UNITED NATIONS UNIVERSITY
UNU-WIDER
World Institute for Development Economics Research

Working Paper No. 2010/97

Toward Efficient Urban Form in China

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September 2010

Abstract

Land efficiency in urban China is examined, using Tianjin as a case study, from the perspective of agricultural land conservation; reduction in energy use, conventional pollution, and greenhouse gas emissions; and human time savings. Issues addressed include increased scatter on the periphery, over-consumption of industrial land, over fiscal dependence on land sales, and loss of valuable agricultural and environmental services land. Policy implications discussed include the need for greater variation in urban densities (leveraging already high densities in urban China – one-third the global median), less broad-brush agricultural land conservation policies, higher floor area ratios near rapid transit stations, etc.

Keywords: China, land conversion, land efficiency, land use policy, urban density

JEL classification: R0, R5, R14, R52

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This study has been prepared within the UNU-WIDER project Asian Development in an Urban World, directed by Jo Beall, Basudeb Guha-Khasnobis and Ravi Kanbur.

UNU-WIDER gratefully acknowledges the financial contributions to its research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development—DFID).

ISSN 1798-7237 ISBN 978-92-9230-335-8

Acknowledgements

This paper is the product of extensive work on Chinese urban systems over several years. Funding from the World Bank, Ford Foundation, and Shui On Land has contributed to past research efforts, and is gratefully acknowledged. However, the views expressed are solely the responsibility of the authors. The authors gratefully acknowledge the research assistance of Jon Valentine, Arizona State University.

Acronyms

BRT	bus rapid transit
CBD	central business district
ETDZs	economic and technological development zones
FAR	floor area ratio
FDI	foreign direct investment
HTDZs	high technology development zones
LEED	leadership in environmental and energy design (US Green Building Council)
TVE	township and village enterprises
TOD	transit-oriented development

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Typescript prepared by Anne Ruohonen at UNU-WIDER

1 Introduction

1.1 Background

Increasing urban land use efficiency is a policy priority of the Chinese government as energy prices are expected to rise, population growth and rising food prices increase concern regarding domestic agricultural production, and China is participating in the global warming discourse.[1]

This study addresses the question of urban land use/transportation efficiency in China's 268 metropolitan areas.[2] Although the authors have studied land use dynamics in over 20 of these metropolitan areas in considerable detail, this paper cites the Tianjin in particular.

By urban land use efficiency we are referring to the energy, pollution, greenhouse gas emissions, and human time benefits/costs associated with patterns of land use in urban China and the existence and use of transportation systems that connect these land uses.

1.2 Potential benefits

(i) Given the expected rise in energy costs and potential scarcity of petroleum-based fuels in the foreseeable future, energy savings from urban form efficiency are important. Perhaps 10-15 per cent of a Chinese city's total energy consumption can be reduced directly through more integrated efficient land use and transportation systems. Additionally, building form/construction materials interact with land use to create additional potential energy savings. For example, high-density neighbourhoods are enabled by good accessibility making possible energy-efficient, highly livable, high-rise neighbourhoods. Since buildings consume approximately 45 per cent of energy in China, the potential for such gains is enormous if buildings are constructed to LEED standards, as proposed by the China Green Building Council.

(ii) Related to energy savings are reductions in greenhouse-gas emissions and conventional pollutants, highly correlated with automobile use. The State of California, USA, recently introduced ambitious greenhouse-gas emissions legislation, which will reduce greenhouse-gas emissions to 1990 levels by 2020. The California state government intends *15 per cent of greenhouse gas emission reduction to result from 'smart growth', i.e., urban land efficiency* (*The Economist* 2007).

(iii) In urban China, the economic cost of human time is rising due to rapid growth in personal incomes, thus very significant benefits to human well-being and urban economic product can be achieved through more efficient urban form, by enabling more efficient commuting and non-commuting travel. In addition, higher density clustering of

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1 The world population is currently about 6.7 billion. It is expected that the global population will level off at approximately 9 billion this century.

2 The 268 prefecture level cities are a rough approximation of the number of metropolitan systems in China.

specialized functions facilitates human transactions, a key driver of innovation and productivity.

(iv) Infrastructure costs per housing or workplace unit, e.g., unit costs of water supply systems, are much lower if land is used efficiently.

(v) China spends approximately 18 per cent of its GDP storing and moving goods. This is high compared with nations such as the United States where the comparable figure is 8-9 per cent.[3] In part, logistics costs in China could be lowered through more efficient urban form.

(vi) China, a mountainous country, is 14 per cent, or less, arable, (Fan 2006) meaning agricultural land is relatively scarce. Thus loss of agricultural land to urbanization is of particular concern given the country's population is over 1.3 billion. This issue has been especially high-profile since 1997, when the extent of loss of fertile agricultural land in China became apparent through the release of time series remote-sensed images. China's cities have tended to emerge in areas of highest agricultural productivity, thus although urban regions consume relatively little land, the land consumed is often of high agricultural value. (The urban built-up land of the 268 prefecture-level cities in China in 2005 constituted only 0.26 per cent of China's land area; officially defined *city propers*, which considerably over-bound actual built-up areas, constituted 6.2 per cent of China's land area in 2005.) In adjacent to cities, the value of agricultural production may be as high as 3 million RMB per hectare. At present, China's national target is to protect 121 million hectares of agricultural land nation-wide in perpetuity (National Eleventh Five Year Development Plan).

(vii) Efficient cities can more economically deliver housing that is *both* affordable *and* accessible to employment, schooling, and places of leisure. High-density development clustered around transit stations enables lower cost housing (land costs per unit are lower) and accessibility, a winning combination that can be difficult to achieve in fast-growing developing metropolitan regions.[4]

2 Defining and analyzing land use efficiency in China

2.1 Urban land consumption: trend analysis

Chinese cities are among the lowest consumers of urban land per capita even when compared to other Asian cities – only India has denser cities. The average land consumption in the largest Chinese cities is about 40m^2 per person, less than 1/3 of the median world consumption.

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3 The comparison is rough. China's economy is obviously more dependent on manufacturing, which is associated with high logistics costs. On the other hand, the consumption-driven US economy is highly dependent on intricate urban distribution systems.

4 Higher floor area ratios, other factors being constant, reduce the land costs of housing, at least until lost floor area to elevator systems negates the benefits of increased height.

One of the Chinese government's main urban policy objectives in the 1980s and 1990s was to increase the living floor area per person. At the beginning of the 1980s the living floor area per person in Chinese cities was extremely low, for most large cities varying between 4 to 6 m^2 per person. In Tianjin in 1988 the average living floor space per person in the city proper had reached approximately 6.5 m^2 per person. In 2000 the living floor space was 19.1 m^2 per person and it has further increased to 25 m^2 per person in 2005 (*Tianjin 2006 Basic Facts*).

The average residential FAR (floor area ratio) in Tianjin is estimated to have been around 1.6 in 2000, a significant increase of 88 per cent over 1988, but not sufficient to compensate for the exceptional increase in floor space per person. As the floor area per person increased by 194 per cent during the same period (1988-2000) the faster increase in the area of residential land relative to the increase in population is neither surprising nor a sign of waste. In fact Tianjin city has been using land more intensively (higher FAR) during this period. In other words, Tianjin was becoming more dense in terms of floor space, but less dense in terms of population, while delivering a substantial increase in the quality of life.

The same is true for commercial area and administrative, business and professional services: the floor space per employee and per customer increased over the years because of the spectacular development of the economy and its diversification into new service sectors, such as real estate brokers, commercial banks, large department stores, advertising and marketing firms, lawyers, accountants, and management consulting firms. While the FARs of non-residential areas increased spectacularly, especially for office and commercial buildings, they did not increase sufficiently to maintain parity between population increase and urban land increase.

3 China's urban land allocation system

In China, market forces play a larger role on the demand side than the supply side in allocating land under current city-building policy frameworks.

3.1 Supply side dynamics

The vast majority of land released by urban local governments (the *primary* land market) is still not the subject of open lowest-bidder *auction* processes, despite administrative regulations. (All land in China is the property of the state, however, leases are allocated for as long as 70 years.)

Until recently, virtually all industrial land was allocated by negotiation, often at a fraction of market value. Other land in China (residential, commercial, mixed) is allocated through both *auction* and *bidding* processes. Auction processes result in land being allocated to the highest bidder – market value. However, much land, particularly larger parcels, is allocated through bidding. Bidding involves a number of invited developers putting forward competing proposals (in terms of FAR, design guidelines, land use and floor space mix, etc.) to develop a particular plot based on government guidelines for the site (which vary widely in detail and scope from site to site and jurisdiction to jurisdiction). The rationale for bidding processes is to ensure high quality urban design, delivery of catalytic facilities, etc., in certain critical locations.

International experience indicates that the use of this mechanism is not necessarily negative, if used selectively.

Property on land allocated through the primary market may be resold (technically on-leased), creating a secondary market in property similar to that seen in Western countries, characterized by higher churn for residential properties. Since local governments can only sell land once, it is a one-off effect in terms of leasing revenue, which is usually paid to local jurisdictions up-front. Since land lease revenues account for approximately 25 per cent of the fiscal revenue of a typical Chinese urban jurisdiction, fiscal sustainability implications are obvious. (Land lease revenues are regarded as 'off budget' in Chinese urban jurisdictions.)

At the national level, certain geographic areas are given preference, such as access to credit for urban investment and increased land quotas, at different times, e.g., Chongqing from 1999 under the 'Go West' programme, Beijing –Tianjin - Binhai from 2006 onwards.

Below the national level, administrative measures, including land quotas and rural-urban land conversion criteria (*protected basic agricultural land*), are established by the Ministry of Land and Resources (prior to 1998, a Special Bureau), and are enforced (to varying degrees) down the vertical hierarchy of governments. In terms of urban land use efficiency, land quotas are becoming less important because local jurisdictions, especially municipalities, have learned to 'game' them, e.g., indicating compensating land has been set aside ('traded') in a remote area to justify urban development beyond a given quota. However, protected basic agricultural land regulations (governing rural-urban land conversion), initially introduced in 1994, are increasingly enforced by the national government. Such monitoring has been made easier and more effective by increased availability of inexpensive remote-sensed images. For example, in the case of Tianjin Municipality, 4,456 km^2 was designated as Basic Protected Agricultural Land in 2005, and the Municipality intends to protect virtually all of this land into the foreseeable future (2020). This does not mean that Tianjin cannot expand at planned densities, there is ample land in the '*other*' category, e.g., low fertility land, unprotected forest, that can be developed until 2079. In many local jurisdictions it is unclear whether protected basic agricultural land has actually been mapped and tied to specific locations or whether it is purely 'abstract' land. Attempts by the researchers to access such maps in a number of Chinese municipalities were unsuccessful, although Tianjin Municipality indicates that such a map exists.

Local governments (with municipal governments exerting the most power, especially in West China where counties are relatively weaker) produce urban master plans that indicate future land use, and influence the spatial allocation of public investment. However, urban master plans often have limited impact in terms of real on-the-ground development. For example, a Ford Foundation and World Bank sponsored study of the relationship between Chengdu Municipality's actual physical expansion in the 1990s and early 21st century and the Municipality's Master Plan, using time series remote-sensed imagery, showed an almost inverse relationship between the 'rational' plan which advocated development to the east where land was less agriculturally fertile and available, and actual large-scale development to the south-west and north-west (Schneider et al. 2003). To the south-west, urban expansion was driven by the new international airport; to the north-west, by the national Hi-Tech New Park and Dujiangyan tourism areas (Schneider et al. 2005).

3.2 Demand side dynamics

Changes in demand preferences for land and buildings will continue to be a significant driver affecting urban form and land use efficiency in China. In the case of demand, the market is king.

Given that China's urban economy is on the verge of major structural change (toward a greater reliance on services and higher-value manufacturing), demand and locational preferences for floor space for manufacturing and services will change significantly. Office space is becoming more important, and workers are demanding larger per capita work space. Similarly, the growth of the hospitality industry and an affluent consumer class is creating demand for new spaces, e.g., hotels, convention centers, mixed use shopping/entertainment complexes.

Continued demand for more residential floor space is expected, the product of aggregate demand (driven by rural - urban migration and envelopment of surrounding communities) and demand for larger residential living spaces. Smaller household size is contributing to growth in demand for housing units in excess of urban population growth.

The third important variable affecting demand is access. In this regard, supply of different modes of transport in different locations obviously interacts with demand.[5] On the one hand, increased motorization would appear to provide consumers with more locational choice, making them more footloose within the metropolitan region. On the other hand, increased road congestion and rapidly increased value of human time (both economically and psychologically) is making access more important. Demand for premium access is likely to continue to increase rapidly. While easy access to peripheral locations (e.g., through ring roads and radial expressways) would likely increase green-field (and rural collective) land consumption, reduced congestion in core city areas, particularly through development of mass transit, is likely to have the opposite effect.

An important fourth factor is amenity. As the population of more affluent socio-economic classes increase rapidly in Chinese cities, housing is becoming more than a commodity. Increasingly, consumers are demanding on-site, or nearby, social and recreational facilities, good schools (especially middle schools), and sites with views or water front locations (the latter considered auspicious in China). The demand for amenity is seen most clearly in purchase of second housing units. In amenity cities such as Haikou (Hainan), Qingdao, Kunming, Lijiang, Xiamen, etc., 20 per cent or more of housing unit sales are for second properties. This inter-city competition is mirrored within cities, increasingly since 1980 Chinese cities have 'high end' and 'low end' neighbourhoods, although the phenomenon is not entirely new. For example, Chengdu's east side has, for a century, had less status than its west side.

A fifth major factor affecting demand is the behavior of land developers. In a 'new' housing market such as China, developers play an important role, through

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5 Important interacting supply and demand variables in this regard include the balance between public and private transportation modes; changing preferences for private vehicle use between commuting and leisure activities; and existing use of, and future plans, for expressways and mass public transit systems.

advertisements, model suites, etc., in shaping demand preferences. Cosmopolitan developers, including foreign developers, introduce international 'best practices,' and larger developers generally work on larger sites resulting in significantly different urban communities in terms of densities, on-site uses, activies, and services, and quality of design. New products are introduced, e.g., live-work loft developments, vertical communities, changing demand preferences.

4 Land use efficiency and the internal spatial structure of Chinese cities

4.1 The importance of FAR regulations in shaping an efficient spatial structure

FAR values have a direct impact on the total area of land a city occupies. In Chinese cities, as in most of the world, the permissible values for FAR are regulated. In China, FARs are identified at the 'detail planning area' scale, with subsequent modification often occurring at the site scale when land is leased to a developer. By establishing an upper limit on the total floor area that can be built on a lot, FAR regulations are in shaping the spatial structure of a city.

In market economies, FAR values are usually set high in areas of high demand and low in areas where demand for land is lower. For instance in New York City, the FAR value varies from18 at Battery Park to 0.4 in the suburbs. An overall plan shows prospective developers the FAR allowed in various parts of the city.

In China, by contrast, master plans show projected land use, but FAR values are not normally part of the master plan documentation. The regulated FAR values are only shown in 'detail plans' encompassing approximately 10 blocks. For most Chinese cities, the regulated FAR values for new housing are mostly uniform and vary between 1 and 2, whatever the location.

Analysis of a few blocks in Tianjin shows a regulatory residential FAR value of 1.5, despite the site being close to the central business district (CBD), and on the planned path of a metro line. This low FAR value indicates that strategic spatial policy, reflecting efficiency objectives, is not manifest in the use of FARs in Tianjin.

The long range consequence of this sub-optimal use of FARs is: (i) an increase in land consumption, (ii) a less efficient transit system, and (iii) higher housing prices, because more land is required per housing units in areas with a low FAR.

4.2 The fragmentation of the built-up area at the fringe of urbanization

While the density of Chinese cities is high by world standards, the fragmentation of the built-up area at the urban fringe greatly reduces the benefits delivered by high density in the core area.

In Tianjin, relatively high-density areas are developed in a discontinuous manner, leaving large areas of vacant or cultivated land within the built-up area. These un-urbanized enclaves are costly for the city. Infrastructure networks, such as roads, water, sewer, telecommunications, and transport have to bypass these areas and as a result become more costly per hectare served.

The result of sample land use surveys conducted in suburban areas in Chengdu, Tianjin, and Zhengzhou by Alain Bertaud shows that on average about 34 per cent of the land within existing ring roads remain under agricultural use while urban development continues to expand in a leapfrog manner, much farther away from the city center (see Table 1).

Table 1
Proportion of land under agricultural use enclaved within urban area
in Tianjin, Chengdu, and Zhengzhou

Agricultural enclaves in metropolitan areas served by urban Infrastructure in Tianjin, Chengdu, and Zhengzhou			
City	% of agricultural use	Total area of sample (km2)	Location
Tianjin	27	22	Northern area inside 3rd ring road
Chengdu	32	70	North West area between 2nd and 3rd ring road
Zhengzhou	41	49	Western area within master plan limit 1995-2010

Source: Authors.

Current systems (i) to protect *basic agricultural land* and (ii) *land conversion quotas* have encouraged urban fragmentation at the fringe. Mechanisms to protect basic agricultural land were imposed by the central government in 1994 to respond to a widespread perception that municipal governments were consuming too much cultivated land. Land quotas, a hierarchical system limiting the aggregate amount of land that can be converted to urban uses over a five year period were imposed in 1988, because the national government determined that cities were developing land in excess of what was justified by economic development. The distortions between the compensation price paid by municipalities for undeveloped land and the sale price of land use rights generate large profits. Accordingly, municipal governments, who have a monopoly on land development, have a strong incentive to develop land to generate municipal revenue.

To prevent this apparent waste of land and infrastructure, the national government chose to impose protected basic agricultural land and land quota mechanisms to slow down land development at the periphery of cities rather than to remove the land price, high short-run municipal revenue generation benefits, and interest rate distortions which created the incentive to low density leapfrogging development on the periphery of Chinese cities in the first place. Thus agricultural land mechanisms (gaining in importance) and land quota legislation (declining in importance) did not remove the incentives to develop land in a financially profitable but uneconomical way. These mechanisms to limit conversion of certain land to urban uses have serious negative side effects, in particular, they distort urban shape.

Because the areas currently occupied by existing ‘collective’ villages and Township and Village Enterprises (TVEs) are not considered agricultural land (and thus not subject to land quotas or protected as basic agricultural land) there is a strong incentive to redevelop the land occupied by villages and TVEs while avoiding the agricultural land

in between. This process results in leapfrogging. In late 2008, holders of rural (collective) land were granted considerably enhanced property rights by the national government. It is likely that this will encourage leapfrogging development, rural landholders will gain a larger share of financial rewards from such land conversion.

4.3 Fragmentation and new primary infrastructure

Urban master plans in China usually include a large programme of primary infrastructure investments and project-scale land use, e.g., industrial parks, compact in shape, aligned with the infrastructure investments. The record of implementing primary infrastructure ahead of development in China is generally good, in contrast to many cities in Asia where urban development is often far ahead of infrastructure investment. However, the difficulties in converting agricultural land that have been projected for urban use in the master plan leads to an under use of already built infrastructure as discussed above.

The economic costs of the urban land fragmentation caused by the land conversion system are threefold: (i) Additional infrastructure costs to land users. (ii) Additional transport costs, and associated energy consumption and pollution, resulting from enclaves and leapfrogging. And (iii) less efficient enclaved agriculture.

4.4 Overdevelopment of industrial land

In Chinese cities the proportion of land devoted to industries is around 26 per cent of the built-up area. Tianjin with 21.7 per cent of land in industrial use is slightly below the Chinese cities mean, but still much above cities in market economies. Seoul uses 6.9 per cent of its built land for industries, Hong Kong 5.4 per cent and New York City only 4 per cent.[6]

This differential is partially explained by historical factors. In a command economy, the case in China prior to 1980, land for industries was heavily subsidized as industrial production was considered to be a privileged component of the economy, while commerce and services were thought to be of minor economic importance. Prior to the 1980s industrial land was allocated administratively to state enterprises in industrial belts very close to, or in, the city center. Since the reforms of the early 1980s, large industrial zones (economic and technological development zones [ETDZs] and high technology developments zones [HTDZs]) have become the norm, attracting dispersed state enterprises and private foreign and domestic firms. However, until 2005, industrial land was usually leased at a negotiated price much lower than the auction price bid for residential land, both in the case of free-standing enterprises (not in industrial zones) and in the case of land leased in industrial zones. Most industrial zones are managed by semi-autonomous local government authorities, usually established by municipalities, and thus land cost is zero or its transfer negotiated at a low rate. However, even private industrial zones and firms negotiated land purchase at very low cost. It was not until 2005 that auctions began to be used to lease land use rights for industrial land, although under pricing of industrial land is still the norm. As expected, land sold below market

6 Data source: Authors. We recognize that Hong Kong and New York are now post-industrial cities; nevertheless, the differences are too large to explain through economic structure differences. Seoul is the most analogous city to the Chinese cities in terms of industrial structure.

price, and often below even infrastructure development cost, was consumed in larger quantities than land obtained through competitive bidding. The large proportion of industrial land found in Chinese cities reflects past practices; it will take a long time to reduce it to more normal proportions.

The excessive consumption of industrial land in Chinese cities is a dead weight on the economy. It extends the built-up boundaries beyond what would be normally needed, it also artificially expands infrastructure and transport networks. In addition, large industrial areas inside cities are blocking normal urban extensions, as it is the case in Zhengzhou where the extensive industrial areas along the railway lines are making expansion in the North West area of the city difficult, decreasing land values.

4.5 The relationships between urban spatial structure and transport efficiency

High residential densities and the concentration of employment in few areas, *nodes*, are consistent with a high use of transit, while low density and the dispersion of employment are more consistent with individual modes of transport. The high density of Chinese cities precludes the use of the individual car as the main mode of transport in the foreseeable future. While densities have been slightly decreasing in the central part of Chinese cities in the past 20 years, their density will remain more than an order of magnitude higher than European or American cities where individual cars are the main transport mode. The national government's concern over land conversion at the fringe of cities will likely lead to action that will ensure that densities stay high in the future, even in suburban and peri-urban areas.

High average density is not enough to allow the efficient operation of transit. The spatial distribution of densities needs to reflect the accessibility created by the transit network. The regulation of FARs in particular is crucial to insure that costly transit investments are fully coordinated with land use.

5 Key issues: potential for improvement

5.1 De-densification/loss of smart urbanism

There is wide variance in levels and trends in density in China among regions. Virtually all Chinese cities are de-densifying with a few notable exceptions such as Wuhan. However, urban regions are de-densifying at widely different rates. For example, in the case of Tianjin, planned densities in the core city (within the third ring road) will actually increase from 12,647 persons per km^2 to 13,824. However, outside this area, including Binhai New Area, urban densities will only be 6,684. In other words, densities in new areas will be approximately half (53 per cent) those prevailing in the existing built-up area – a significant loss of density.

New towns on the edge of existing cities can be a key contributor to de-densification. These 'start again' cities are often motivated by preferences for modernity, and/or the fact that it is less expensive to build new towns than redevelop existing run-down urban fabric. In the case of new towns, densities vary greatly - they are not necessarily major contributors to de-densification. In some cases new towns are being built that may be unnecessary and may never achieve populations and forecast densities because they are

based on faulty demographic forecasts. For example, in Harbin, a slow growing northeastern city, the new town being constructed across the Songhua River is probably too large given that city's very slow economic growth. New towns should have a strong demographic, economic, and environmental rationale before being built and should be built at close to prevailing densities, or at least the 10,000 persons per km^2 prevailing standard of the Ministry of Construction.

5.2 Potential for infill

Some experts argue that much of the remote-sensed analysis of Chinese metropolitan areas in the late 1990s over-counted urban land conversion because it liberally defined built-up edges of cities and classified all land within these edges as urbanized. They argue that considerable infill land exists in China, which could absorb large populations. An international comparative study of urbanization in the 1990s (1990-2000 time series analysis) by Angel et al. (2005), commissioned by the World Bank, pointed to the importance of infilling as a means to reduce urban-rural land conversion world-wide. Images of Chinese cities, e.g., Guangzhou, over the 1990-2000 period indicated considerable leapfrogging, and thus potential for infilling. Worldwide, approximately 8 per cent of land within 'built-up' urban areas is vacant and available for infilling (Sheppard 2010). If all 660 Chinese cities are included in the sample, about 15 per cent of land in China's built-up areas is vacant according to Fan (Fan 2006). However, if we limit our sample to the 286 prefecture level cities, the figure is approximately 10 per cent, or less.

Based on our research, in the case of Tianjin, available land totals 28.4 km^2.[7] This represents 9.7 per cent of the area within the third ring road (which approximates the built-up area). In other words infill potential is close to the world norm, and not particularly extensive. If the 28.4 km^2 of vacant land within the third ring road were developed at 2020 densities (13,824 per km^2), the land could accommodate 392,600 people. However, if these infill sites were strategically developed as high-density nodes at the highest prevailing densities (47,000 per km^2 found in Heping District), they could accommodate 1,335,000 people.

In sum, based on our analysis of Tianjin, and other Chinese cities, if we analyze potential infill land available within core cities (roughly corresponding to contiguously built-up edges) in China, the percentage of land available for infilling tends to be close to global norms. But infill land is very important in China for other reasons, it is often in prime locations (industrial work units were often located near the center of the city) suitable for high-density transit-related development. Larger sites, e.g., abandoned large-scale industrial sites are of sufficient scale to be used for urban sub-centers that can dramatically improve overall land efficiency and catalyze redevelopment of urban cores. In sum, infill sites in China can and should play a catalytic role in reconfiguring and retrofitting land. Many infill sites, especially larger ones, should not be viewed as just another source of land but as special sites capable of playing a catalytic role.

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7 Potential infill land consists of: (i) vacant land: never built up or already cleared, (ii) severely substandard housing sites to be demolished, (iii) abandoned/dispersed industrial sites or to be abandoned/dispersed industrial sites.

5.3 Scatter on the periphery

Scattered peripheral development is a major problem in virtually all Chinese urban regions, but particularly a problem in economically successful coastal metropolitan and megapolitan regions, such as Hangzhou, and the Pearl River Delta megapolitan region, that have attracted large amounts of capital, particularly, foreign direct investment (FDI) in manufacturing.

Chinese cities tend to be built out contiguously to an often highly visible perimeter, usually reached around 1990, then scatter sets in. The key question is whether this scatter is temporary, i.e., will infilling result in eventual contiguous development or is this *two ring* pattern becoming the norm.

Several factors tend to be encouraging peripheral scatter as the new norm:

(i) The Protection of Basic Agricultural Land law of 1994 has mechanistically blocked development of relatively small, cultivated areas to urbanization.

(ii) Local governments below the municipal level are often pro-development, driven by fiscal incentives, encouraging leapfrog development, especially along expressways.

(iii) As noted, rural collective village areas are targeted for large-scale peri-urban development around cities. Most undeveloped land on the periphery is still controlled by rural collectives. Since such villages are by definition not protected agricultural land, they are often targeted by local governments (and indirectly private developers) for higher density urbanization. (Such conversion processes usually increase densities by three to four times, relative to traditional village development.) The second reason for such targeting is that conversion of such land to urban land uses does not count against the land quota, they are already considered urban.

(iv) Rapid Motorization and Expressway Construction. As the middle class becomes motorized, they are able to take advantage of inter-city expressways emanating from existing metropolitan regions. At first access to the city from remote peripheral locations seems easy by private vehicle, until others buy into leapfrogging developments creating road congestion.

In sum, two ring cities are emerging in China. The (i) inner ring, usually the product of pre 1990 urbanization, is contiguously built up, to high densities, with little vacant land available for infilling while the (ii) outer ring can be described as scattered and leapfrogging.

5.4 Lack of variance in FARs/nodality

As noted, Chinese cities are characterized by relatively uniform FARs. The relative uniformity of FARs, densities, and employment distribution in Chinese cities is not a desirable spatial pattern in that mass transit systems operate much more efficiently if cities contain several peaks (of different levels) of density in terms of both residences and employment. If rapid transit networks join these peaks they generate high accessibility throughout the city and benefit from much higher ridership. For benefits to accrue, it is not necessary to have housing-jobs fit within nodes, travel between nodes is highly efficient. Benefits of nodality include:

(i) Dramatically improved economics of mass transit. If land use and mass transit are optimally aligned, mass transit systems can be close to self-financing, i.e., they require very little public expenditure.

(ii) Lower unit costs of infrastructure. Densely clustered development (even if surrounded by green or public space) lowers unit costs of infrastructure, especially for network based systems, such as sewerage. Infrastructure experts estimate cost savings through compact development in the order of 33 per cent; our analysis indicates even greater possible savings, approximately 55 per cent.

(iii) Well-designed nodal communities create vital environments for leisure and high transaction office environments, conducive to happiness, productivity and innovation.

(iv) Nodality increases access, which reduces wasted human time in travel.

(v) Nodality saves energy by increasing the percentage of trips on energy-efficient modes (particularly rail, but also bus rapid transit [BRT] etc.), and by enabling energy efficient dense buildings, etc.

(vi) Nodality creates the possibility of increased affordable housing supply, particularly in nodes away from the CBD - where land is less expensive, but accessibility still high. High densities reduce the land cost per metre of floor space.

5.5 Alignment between transport and land use planning/investment systems

In Chinese cities, there is often insufficient integration of land use and transportation planning. A clear example is the new CBD planned for Wuhan. Although the core of the planned CBD is completely pedestrian oriented, the major subway intersection in the city is located over a kilometre to the east of the CBD's peak value intersection. This situation, typical of Chinese cities, is the product of: (i) With rare exceptions, *Chinese mass transit systems are financed and operated as public facilities, thus institutionally there is little incentive for the organizations responsible for their construction and operation to maximize ridership or generate operating financial surpluses.* (ii) In most municipalities the transportation and land use planning agencies are separate, with co-ordination between them limited. And (iii) there may be a lack of awareness concerning the enormous benefits in terms of both ridership and land use efficiency through integration of the two systems.

5.6 Loss of fertile agricultural land

Loss of fertile agricultural land has driven much of the concern in regard to urban land efficiency in China. It is commendable that the issue has received such a high profile, but the greatest gains to the economy and environment from improved urban land efficiency may not be related to protection of fertile agricultural land but be expressed in reduced energy costs, emissions, and lost human time through more efficient urban form, greater variance in FARs/densities, and alignment of mass transit stations and land use.

We do not see a tradeoff before mid-century (after which urbanization in China will slow down dramatically) between protecting basic agricultural land and expanding cities at a density of approximately 10,000 persons per kilometre. For example, even in the heavily urbanized coastal Tianjin metropolitan area, our analysis indicates that all

protected land can be preserved and urban areas expanded at densities even below 10,000 per km^2.

The real issue is not whether protected land can be preserved consistent with China's forecast urban growth and national targets for aggregate protected agricultural land but *how* it should be done. The Protected Agricultural Land Law of 1994 is vague and differentially implemented. Enough technical support does not seem to have been allocated to make this process effective at the local level. There are several issues: (i) Protected land is defined on the basis of currently cultivated land rather than agricultural potential.[8] (This issue may not be as serious as it appears, because over thousands of years of agricultural cultivation in China, the best land has almost certainly been identified by farmers.) (ii) It appears that most municipalities (with notable exceptions such as Tianjin) have not prepared basic protected agricultural land maps. Thus, de facto, existing agricultural plots are assumed to be what should be protected. Most municipalities seem to have a numerical quota for protection of agricultural land, but it has not been mapped. This creates ambiguity for all actors involved in land allocation and development. (iii) The system seems to be enforced either mechanistically in some jurisdictions (all cultivated land is to be avoided) or in an extremely flexible way in others, because no maps or hard criteria exist.

What is needed are mechanisms to 'smooth out' agricultural protection boundaries and urban areas – to the benefit of both. This could take the form of *growth boundaries* or *service boundaries*, as practiced in many jurisdictions worldwide, e.g., in Canada, Quito, European states such as Germany and the Netherlands, and US states such as Maryland and Oregon. If carefully implemented, such an approach could actually increase the amount of agricultural land and environmental services land (equally important in and around cities) protected, e.g., by protecting more Class 2 agricultural land, increasing densities on the periphery, and by avoiding zones of high fertility and important environmental services use all together. It would not be inexpensive to implement such a system, but the gains (cost : benefit ratio) would be enormous.

In sum, China is not in danger of losing adequate levels of prime agricultural land, in aggregate, if forecast urbanization occurs, at planned densities, provided reasonable measures are taken to steer urbanization away from areas of high agricultural productivity. However, the present system to protect basic agricultural land is under-developed, inefficient, not transparent, and exerts costs on both the agricultural and urban users of land. Investment in designing and implementing a 'less broad brush' system would pay high dividends given the extreme importance of the issue to Chinese society and economy, and the substantial economic and environmental implications.

5.7 Lack of fiscal sustainability and fiscal biases on land use

Municipalities in China depend on land lease revenues for approximately 25 per cent of their revenues, sometimes considerably more. Since this is a one-off effect, i.e., land that is leased by governments eventually finds its way into the secondary market,

8 This is different from international practice, e.g., the use of the Canada Land Inventory to enforce the British Columbia agricultural land reserve law. In that Canadian Province, as elsewhere in much of the world, Class 1 agricultural land is preserved rather than cultivated land per se.

alternative modes to generate large scale local urban revenues, e.g., property taxes, will eventually (before mid-century) need to be devised.

The dependency on land lease revenue (almost invariably paid up front) encourages governments to release more land than may be optimal. The alternative strategy of local governments would be to hold out for higher prices by releasing less, such as in Hong Kong. Net revenue might remain the same, with less land released, that would be developed at higher intensity. Excess release of land encourages de-densification, lack of nodality, etc. The lack of property tax or an idle land tax (land is supposed to be developed within two years of release in China, but there are many ways around this requirement) reinforces this dynamic.

From a fiscal perspective, local governments favour manufacturing activity/land use (which generates shared corporate tax, excise tax) over residential and other uses. Also, importantly, since local officials are judged to a significant extent on GDP growth in their jurisdictions local officials chase manufacturing because of its ability to generate GDP growth. As a result, industrial land (economic zones) proliferate in Chinese urban regions and are found in virtually every jurisdiction within the municipality, often to the detriment of land use and economic efficiency (impeding cluster development, inefficient commuting, higher logistics costs) and amenity (juxtaposition of industrial and residential land uses). This issue is discussed in more detail in a World Bank/Cities Alliances report by Webster, Cai and Maneepong (Webster et al. 2006).

6 Policy implications

6.1 A major cause of urban land use inefficiency in China is that most land is not priced at market value. Financial incentives, which encourage over-release of land by municipalities should be reduced, in particular the current off-budget importance of land lease revenues. Using market prices for farmer and TVE land expropriation, which would make the cost to municipalities of land purchase on the fringe higher, and using a market rate of interest for financing infrastructure construction would remove much of the financial incentive to convert more land than necessary.

6.2 Chinese municipalities should consider introducing *growth boundaries or service boundaries* to address the problem of scattered peripheral growth. Common sense should be applied in protecting basic farm land, with some high fertility agricultural land sacrificed to create dense peripheral development, utilizing efficient spatial patterns, in particular, necklace development (TOD nodes along corridors). At the same time, in vectors of high agricultural land fertility, farmland protection should be given preference. Growth boundaries would need to be reviewed regularly (at least every five years) and would not necessarily be limited to the contiguous city, that is, they should also be drawn around outlying satellite cities, major developed patches, etc.

6.3 To implement the above, the national government should develop a standardized system for identifying high fertility farmland.

6.4 Chinese cities, through their urban planning, including spatial distribution of FARs, should encourage development of a hierarchy of nodes.

6.5 Large metropolitan areas should accelerate development of mass transit systems, aligned with future land use. Such systems should involve innovative finance, and possibly full or partial private ownership so that transit system operators will have an *incentive to align with employment and residential patterns* to generate increased revenues, and possibly make a profit.

6.6 Auctioning industrial land should reduce the problem of over-consumption of industrial land in the long run.

6.7 Two interacting factors are making it increasingly more difficult for the public sector to redevelop areas in need of urban renewal. One is the strengthening of urban property rights based on changes to the Chinese Constitution in 2007. The other is the informal development of civil society, e.g., neighbourhood preservation groups, a movement that has been gaining speed over the last 5 years.

The increase in property rights and development of neighbourhood organization is obviously desirable. It will enable neighbourhoods to take more responsibility for their own development. However, the situation that is emerging increasingly resembles the debate over eminent domain in the United States, i.e., limits on the right of the state to expropriate land for certain types of public uses under a redevelopment rationale.

Given the changed context affecting urban redevelopment, new mechanisms need to be initiated in China such as land readjustment and possibly even direct sale of property by existing apartment residents to developers to enable win-win situations to develop, freeing land for redevelopment. In other words, in areas in need of redevelopment, *the benefits to present residents and businesses to voluntarily sell their land need to be increased*. Land readjustment and direct sales to developers, which is occurring informally in some parts of China, e.g., the northwest of Beijing peri-urban area, is such a mechanism.

6.8 As redevelopment of existing communities becomes more difficult, more pressure will be placed on development of brown field sites, i.e., former industrial sites. Such sites are abundant in urban China because industry was located in core cities between 1949 and 1980. Planting (greening) of old demolished industrial sites is mistaken for environmental mitigation of old industrial sites in some Chinese urban areas. Clear brown field redevelopment guidelines and mechanisms are needed.[9]

6.9 Land quotas could be made obsolete if: (i) Most land is released through auctions and price competitive bidding. (ii) Local governments constrain the release of land to prevent land from being under-priced. (iii) Basic agricultural land is protected through growth boundaries or similar mechanisms. And (iv) developers receive permission to build only after land is serviced and pay for utility services (impact fees), thereby discouraging leapfrogging.

6.10 There should be much greater variance in FARs. Higher FARs (or no FARs) in areas with high accessibility will enable mass transit infrastructure to be self-financing at least in terms of operating costs. Overall urban plans should (i) identify indicative

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9 Some international practice, such as the US superfund system, is probably not appropriate for China at its current stage of development.

FARs, (ii) be based on policies linking FAR values to accessibility in different areas of the metropolitan zone, (iii) include current and projected net and gross average FARs[10] to be calculated at the sub-district level.

6.11 Awareness needs to be raised among government officials, developers, and property consumers regarding the value of access.

6.12 Given the economic value of land in China, green space planning should emphasize linear parks, which maximize perimeter, and thus household access to parks.

Green belts should be avoided as they increase commuting costs by forcing developers and commuters to skip over the green belt. On the other hand, green wedges, as in Chengdu's and Wuhan's new urban plans, which follow ecological systems, e.g., river valleys into urban areas, are superior both in land use efficiency and ecological terms.

6.13 Awareness of the high quality of life achievable at high densities should be spread to city-building officials throughout China. For example, a residential development with an FAR of 5 with recreational facilities, schools, small parks (inside and outside high-rises), convenience stores, restaurants, medical clinics, etc., offers a much higher quality of life than a walk-up apartment development from the 1970s with a FAR of 1.8.

10 The net FAR is the regulatory maximum FAR for lots auctioned to developers, the gross FAR is calculated by neighbourhood or even sub-district by adding all the area of residential and business floor space and dividing it by the entire area of the neighbourhood or sub-district. The gross FAR allows planners to calculate the amount of land, which is required per unit of floor space. The net FAR is a regulation, the gross FAR is a planning indicator.

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