregoing factors, there is evidence of increasing non-contiguous development, lower densities and coarser road grids associated with Baoshan's recent urban expansion. Road cross-sections are abnormally wide in the expansion areas, constraining the creation of walkable, human-scale environments.



## SANYA CASE STUDY

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### 3.1 SANYA OVERVIEW

Sanya is the number one beach destination in China; it is China's only significant sub-tropical beach environment (approximately on the same latitude as Hawaii), and was the pioneering area in mass beach tourism in China. For this reason, Sanya, although a Third Tier City, has attracted global attention, being discussed in leading global media such as the *New York Times* and *The Economist*.<sup>12</sup>

Sanya attracts over 13 million tourists annually. On an average day, there are 107,000 tourists in the city on top of the official 750,000 local population. However, on peak days in the winter, the total population of the city can be over 1.6 million people. 500,000 pensioners alone spend the winter in the city, usually escaping the winter in harsh northern climates, such as Heilongjiang Province.

The scale of tourism means that Sanya is in the top tier of beach resorts in Asia measured by visitors, rivaling Phuket, Thailand; Bali, Indonesia; as well as large-scale American beach resorts such as Honolulu and Miami Beach. In many ways, the urban landscape resembles these other leading global beach cities. The difference is that Sanya came on the scene later, and so its policies and development styles are still evolving through learning. As a first mover in China, many mistakes were made in Sanya's development, particularly the decision to try to create a diverse economy that included industry, rather than focusing on the city's comparative and competitive advantage, which is tourism and amenity.

Of particular concern, is that the city is running out of beach land. This is because the value of beach land was undervalued in the late twentieth and early twenty-first century, so that it was underpriced, and often misallocated to less optimal functions such as industry.

Increasingly, partly because the beaches are already built out, tourism, and related amenity development, e.g., second homes, are protruding along river valleys into the mountains, putting enormous pressure on these fragile environments. The Sanya Municipal Government is particularly worried about this phenomenon in that much of the development involves investors making private deals with rural collective villages, bypassing official land development mechanisms, a gray area legally. To the Municipal authorities, this often results in poor quality and/or inappropriate scale development. Because of Sanya's high profile, this development has also attracted the attention of international environmental agencies and INGOs.

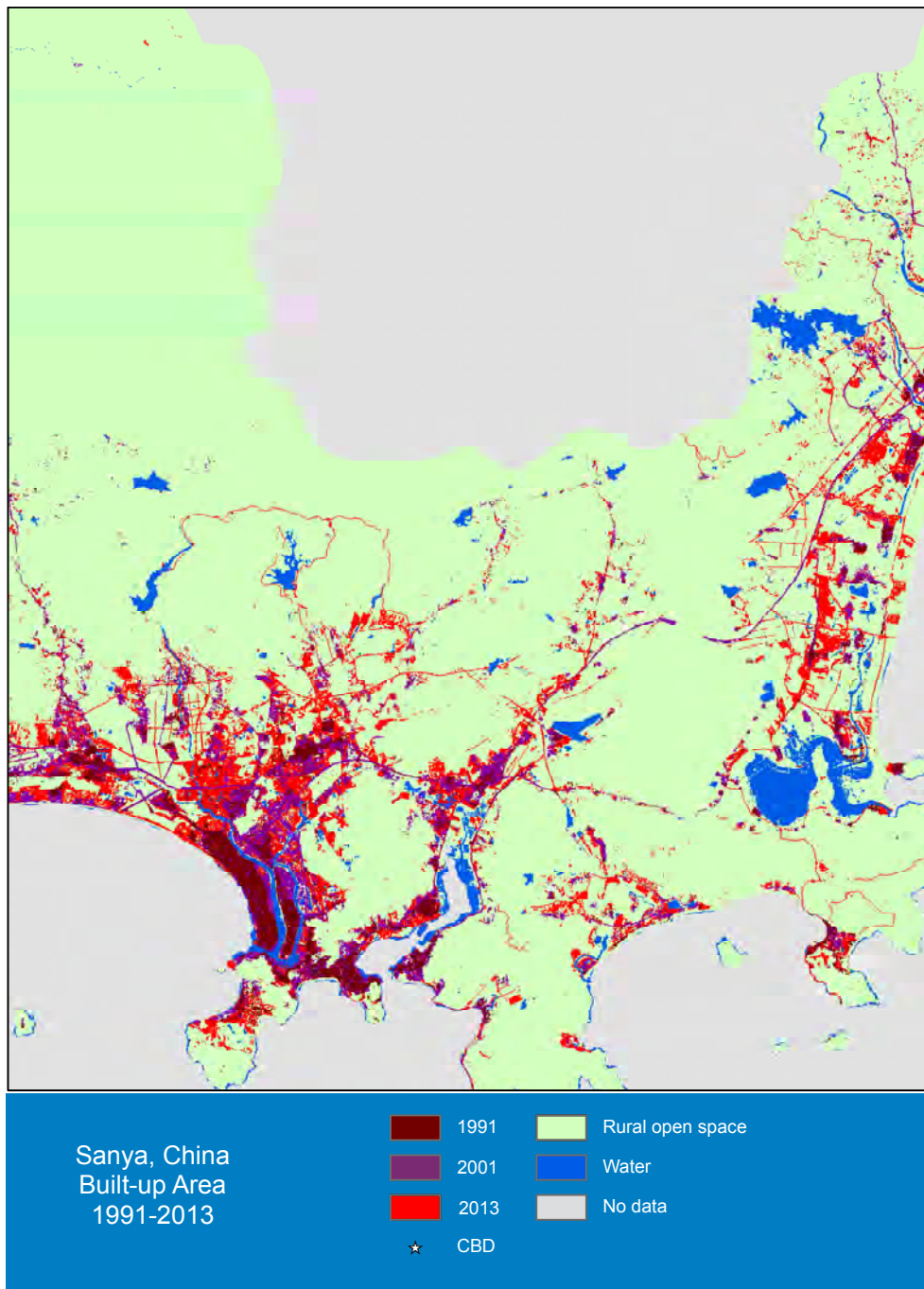
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<sup>12</sup> "Sanya - People Used to Retire Where They Lived and Worked. That Is Beginning to Change", *The Economist*, May 28, 2016, pp. 36-37

Tourism is morphing, paralleling experience elsewhere, into a broader amenity economy, e.g., into retirement living (100,000 Chinese retirees have settled in Sanya full time), and development of second homes for the more affluent Chinese upper-middle class.

Given the above dynamics, it is not surprising that Sanya is the fastest growing demographically of the four Tier Three Cities studied.

### 3.2 LAND USE / DENSITY CHANGE: SANYA



	1991	2001	2013
Urban Built-up (sq.km)	3.77	12.05	38.44
Suburban Built-up (sq. km)	15.94	40.93	72.09
Total Urban + Suburban Built-up (sq.km)	19.71	52.97	110.53
Density (pax/sq.km)		6,208	5,241

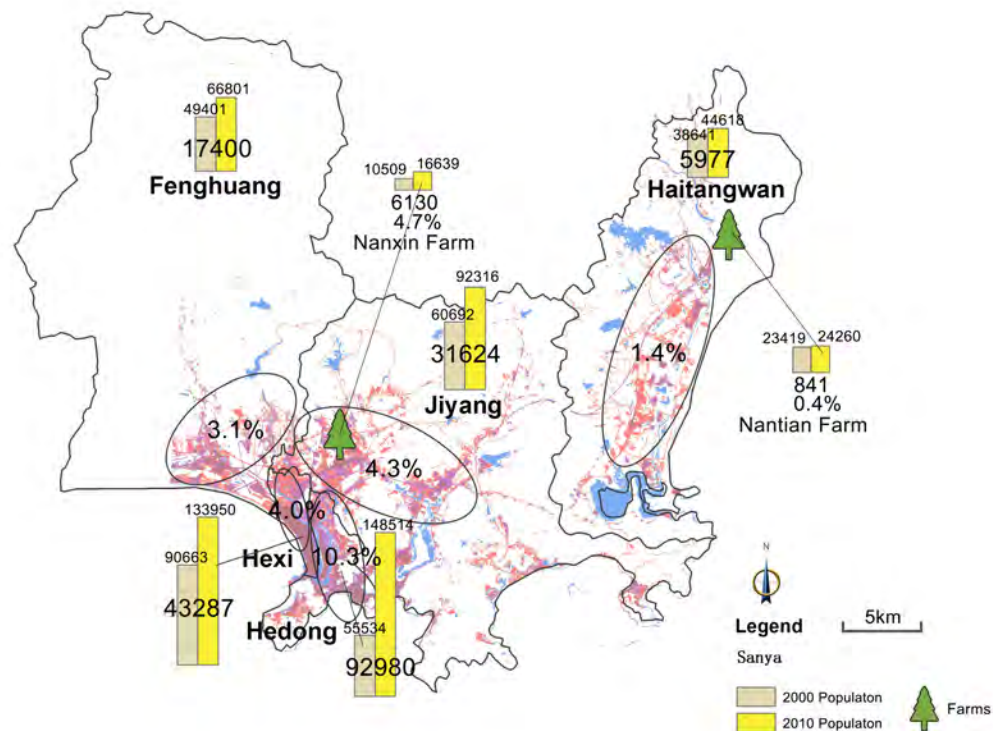
**Figure 5: Sanya Land Use Change: 1991 – 2013**

*Note: “Urban” refers to the Hedong and Hexi “Street Level” Data Areas (somewhat equivalent to US Census Districts). The rest of the study area is deemed “Suburban”.*

Source: Research Team and NYU Urban Expansion Project Team

Using NYU’s Urban Expansion Initiative’s land use change detection methodology and official government demographic information, Figure 5 describes spatially, and in tabular form, changes in built up area from 1991 to 2013. As indicated by Figure 5, the built up urban land area increased by 2.7X between 1991 and 2001, and by 2.1X between 2001 and 2013. Between 2001 and 2013, urban densities dropped from 6,208 people per square kilometer to 5,241. As further indicated by Figure 5, significant new urban development has occurred both in the core urban areas and in outlying corridors and nodes.

Change in the spatial distribution of population in Sanya is described in Map 9. The greatest population gains between 2000 and 2010 (inter-census data) occurred in the core area, Hexi (43,287 gain) and Hedong (92,980 gain) urban Districts, particularly the latter. However, Jiyang District also experienced significant gains, reflecting the river valley / mountain development discussed above. The data for Haitangwan District is unrepresentative of its likely demographic future. A major new beach oriented *New Comprehensive City* is under construction in Haitangwan, likely to be reflected in very major population gains in the 2020 census. In general, the axis of growth is to the east and the north, with the north-west (Fenghuang District) remaining somewhat slower growing.



**Map 9: Sanya: Spatial Distribution of Population Change**

*Note 1: Bar charts and absolute population data (including change) are based on local jurisdictions (or groups of jurisdictions), as named. Percentage change data (in circles) is based on the foregoing data; circles indicate the prime spatial areas of demographic growth within each jurisdiction (or group of jurisdictions).*

*Note 2: Small numbers above bars indicate absolute population for the year in question; Bold numbers indicate change in population.*

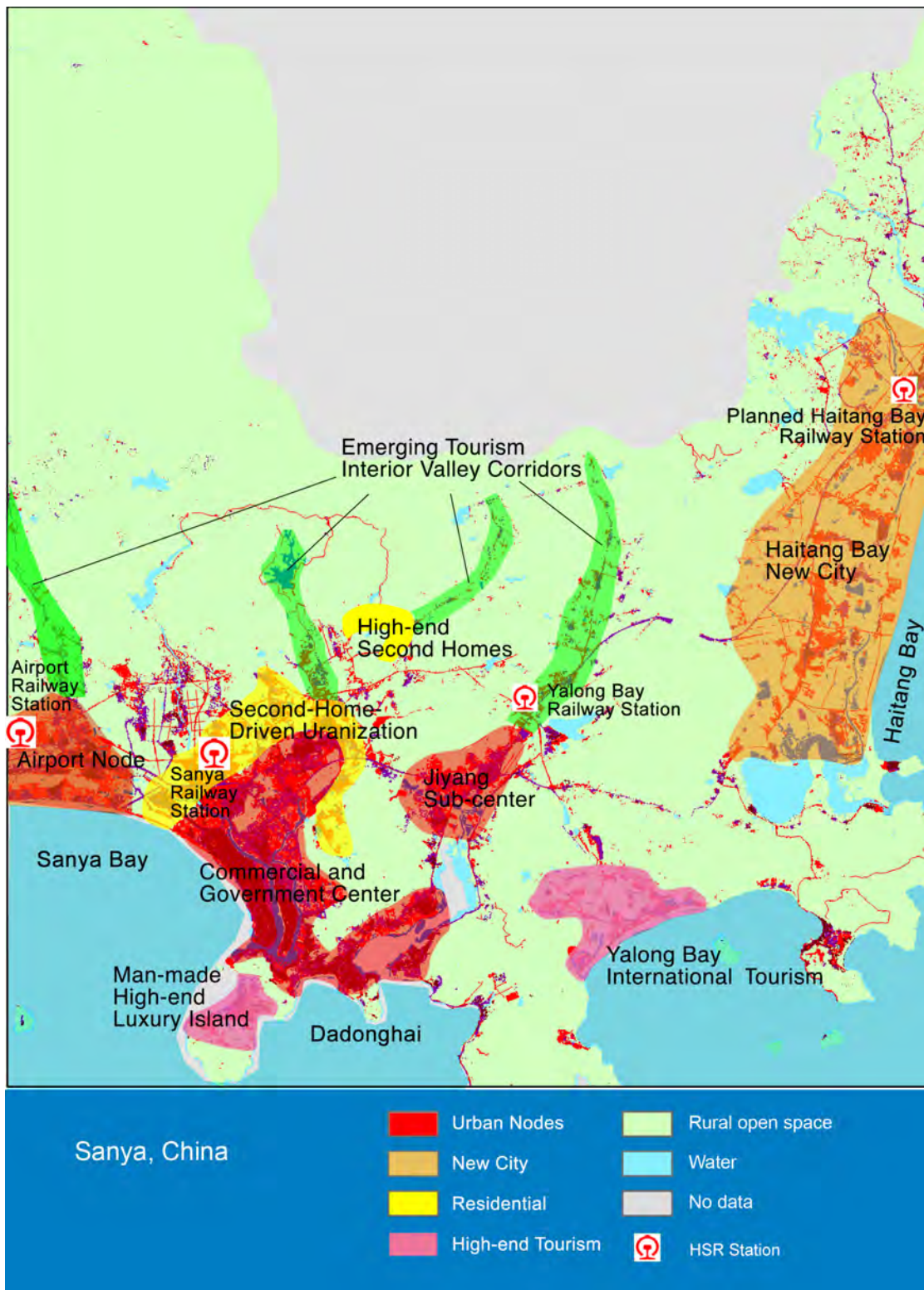
Source: Research Team based on census data

### 3.3 SANYA'S URBAN STRUCTURE

Figure 6 describes key spatial elements constituting Sanya's existing and evolving *multi-nodal* urban structure. The current heart of the city is Sanya Bay, the most important beach area (by visitor numbers) and the location of the Municipal Government. In addition, there are three other important nodes: (i) Yazhou Bay, to the west along the coast (not part of the study area), where Sanya's long history evolved as a place of exile, a small but strategically located trading center, and military base (Map 10 below indicates the location of the Yazhou Bay urban center); (ii) Yalong Bay, the high end beach area, home to many of the world's leading resort hotel brands; this development was started in 1996; and (iii) Haitang Bay, the site of a New Comprehensive City, which will include beach resorts (11 hotels are planned, 7 under are already open or under construction)<sup>13</sup> started in 2005; Haitang Bay New City is expected to be built out by 2025.

<sup>13</sup> The natural quality of the Haitang Bay beach is poor compared with Sanya Bay and Yalong Bay. Essentially, the beach at Haitang Bay is being constructed.



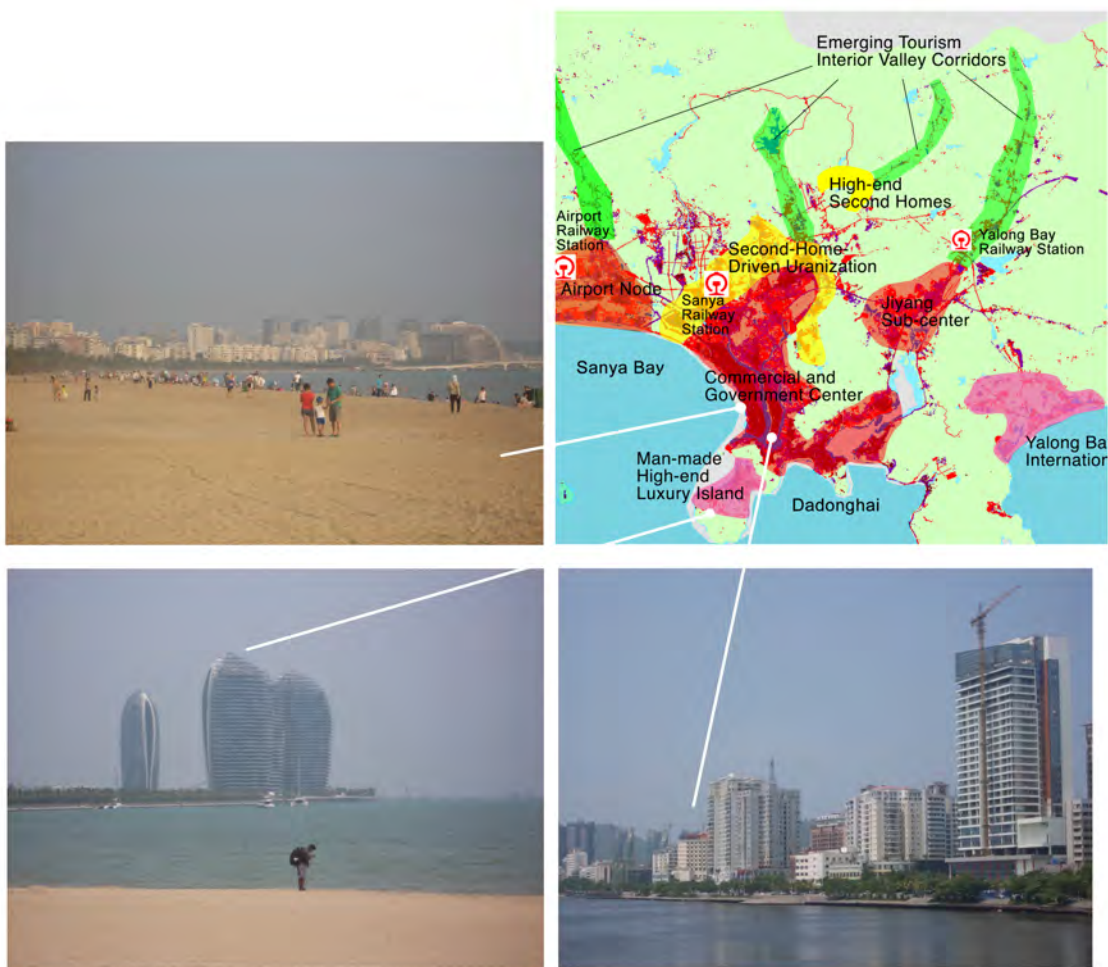


**Figure 6: Sanya's Multi-Nodal Structure**

Source: Research Team

Throughout the greater Sanya urban area, all beach front is essentially committed, which is driving land reclamation (e.g., the artificial islands pictured in Image 7 – bottom left image), beach construction, and tourism / amenity oriented development in valleys to the north of the built up urban area - 70% of land in the Municipality is mountainous. Urban expansion is largely driven by new residential units, 80% of which will be bought as second homes.

Image 7 illustrates key elements of Sanya Bay's urban development. Image 8 describes key characteristics of the high-end internationally oriented Yalong Bay area. Image 9 describes typical emerging elements in the Haitang Bay New Comprehensive City. Image 10 describes typical developments in the valleys to the north of the built up urban region. Image 11 describes Sanya's urban form from a remote sensed image perspective.

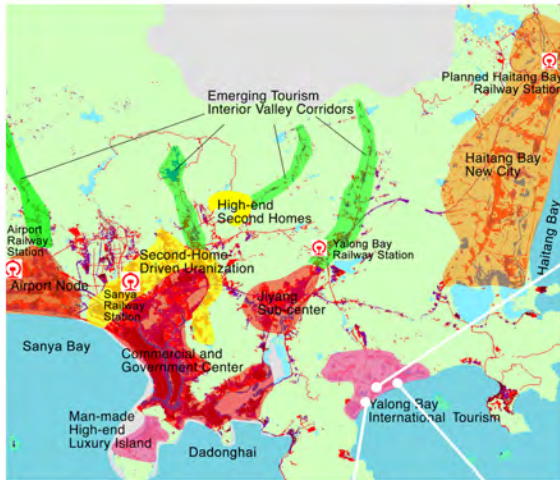


**Image 7: Sanya Bay Urban Elements**

*Top left: Sanya Beach*

*Bottom row from left: Man-made Isle; Riverfront CBD*

Source: Research Team



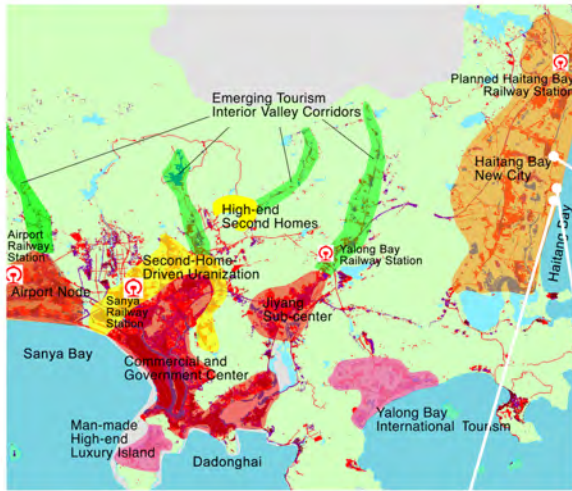
### Image 8: Yalong Bay Key Elements

*Top right: Commercial Center*

*Bottom row from left: Beach Hotels; High-end beach*

Source: Research team





### Image 9: Emerging Elements: Haitang Bay New Comprehensive City

*Top right: Convention Center*

*Bottom row from left: Beach quality lower; Reconstructed Tourist Beach*

Source: Research Team

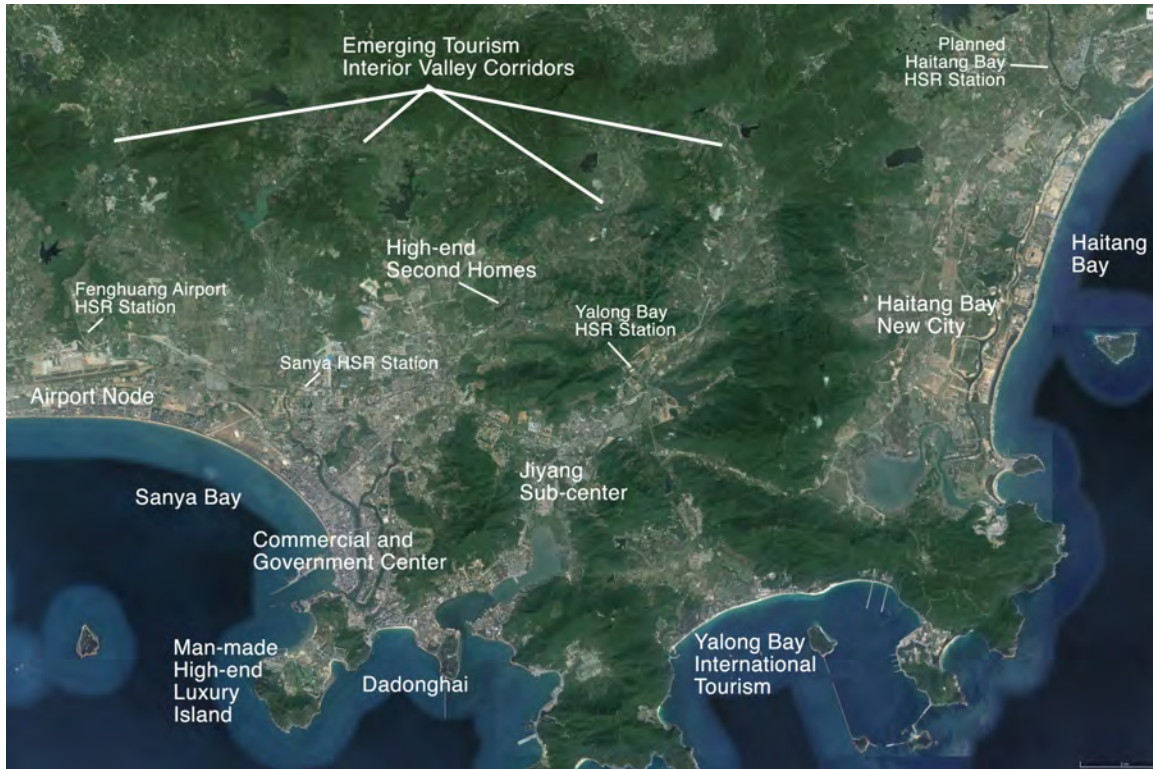




### Image 10: Interior Valley Corridor Development

Counterclockwise from top left: Hybrid village near airport node; Collective village amenity development in airport valley corridor; Residential apartments near Airport Node; High-end second homes in valley: Vanke Forest Holiday Park

Source: Research Team



**Image 11: Remote Sensed Image: Sanya Urban Area**

Source: Google Earth; Downloaded on January 27, 2015

### **3.4 SANYA'S LAND USE AND TRANSPORTATION PLANNING**

As noted in Map 10, the current Sanya Master Plan envisions future urban development being centered on the Haitang Bay New Comprehensive City, on the edges of existing urban sub-centers (particularly Sanya Bay), and advocates limited, controlled development into the city's mountainous hinterland. The latter is planned to be achieved by construction of limited capacity two lane (Level 3) roads into the mountainous valleys (see Map 11). However, as noted, the Municipal Government is finding it difficult to limit development in the river valleys north of the city. Overall, the transport plan aligns well with the land use plan. This is more likely to occur in smaller (Tier 3 and smaller) cities where the Transport and Land Use Planning functions are normally undertaken by the Planning Bureau. (Actual transport infrastructure implementation is undertaken by a Transport Bureau.)



**Map 10: Sanya Master Plan: 2012-2020**

Source: Sanya Urban Planning Bureau



**Map 11: Planned Controlled Access to Mountainous Hinterland Valleys: Sanya**

Source: Sanya Urban Planning Bureau



Map 12 describes the existing and planned transportation network in the Sanya urban area. As is clear, the intention of the transport plan / investment is to reinforce the east-west urbanization pattern, that parallels the coast. Unique to the four case study cities, and rare in a Third Tier Chinese city, the Sanya urban region is served by a just opened HSR rail line (Yuncheng, discussed below, has one HSR station, but there is no intra-urban service). This HSR line will eventually circle Hainan Island as a whole; however, because there are four stations (see Figure 6, Image 12, and Map 11) in the Sanya area, it acts both as an intra-urban and inter-urban train. In addition to the HSR service, tram service is planned in the denser tourist areas. The spatial impact of the major east-west limited access highway running east-west through the urban area has now been reinforced by the HSR line which essentially parallels this highway. Image 13 illustrates the HSR line along the built out northern edge of the Sanya Bay urban node – note the clean distinction between the urban and rural because of Basic Farmland policy protection to the valuable lowland agricultural land.



**Map 12: Sanya's Coastally Oriented Transportation Plan**

Source: Sanya Urban Planning Bureau



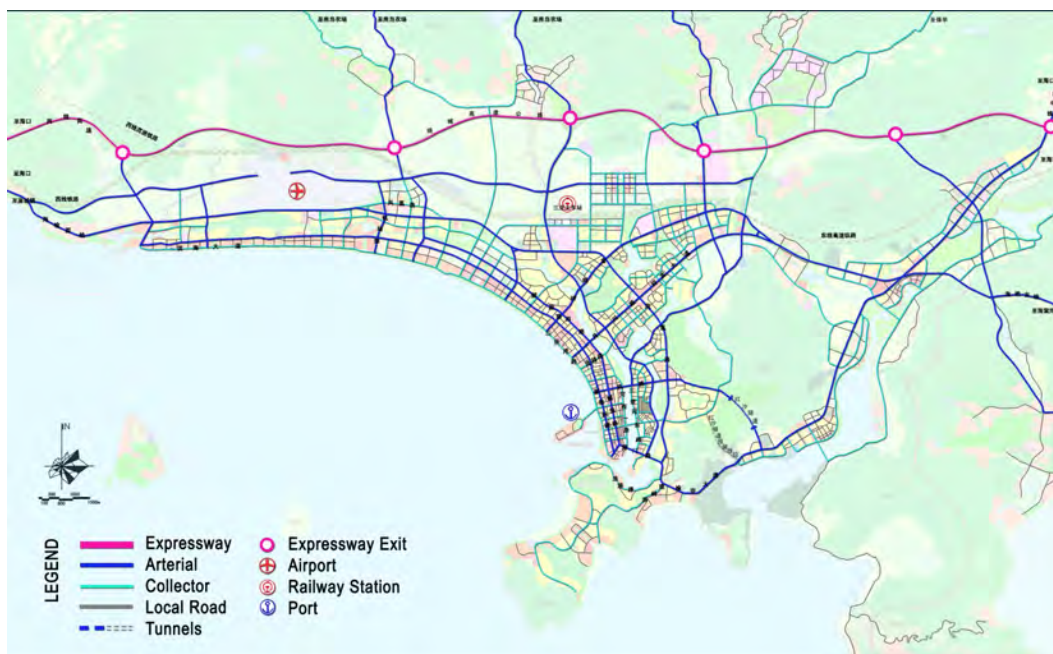
**Image 12: HSR Line & Clean Distinction Between Urban and Protected Basic Farmland**

Source: Research Team

A major issue facing Sanya, as a booming tourist center, is that the current airport is operating vastly beyond capacity. Local and national authorities need to determine an appropriate location for a new airport because the current site is not large enough to handle current, yet alone future demand. Where this new airport is located will have a major impact on Sanya's future spatial form.

At the micro level in the core city, Sanya Bay, the road network is relatively fine, based on a grid where

topographically possible – see Map 13. The system is appropriately hierarchical: expressways, arterials, collectors and local roads. Given the rugged topography, the road network very much reflects the local geography.



**Map 13: Sanya Bay: Urban Core Road Network**

Source: Sanya Urban Planning Bureau

In Yalong Bay, the road network is also appropriately design in terms of grid and road cross-sections. For example, the main artery through the Yalong Bay tourist node is not overly wide, essentially designed to serve forecast traffic, and is attractively landscaped. Image 13 illustrates typical roads in Sanya Bay and Yalong Bay urban centers.



**Image 13: Roadscapes: Sanya Bay and Yalong Bay**

*Left: Main Thoroughfare at Yalong Bay*

*Top right: Downtown Street: Sanya Bay*

*Bottom right: Oceanfront Road at Sanya Bay*

Source: Research Team





However, of concern is the road network being constructed in the New Haitong Bay Comprehensive City. The road network is convoluted, not grid like, forcing traffic onto the limited main arterials and making direct journeys within this urban sub-center difficult. Image 14 describes the road pattern in Haitong Bay Comprehensive City, while Image 15 illustrates the overly wide beach boulevard in this new city.

**Image 14: Road Pattern: Haitong Bay New Comprehensive City**

Source: Sanya Urban Planning Bureau



**Image 15: Main Thoroughfare: Haitong Bay New Comprehensive City**

Source: Research Team

### 3.5 SANYA: POPULATION AND LAND PROJECTIONS

Table 5 describes population and land projections for Sanya, based on low and high growth assumptions. Because of Sanya's booming tourism / amenity economy, it will soon graduate to Tier 2 City status. Given this growth, it will require large amounts of new urban land, as much as 725 square kilometers by mid-century. Given the current low density of development, 5,241 persons per square kilometer, half of the national government's recommended urban density, future planning should attempt to densify development in clearly defined expansionary areas, and through infilling and densification of the current built up area.

**Table 5: Sanya Population and Land Projections**

Forecasts	Population		Land Requirements (sq.km) <sup>1</sup>	
	2030	2050	2030	2050
Low Growth Assumption <sup>2</sup>	1,354,112	2,170,382	258	414
High Growth Assumption <sup>3</sup>	1,967,617	3,801,590	375	725
Notes:				
1. Land Requirements based on 2013 population density (pax/sq.km)				5,241
2. Low growth forecasts based on constant 2000-2010 CAGR for Study Area				4.8%
3. High growth forecasts based on constant 2000-2010 CAGR for Core City				6.8%

Source: Research Team

### 3.6 FINDINGS AND CHALLENGES: URBAN EXPANSION IN SANYA

(1) In Sanya, densities continue to fall, but not as fast as in the other case study cities. Also, there may be a statistical problem - real densities are probably significantly higher because permanent retirees (100,000) may not be properly counted in the density figures and cyclical migrants (wintering in Sanya) currently totaling 500,000 (up from 400,000 in 2012) are not counted. In sum, there is a data challenge in terms of the second home population.

(2) New development, particularly as exemplified by the road grid in Haitang Bay Comprehensive New Town, is too coarse and convoluted. This is energy, environmentally, and human time wasteful.

(3) New mechanisms need to be developed for collective villages to make development deals with developers more consistent with the urban plan and the overall public good. Other Chinese jurisdictions, e.g., Beijing, are developing win-win mechanisms, on a pilot basis, to address this issue. Essentially, at present, rural (collective) villages have become independent actors in terms of determining land use. This issue will continue to become more pressing as contiguous and leap-frogging development envelops peripheral villages. Highland valley corridors, with their fragile ecologies, are under pressure from second home developers, investors in tourist attractions, e.g., "Farms" which can attract a million or more visitors annually, etc.



(4) The Intra-Urban HSR system which has just opened in the Sanya urban region represents an opportunity for Transit Oriented Development (TOD) around the stations that should be exploited.

(5) A dominant theme in Sanya's planning is "Double Urban Repair", i.e., upgrading the existing urban fabric while protecting peripheral ecological areas. As noted above, new mechanisms need to be developed to protect the peripheral ecological areas as well as to encourage upgrading, infilling, etc., of the built up core city.

(6) Although not directly a land use issue, the highly seasonal economy creates impacts e.g., health care demands, lack of consumer demand off-season, that results in high pressures on the system at certain times of the year and lack of demand at other times.

(7) Sanya currently deploys "soft" growth boundaries (green, yellow, red). However, this mechanism appears not to be working effectively. During the 13<sup>th</sup> plan, more sophisticated instruments will need to be developed to more clearly bound designated expansion areas that recognize the key stakeholders in the urbanization process.

(8) In terms of the economy, which will be reflected in land use, the challenge is to guide the movement from a tourist to amenity economy. Tourists become long-term residents and second home buyers. They then require public, e.g., health care, and private services, that need to be provided, and reflected in community and urban scale urban planning.

(9) The location of the new airport is one of the most pressing issues facing Sanya, as it will dramatically affect urban form and land use. For example, should it be built on reclaimed land, Osaka style, or can another appropriate site be found?

## YUNCHENG CASE STUDY

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### 4.1 YUNCHENG OVERVIEW

Yuncheng can best be described as a “Conventional Workhorse City in Central China”. It is five hours drive to Taiyuan, the Provincial capital, but only one hour and four minutes to Xi’an, a much larger metropolis, by HSR.

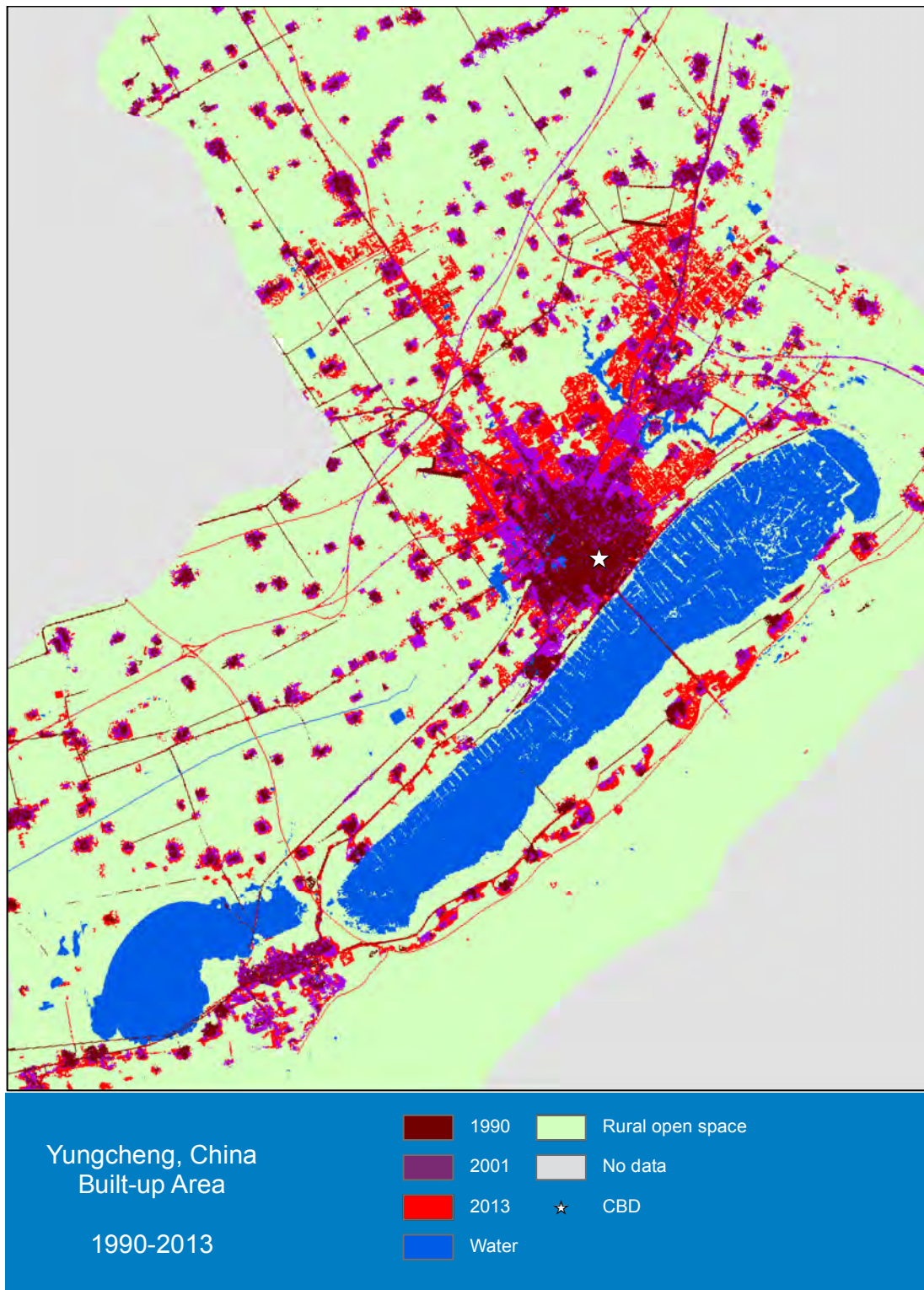
Yuncheng’s economy is diversified, including administrative, trading, manufacturing and tourism functions. At present, it is the recipient of industry relocating from the coast, and is chasing more of this industry, e.g., a major petro-chemical cluster. As an area with a millennia long history, it is a tourism base for 99 National Tourism Sites in surrounding county areas, the largest number of such sites in China. This is reflected in the presence of 39 hotels in the city.

Pollution, both of the air, and Salt lake, is a major challenge, directly affecting the spatial structure – residents avoid the highly air polluted west side of the urban area. New industry, which the city is trying to attract, could exacerbate environmental problems.

Recent dramatic changes in transportation access to Yuncheng have provided a positive boost to its economic development; scheduled commercial air service started in 2005, while HSR service commenced in 2014.

### 4.2 LAND USE / DENSITY CHANGE: YUNCHENG

Using NYU’s Urban Expansion Initiative’s land use change detection methodology and official government demographic information, Figure 7 describes spatially, and in tabular form, changes in built up area from 1990 to 2013. As indicated by Figure 7, Yuncheng’s built up area has expanded 1.8X between 2001 and 2013. There has been a dramatic drop in density between 2001 and 2013 – from 6,466 to 4,655 persons per square kilometer, a product of only moderate population growth combined with a leap-frogging expansionary process.



	1990	2001	2013
Urban Built-up (sq.km)	10.07	27.29	63.03
Suburban Built-up (sq. km)	24.49	52.11	80.60
Total Urban + Suburban Built-up (sq.km)	34.57	79.39	143.63
Density (pax/sq.km)		6,466	4,655

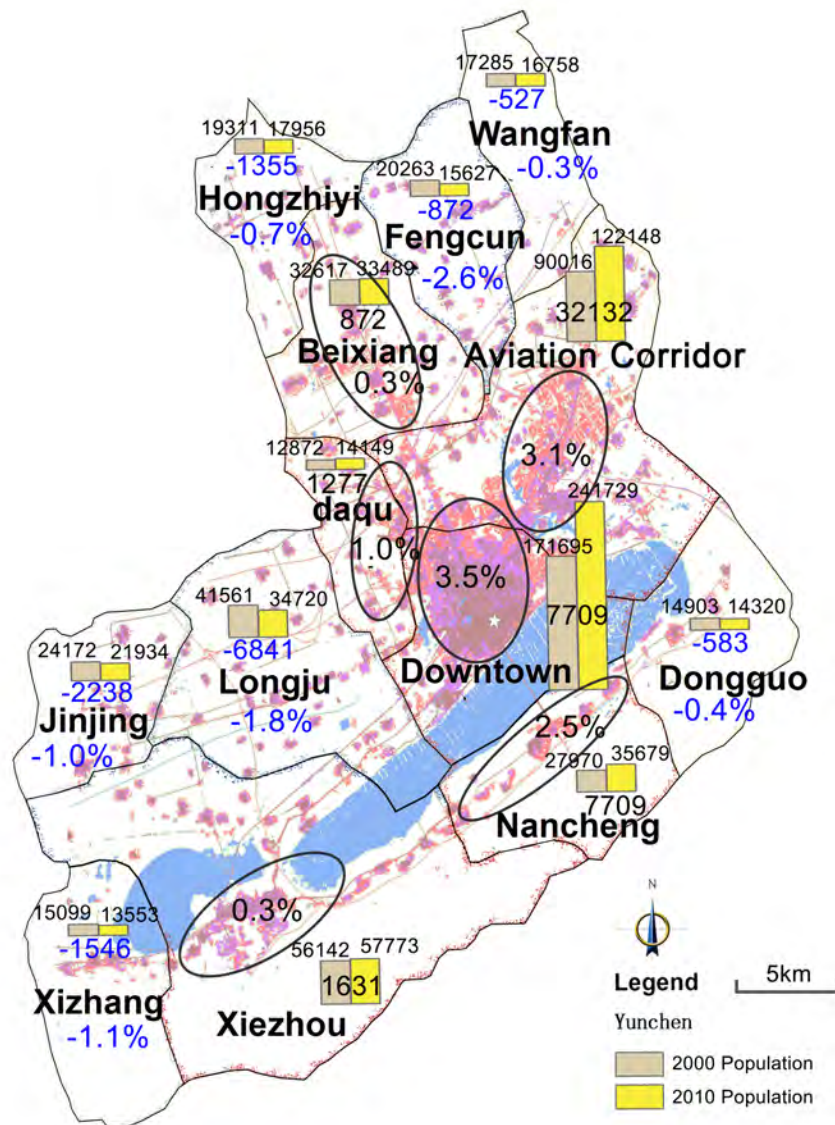
**Figure 7: Yuncheng Land Use Change: 1990—2013**

*Note: “Urban” refers to the Zhongcheng, Dongcheng, Xicheng and Beicheng “Street Level” Data Areas (somewhat equivalent to US Census Districts). The rest of the study area is deemed “Suburban”.*

Source: Research Team and NYU Urban Expansion Project Team

Map 14 describes change in the spatial distribution of population in the Yuncheng urban area. It indicates that the fastest population gains are in, and on the edges of, the downtown, and along the Aviation Corridor to the north-east from the downtown to the airport area. The only other area showing significant population growth is in Nancheng District, immediately across Salt Lake from the downtown. All peripheral jurisdictions to the north, west, and far east are showing population decline, probably the result of rural-urban migration closer to the built up city or to other cities in China – the farmland surrounding the city is of relatively low agricultural productivity, probably contributing to this exodus.





**Map 14: Spatial Distribution of Yuncheng Population Change: 2000-2010**

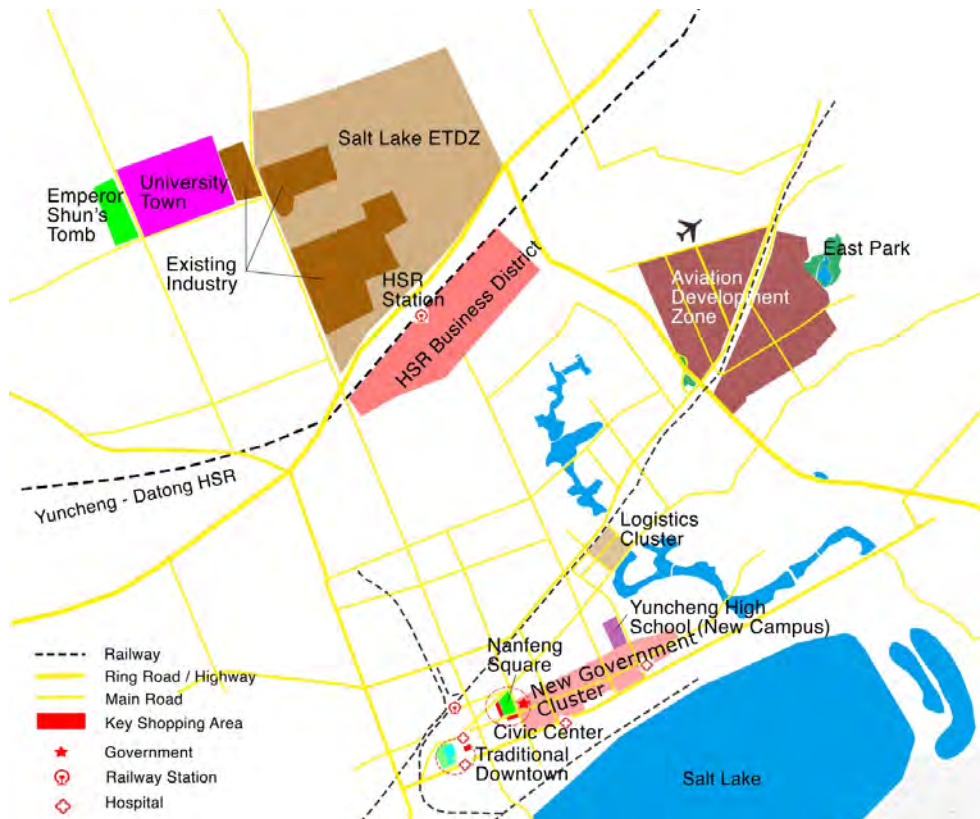
*Note 1: Bar charts and absolute population data (including change) are based on local jurisdictions (or groups of jurisdictions), as named. Percentage change data (in circles) is based on the foregoing data; circles indicate the prime spatial areas of demographic growth within each jurisdiction (or group of jurisdictions).*

*Note 2: Small numbers above bars indicate absolute population for the year in question; Bold numbers indicate change in population.*

Source: Research Team based on census data

### 4.3 URBAN STRUCTURE: YUNCHENG

Key elements constituting Yuncheng's urban structure are described in Figure 8. The dominant structural dynamic is the eastward movement of the downtown propelled by the new government complex and the emergence of the downtown – airport corridor driven by the successful Aviation Development Zone (described below) over the last decade. Midway between the airport and the downtown is a Logistics Cluster which reinforces this Corridor structure.



**Figure 8: Key Elements: Yuncheng Spatial Structure**

Source: Research Team

A key new spatial element is the HSR Station which became operational in July 2014.<sup>14</sup> This station is likely to change Yuncheng's structure from a downtown to airport corridor structure to more of a built-up triangle structure with the points of the triangle being the downtown, the Aviation Development Zone, and the HSR Station (perhaps including the Northern Spatial Cluster, discussed below). (Image 16, a remote sensed image describes the airport corridor, HSR station and Salt Lake ETDZ / University Town Northern Spatial Cluster. However, development of this triangle will be dependent on new road construction. Currently, there is no direct road route from the Aviation Development Zone to the HSR station, and the center of the triangle

<sup>14</sup> Partly because China's HSR system was built relatively late in its rural-urban trajectory, stations tend to be in suburban location, unlike in Europe or Japan where HSR stations are more likely to be located in the central city. Although there is much criticism of the location of HSR stations in China, the new urban stations represent catalysts for development of major new urban sub-centers, a process already underway in many cities, including Nanjing, Guangzhou, Harbin, Changsa.

described above is not yet served by a road network, remaining undeveloped land (see Images 16 and 17).



**Image 16: Remote Sensed Image: Northern Yuncheng**

Source: Google Earth; Downloaded on January 29, 2015



**Image 17: Evolving HSR Station Node**

*Top Left: Yuncheng HSR Station*

*Top Right: Large Area Undeveloped Land to South of HSR Station*

*Bottom Left: Model of Planned HSR Business District*

Source: Research Team



A new HSR Business District, to be four square kilometers in area, is planned and construction is starting. It will be oriented to personal and hospitality services, e.g., education, health and tourism (a Hilton Hotel and a Tourist Information Center are planned).

The Aviation Development Zone is to be the dominant future industrial area, it is currently 30 square kilometers in area, with 16 square kilometers already built up; however, plans exist to more than double its size. Although the airport, which opened to commercial air traffic in 2005 is the rationale for this zone, it is only one of several drivers. The Aviation Development Zone is projected to have a population of 100,000 by 2020. It is emerging as a comprehensive community containing a range of housing, a theme park, hotels, conference facilities, etc. As noted, the management of the Zone is currently trying to attract a major petrochemical complex to the site.

The Salt Lake ETDZ, of which 10 square kilometers of its 29 kilometer planned area is built out, appears uncompetitive with the Aviation Development Zone. Immediately across the main arterial Jiefang North Road to the west, from the Salt Lake ETDZ is a Tourism Cluster anchored by Emperor Shun's Tomb, and a University Town, home to several academic institutions. The Salt Lake ETDZ, Shun's Tomb Tourism Cluster, and the University Town constitute a Northern Spatial Cluster, which is currently scattered, but could coalesce into a northern urban sub-center in the future, especially with appropriate catalytic infill planning and development in the area. This northern cluster could eventually include the HSR station, increasing the importance of the Northern Spatial Cluster within the overall urban area.

There is no protected basic farmland on the periphery of Yuncheng because the low agricultural productivity of the surrounding land. In addition, the land north of Salt Lake is flat, thus the city is free to move in any direction, driven by market and/or policy forces.

Of interest is the fact that heavy, highly polluting industry to the west of the downtown along Salt Lake has created poor living conditions (see Figure 8) and a bad reputation from that area, effectively repelling development, as indicated in the spatial demographic dynamics (see Map 13).

Figure 9 describes Yuncheng's peri-urban dynamics, a product of the above forces.





**Figure 9: Yuncheng Peri-Urban Dynamics**

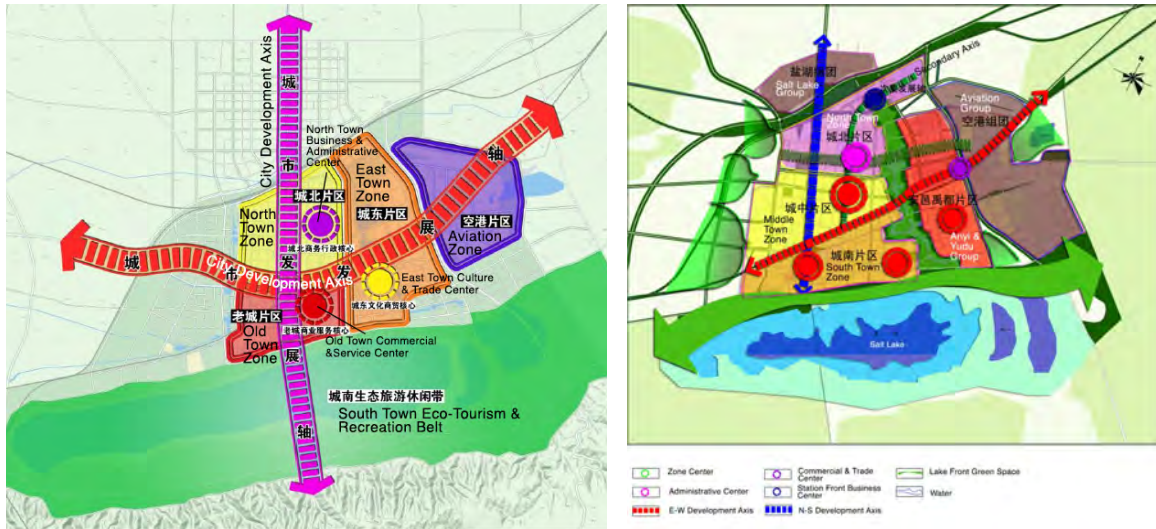
*Top left: Polluting Chemical Industry*

*Bottom left: Main node south of lake gateway to mountain historical tourism*

Source: Research Team

#### 4.4 LAND USE / URBAN FORM / TRANSPORTATION PLANNING: YUNCHENG

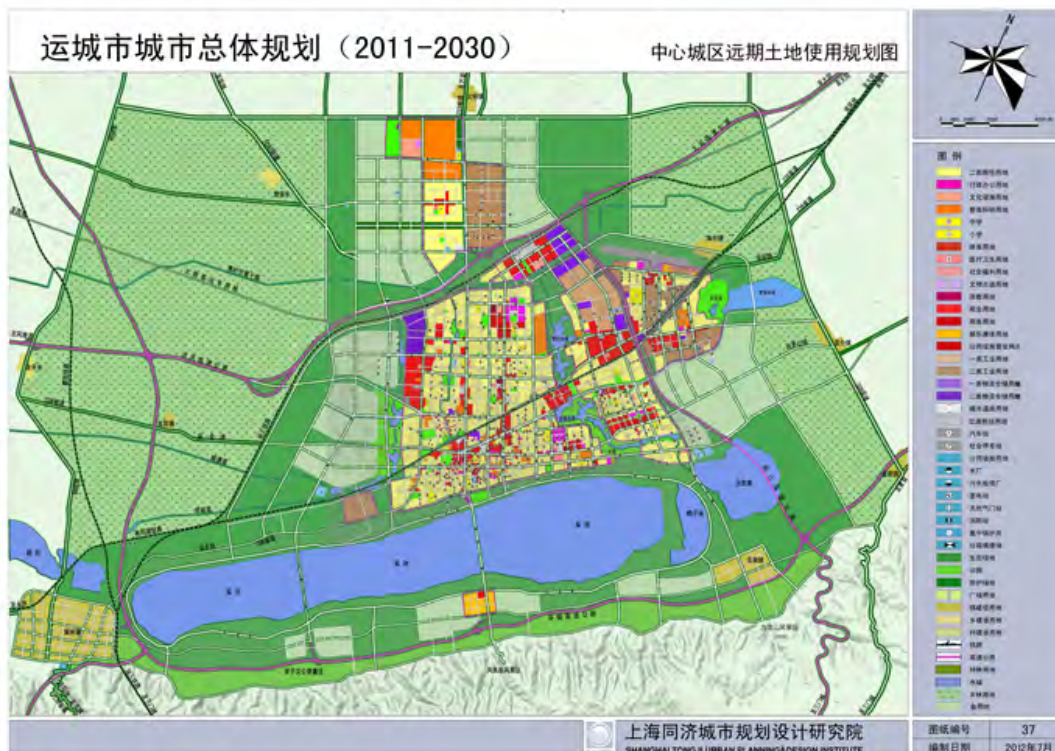
Map 15 describes the evolution of Yuncheng's urban structure planning. Basically, the revised structural plan recognizes ongoing and likely future market spatial dynamics, and thus is realistic. As indicated by Map 15, Yuncheng's planners now recognize the need for better linkages between the Aviation Development Zone, the HSR Station, and the Northern Spatial Cluster. They recognize the need to create a new sub-center in the current undeveloped area south of the HSR station (see Figure 8). And, they recognize the eastward movement of the center of gravity of Yuncheng's downtown.



**Map 15: Evolution of Yuncheng's Spatial Structure Planning. Left: 2012; Right: 2015**

Source: Yuncheng Planning Bureau

Map 16 describes the current urban plan in effect – for the 2011 – 2030 period. It appears outdated, not reflecting the new structural themes outlined in the latest structural plan (see Map 14 – right side), nor the on-the-ground spatial dynamics outlined above.



**Map 16: Yuncheng's Official Master Plan: 2011-2030**

Source: Yuncheng Urban Planning Bureau. Date 2010. Prepared by Tongyi Urban Planning & Design Institute



Map 17 describes the current transportation plan. It, too, does not seem to reflect the city's latest, improved, urban structural planning. Of interest is the fact that the planners do not advocate expressways penetrating the city, the Vancouver, Canada model; likely a positive policy for a city the size of Yuncheng.

Of concern is the fact that the road grid becomes less fine (with wider roads) in the more recently built up areas, particularly to the north. (The exception are enveloped villages, which retain their finer road grids within the village area, enabling appropriate local transportation – see Image 18). This is the same phenomenon noted in the other three case study cities. There does not seem to be an understanding that these new areas will not always be peripheral, but will become part of the core city or inner suburbs, where residents and workers will want more walkable, livable environments. Image 19 illustrates the difference between road widths in the peri-urban area compared with one of the main intersections in Yuncheng's CBD. As can be seen, despite the much greater traffic flows in the CBD, the roads are narrower, and the intersection thereby less dangerous and more land efficient.



**Map 17: Yuncheng's Official Transportation Plan: 2011-2030**

Source: Yuncheng Planning Bureau. Date 2010. Prepared by Tongyi Urban Planning & Design Institute



**Image 18: Enveloped Village to North of Salt Lake ETDZ**

Source: Research Team



**Image 19: Yuncheng Peri-Urban Intersection (Left) Versus CBD Intersection (Right)**

Source: Research Team

## 4.5 YUNCHENG: POPULATION AND LAND PROJECTIONS

Table 6 describes population and land use projections for Yuncheng based on high and low growth assumptions, based on the current low population density of 4,655 persons per square kilometer. Because Yuncheng is expected to be a demographically slower growing city than Baoshan or Sanya, the future land requirements are forecast to be lower than in those cities. However, as in the case of Baoshan, projecting population in Yuncheng is difficult. If Yuncheng were to attract the targeted major petro-chemical complex from the coast, this would make a significant difference in its future population, and land use requirements, particularly for heavy industry. Assuming slow to moderate population growth, this raises a concern in regard to the leap-frogging nature of urban development in Yuncheng. There may not be enough population growth in the future to infill in areas among scattered nodes.



**Table 6: Yuncheng Population and Land Projections**

Forecasts	Population		Land Requirements (sq.km) <sup>1</sup>	
	2030	2050	2030	2050
Low Growth Assumption <sup>2</sup>	993,897	1,238,734	214	266
High Growth Assumption <sup>3</sup>	1,268,266	1,785,588	272	384
Notes:				
1. Land Requirements based on 2013 population density (pax/sq.km)				4,655
2. Low growth forecasts based on constant 2000-2010 CAGR for Study Area				2.2%
3. High growth forecasts based on constant 2000-2010 CAGR for Core City				3.5%

Source: Research Team

## 4.6 YUNCHENG: FINDINGS AND CHALLENGES

Major findings from our research to date on Yuncheng are:

- (1) The city is experiencing considerable leapfrogging in its urban expansion process. This is of special concern because the city is expected to grow less quickly than fast growing Tier 3 cities such as Baoshan and Sanya, which could “lock in” this leapfrogged inefficient urban form / land use pattern.
- (2) Outside the CBD and the Airport Corridor, arterial road accessibility is poor, e.g., from the Aviation Development Zone to the HSR Station creating unnecessarily long travel distances / times / energy consumption.
- (3) Yuncheng lacks efficient public transportation. The public bus system is inefficient; it has recently been acquired by the Municipal Government, who intend to make improvements. Currently, there are no plans for a BRT system; the latter would be appropriate for a city Yuncheng’s size, particularly along the Downtown – Airport Corridor. At present, Yuncheng has high auto dependence, with autos being the source of 30% of the city’s air pollution.
- (4) Yuncheng has over allocated (sold) residential land contributing to a housing glut (and low housing prices) and the leap-frogging urban expansion pattern described in this report.
- (5) There also appears to be over allocation of industrial land, as both the Aviation Development Zone and the Salt Lake ETDZ aggressively attempt to enlarge and develop their properties. There is some concern that this aggressive chasing of industry may be resulting in “race to the bottom” dynamics, which could be damaging the Yuncheng’s future.
- (6) The Yuncheng case illustrates that heavily polluted areas can significantly affect the macro urban form of a Tier Three City.
- (7) Given that Yuncheng is pressed fiscally, there are inadequate financial resources to meet infrastructure needs in the city.

## CONCLUSIONS

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### 5.1 THE AWKWARD TRANSITION FACING 3<sup>RD</sup>/4<sup>TH</sup> TIER CITIES

Key findings from this exploratory study that need to be addressed in follow-up applied research and action include:

(1) Inappropriate road networks (abandonment of grid patterns often found in the core city) and too-wide roads, often with inappropriate cross-sections (e.g., electric motorbike and BRT lanes) in expanding areas.

(2) The lack of movement toward second-stage cost-effective transport investments, e.g., flyovers at bottleneck intersections, BRT development, etc.

(3) Falling densities associated with over release of under-priced land, leap-frogging development, over-allocation of industrial land which is allocated far below market value, etc.

(4) Adoption of urban form patterns, prematurely copied from large metropolitan areas that are inappropriate at the Tier Three city level, e.g., too many sub-centers, satellite peri-urban towns.

(5) Massive land use / transport distortion effects, including constraints to contiguous development along development vectors, caused by mechanistic implementation of the Basic Agricultural Land Protection policy. Equal, or more agricultural land could be saved in / around Third Tier (and other tier) Cities if the Basic Agricultural Land Protection policy could be better aligned with land use and transportation planning, essentially be more pragmatically applied.

(6) A tendency to perceive newly developed urban areas on the periphery as a different genre of urbanization, rather than new urban fabric which likely will eventually become part of the core city or become inner suburbs as the city continues to expand outward.

(7) More inaccurate than necessary future projections caused by over reliance on too optimistic assumptions and use of mechanistic forecasting methods in isolation. In the case of Third Tier Cities, which usually have more volatile economies (e.g., less diversified; economies based on tourism, cross-border / geopolitical dynamics, industrial relocation) than larger cities, and thus their futures are more difficult to forecast / project, use of methodologies such as exploratory scenarios would be useful.

(8) Although there appears to be good alignment among plans, i.e. land use, structural, and transportation, the content is often not keeping pace with reality, given rapid change occurring in many Third Tier cities.

(9) Surprisingly, more expansion is occurring on the fringes of built up urban cores, essentially backfilling, than we expected. This process is to be encouraged and care should be taken to maintain densities and fine road grids, as often already found in the core city.

(10) Less access to best practice knowledge in city building than larger cities.

(11) In many cases, fiscal challenges, compared with larger cities.

(12) In addition to the cross-cutting urban expansion issues outlined above, each city exhibits individual issues, as outlined in this report, that will require customized action. prescriptions.

## **5.2 FUTURE COMMITMENTS BY LOCAL GOVERNMENTS / APPLIED RESEARCH / ACTION**

All four case study cities have indicated a strong willingness and commitment to participate in a follow-up action phase of the project.

We suggest that the next phase of the project kick-off with a workshop in Beijing that deals with urban expansion issues facing Third / Fourth Tier Cities, using the four case study cities as examples of the issues, and types of action required. Involvement of national ministries, particularly the Ministry of Housing and Urban Rural Development, and / or the National Development Reform Commission (NDRC – the national planning agency) would be ideal.

The workshop would highlight the different types of problems facing Third/Fourth Tier cities with different functions, with particular attention to Amenity Cities and Industrial Relocation Cities, plus Third / Fourth Tier Cities experiencing dramatically improved access, e.g., commercial aviation or HSR service.

Following the workshop, the project would work directly with local government and other key stakeholders in three or four of the cities identified in this Study. Local Planning Bureaus would be the key point of contact, based on the relationship we have already developed. We would work directly with local planners to develop effective responses to priority problems and issues such as:

- Economic Development Strategizing / Forecasting (currently often unrealistic)
- Scenario Methodologies
- Demographic Forecasting (currently often unrealistic)
- Land Use Demand Forecasting
- Transportation Planning: Modes & technology, Road Grids, Road Cross-Sections, Public Transit Networks including BRT
- Urban Structure Planning: Urban Activity Systems / Patterns:
- Community internal design, e.g., gating (based on the new Chinese policy)
- Industrial zones: Location; Internal Land Efficiency

- Decentralization of Public Services (this is improving in Third Tier cities, probably more so than in Tier 1 cities)
- Innovative Infrastructure Project Finance

Expert Driven Workshops would be held in each participating city with key stakeholders to determine the most effective way forward to improve urban expansion processes.

To the extent possible, hard deliverables would be developed with the local authorities, and thus constitute official actionable documents

We recommend that Phase 2 of the project start with three cities: Baoshan (Frontier – Geo-Strategic), Sanya (Tourism), Yuncheng (Industrial, Regional Center); other cities can be added over time as appropriate.

In terms of funding, we recommend that international funding be partnered with funding from a Chinese Ministry, NDRC or/and the Ministry of Housing, Urban & Rural Development. Such national government funding would mean “buy in” by the government, aside from the financial advantages. Multinational MNCs working in the case study cities could be a possible source of funding for Phase 2 of the Project.



## **APPENDIX 1: Typical Key Urban Construction Standards**

- Code for Design for Building Fire Protection and Prevention
- Code for classification of Urban land use and planning standards
- Code for urban residential areas planning and design
- Code for transport planning of urban roads
- Code for urban engineering pipeline comprehensive planning
- Code for Scenic Area Planning

New laws and regulations have / are being introduced as issues emerge or the policy framework changes, e.g.,

- The land administration law of the PRC
- The cultural relics protection law of the PRC
- The estate management law of the PRC for urban housing
- The environment protection law of the PRC

## **APPENDIX 2: Jurisdictions included in population analysis of case study cities**

Baoshan: The Study Area includes Yongchang + Lancheng street statistical areas, Banqiao Town, Jinji Township, Hetu Town, Hanzhuang Town, and Xinjie township. The Urban core (or downtown) is defined as: Longyang + Lancheng. The remaining statistical areas are towns and townships which we term Suburban.

Sanya: The Study Area includes: Hedong (river east), Hexi (river west) street statistical areas; Hangtang Bay Town, Jiyang Town, Fenghuang Town, Nanxin Farm, and Nantian Farm. The Urban core includes Hedong and Hexi street statistical areas. The remaining statistical areas we label Suburban.

Yuncheng: The Study area includes: Zhongcheng (in Chinese, meaning middle of town), Dongcheng (east of town), Xicheng (west of town), and Beicheng (north of town); Aviation development zone, Beixiang Town, Nancheng (south of town), Daqu street, Hongzhiyi Town, Fengcun Township, Wangfan Township, Dongguo Township, Xizhang Township, Jinjing Township, and Longju Town. The urban core includes the Zhongcheng, Dongcheng, Xicheng and Beicheng street statistical areas. The remaining statistical we label suburban.

### APPENDIX 3: Typical Second home amenity development in Tengchong, Baoshan China



Source: Research Team